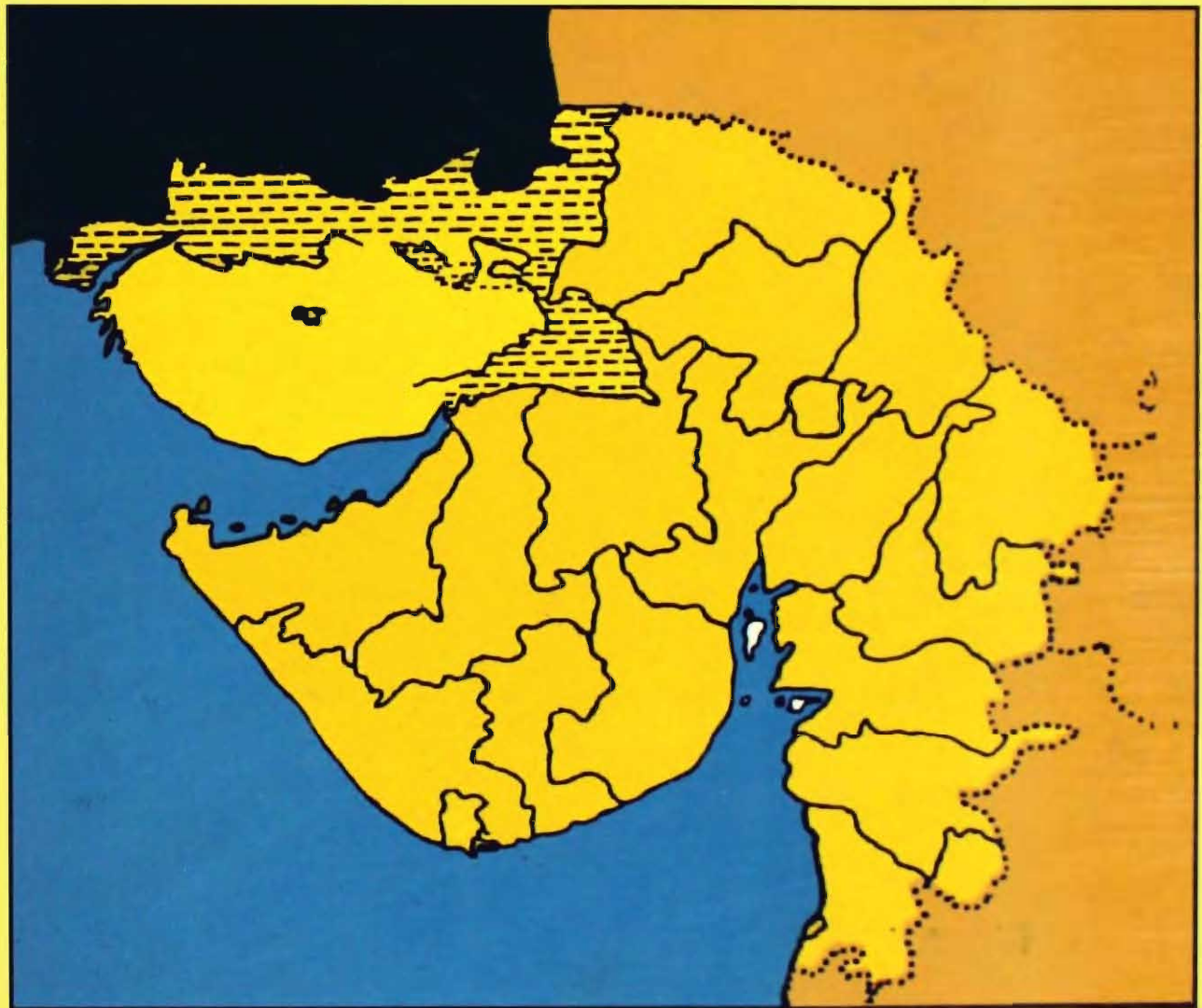


State fauna series 8

FAUNA OF GUJARAT

(Part - 2)



ZOOLOGICAL SURVEY OF INDIA

State Fauna Series 8

**Fauna
of
Gujarat
(Part-2)**

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ORIBATID MITES (ACARI : ORIBATIDA)

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INTRODUCTION

Oribatid mites, otherwise called “moss” mites or “beetle” mites, are the predominating group among the soil and litter inhabiting fauna. They form a complex group under the order Acarina. They are primarily fungivorous, algivorous or saprophagous and occur in litter, soil, humus, compost heaps, moss, lichens growing over tree stumps, twigs and leaves, nests of birds, house dust, caves, nests of small mammals and various other places, viz., pasture soils, coniferous taiga forest, arctic tundra and even in Antarctica. Infact they occur in all ecological niches, especially where vegetative material decay in sufficient moisture and are penetrated by mycelia.

Oribatid mites are of considerable importance due to their direct and indirect effect on man and animal. They are known to promote soil fertility through humification of organic matter. They also act as an agent for biological control of pests. A few oribatid mites are known to feed on plants. They also transmit various helminth diseases to domestic animals.

Information on the group from the world

This group of mites had attracted attention of acarologists since 1804, when Hermann first reported oribatid species from European soils. Later several workers had studied the mites from all over the world (Sanyal, 1995). Presently the oribatei are represented by more than 6000 species under about 800 genera from the world.

Information on the group from India

In India, Pearce (1906) first studied the oribatid mites from the Sikkim Himalaya. Later the

knowledge has been enriched to a great extent by the works of acarologists in different parts of the country. The details of studies are given in Sanyal, 1995. Till date 425 species and subspecies under 180 genera and 80 families are known from India.

Information on the group from Gujarat

The oribatid mites from most of the states of India have been surveyed and studied except a few of which Gujarat is one.

The present work is based on a collection of oribatid mites made from different parts of Gujarat by Sri Asit Kumar Bhattacharyya, Senior Research Fellow, Zoological Survey of India during September, 1997.

The contents of the present paper

A list of 18 species under 15 genera and 12 families of oribatid mites hitherto known from Gujarat has been incorporated in the paper. The first and important references, diagnostic features, distribution and remarks if any, of each species and key to the identification of the genera and species have also been incorporated. The species studied in the present work are deposited in the National Zoological Collection.

General morphology and terminology

The morphological features vary greatly in shape and size in different taxa of oribatid mites. The important features and terms, broadly necessary for understanding these mites and for their identification are discussed here in brief. The detailed account has been given in Sanyal, 1992.

The body length varies between 100-1000 μm . These mites are generally dorsoventrally flattened

but occasionally they may be cylindrical or laterally compressed. The body is covered by thin or hard cuticle and their colour may be opaline white, yellow-brown, dark brown or even black. The body surface shows various ornamentations.

The body is divided into two parts, viz., proterosoma and hysterosoma. Dorsally the proterosoma is covered by the shield called prodorsum and the shield covering hysterosoma is notogaster. The ventral shield is called ventral plate.

Prodorsum : The frontal pointed portion is called rostrum. There is a pair of longitudinal lathe on prodorsum known as lamellae or costulae. There are other prodorsal organs of various shapes and sizes like translamellae, condyles, turtorium, pedotecta, tubercles, bothridial or other protuberences, condyles, etc. The prodorsum may bear 4-6 pairs of setae, viz., rostral (*ro*), lamellar (*la*), interlamellar (*in*), anterior exobothridial (*exa*), posterior exobothridial (*exp*) and sensillae (*ss*). The prodorsum is separated from the notogaster by dorsosejugal (*dsej*) and sejugal (*sej*) sutures.

Notogaster : It is a coalesced form of a total of 10 segments but only six segments can be traced in the adults. The notogaster may bear chitinous excrescens like spines, condyles, teeth, posteriorly decurrent lamellae or cristae. Also there are some wing like extensions of notogaster the pteromorphae is present in a number of genera. The notogaster bears 15-16 pairs of setae in primitive group or 0-10 pairs in the higher oribatids. In some groups secondary setae other than the normal number may be observed. This condition is called neotrichy.

The notogastral surface often displays octotaxic organs like, glands (*gla*), stigmata and other sense organs (laryfissure), arae porosae, pori, sacculi, etc.

Gnathosoma : It is formed of chelicerae, pedipalpi, hypostomal and epistomal structures.

Epimeral region : The epimeral fields of epimeres (*ep₁-ep₄*) are separated from one another by epimeral furrows and their continuations the apodemes (*ap₁-ap₃*). The sejugal furrow is backed by sejugal apodeme (*ap-sej*), and often connected longitudinally by sternal apodeme (*ap.at.*). The epimeres bear setae.

Anogenital region : The region accommodates the genital and anal plates and openings. The types and subtypes of anogenital region are mentioned in Sanyal (1992).

Legs : The legs are usually divided into 5 free segments, viz., trochanter, femur, genu, tibia and tarsus. In some cases when coxa does not fuse with the body, there are 6 free segments.

MATERIAL AND METHODS

For taxonomic studies of oribatid mites, samples mainly litter, soil and humus from all possible habitats in all the districts of Gujarat were collected. The samples were taken from upper 10 cm of soil profile and kept in polythene bags till those were subjected to the process of extraction. The mites extracted from the samples by using modified Tullgren funnels were collected in glass vials containing 90% alcohol.

The body of oribatid mites is heavily sclerotized and opaque. So that the extracted material were made ready for taxonomic study following the usual procedure of keeping the mite in a solution of 90% alcohol and lactic acid (v/v) as advocated by Balogh (1965). For microscopic observations, Balogh's (1965) method of temporary mounting in lactic acid was followed. After necessary microscopic observation the specimen was transferred in small glass vials containing 90% alcohol. The vials were then properly labelled and stored. The measurements provided in the text were taken with the help of ocular and stage micrometers. The measurements of the specimens have been given in micron (μm).

LIST OF ORIBATID TAXA KNOWN FROM GUJARAT

1. Family PHTHIRACARIDAE Perty, 1841
 1. Genus *Atropacarus* Ewing, 1917
 1. *A. (Hoplophorella) scapellatus* (Aoki, 1965)
 2. *A. (Hoplophorella) singularis* (Sellnick, 1959)
2. Family EUPHTHIRACARIDAE Jacot, 1930

2. Genus *Rhysotritia* Markel and Mayer, 1959
 3. *R. ardua penicillatus* Perez-Inigo, 1969
 3. Family LOHMANNIIDAE Berlese, 1916
 3. Genus *Haplacarus* Wallwork, 1962
 4. *Haplacarus* sp.
 4. Genus *Heptacarus* Piffil, 1963
 5. *H. hirsutus* Wallwork, 1964
 4. Family EPILOHMANNIIDAE Oudemans, 1923
 5. Genus *Epilohmannia* Berlese, 1916
 6. *Epilohmannia* sp.
 5. Family NOTHRIDAE Berlese, 1885
 6. Genus *Nothrus* Koch, 1836
 7. *N. gracilis* Hammer, 1961
 6. Family TRHYPOCHTHONIIDAE Willmann, 1931
 7. Genus *Archezogetes* Grandjean, 1931
 8. *A. longisetosus* Akoi, 1965
 7. Family TECTOCEPHEIDAE Grandjean, 1954
 8. Genus *Tectocephus* Berlese, 1913
 9. *T. velatus* (Michael, 1888)
 8. Family OPPIIDAE Grandjean, 1954
 9. Genus *Arcoppia* Hammer, 1977
 10. *A. mcadami* Balogh and Balogh 1986
 10. Genus *Multioppia* Hammer, 1961
 11. *M. stellifera* Hammer, 1961
 12. *Multioppia* sp.
 11. Genus *Oppia* Koch, 1836
 13. *O. kuhnelti*
 9. Family XYLOMBATIDAE Balogh & Balogh, 1984
 12. Genus *Setoxylobates* Balogh and Mahunka, 1967
 14. *S. foreolatus* Balogh and Mahunka, 1967
 10. Family SCHELORIBATIDAE Grandjean, 1953
 13. Genus *Schelorbates* Berlese, 1908

15. *S. albialatus* Hammer, 1961
 16. *S. thermophilus* Hammer, 1961
 11. Family ORIBATELLIDAE Jacot, 1925
 14. Genus *Lamellobates* Hammer, 1958
 17. *L. palustris* Hammer, 1958
 12. Family GALUMNIDAE Jacot, 1925
 15. Genus *Galumna* von Heyden, 1826
 18. *Galumna* sp.

SYSTEMATIC ACCOUNT

Key to the families of oribatid mites from Gujarat

- 1(4). Body ptychoid, propodosoma can be shut back against the hysterosoma and ventral region like blade of penknife; body generally laterally compressed
 2(3). Anogenital region wide, body not much compressed laterally
 PHTHIRACARIDAE Perty, 1841
 3(2). Anogenital region narrow; body considerably compressed laterally
 EUPHTHIRACARIDAE Jacot, 1930
 4(1). Body not ptychoid, propodosoma can not be shut back against the hysterosoma and ventral region; body never laterally compressed
 5(10). Anogenital region macropyline type
 6(7). Body dichoid, preanal plate present
 LOHMANNIIDAE Berlese, 1916
 7(6). Body holid, preanal plate absent
 8(9). Epimeral neotrichy strong; epimeres II with 3-6 pairs of setae
 NOTHRIDAE Berlese, 1885
 9(8). Epimeral neotrichy absent; epimeres II with 0 or 1 pair of setae
 TRHYPOCHTHONIIDAE Willmann, 1931
 10(5). Anogenital region brachypyline type
 11(16). Notogaster pycnonotic i.e. areae porosae, sacculi or pori absent; usually without pteromorphae

- 12(15). Prodorsum without true lamellae; dorsosejugal suture present
- 13(14) Prodorsum with thin crest-shaped lamellae or thin costulae; genital setae 4, 5 or 6 pairs; genital and anal plates small, placed far from each other
.....OPPIIDAE Grandjean, 1954
- 14(13) Prodorsum without crest-shaped lamellae or costulae; genital setae 8 pairs; genital and anal plates large, place close to each other and separated by a straight line ..
EPILOHMANNIIDAE Oudemans, 1923
- 15(12). Prodorsum having lamellae; dorsosejugal suture absent; lamellaer complex 'H' shaped
...TECTOCEPHEIDAE Grandjean, 1958
- 16(11) Notogaster poronotic i.e., areae porosae, sacauli or pori present; pteromorphae usually present
- 17(18). Pteromorphae movable, articulate or semicircular; prodorsum without true projecting lamellae
..... GALUMNIDAE Jacot, 1925
- 18(17). Pteromorphae immovable but never articulate, sometimes absent
- 19(20). Prodorsum with tutorium; usually six pairs of genital setae; lamellae broad, sometimes synlamella type
...AUSTRACHTERIIDAE Luxton, 1985
- 20(19). Prodorsum without tutorium; usually 3-5 pairs of gentle setae
- 21(22). Notogaster with true areae porosae; sensillus usually long, reclinate; 5 pairs of genital setae
...XYLOBATIDAE Balogh and Balogh, 1984
- 22(21). True areae porosae absent, notogaster with sacculi or pori; usually 4 pairs of gentle setae
.... SCHELORIBATIDAE Grandjean, 1953

1. Family PHTHIRACARIDAE Perty, 1841

1. Genus *Atropacarus* Ewing

1917. *Atropacarus* Ewing, *J. Economic Ent. Concord.*, 10 : 131.

1986. *Atropacarus (Hoplophorella)* Niedbala. *Acarologia*, 27 (1) : 80.

Key to the species of *Atropacarus (Hoplophorella)*

- 1 (2). Notogastral setae and ad_2 spatulate
.....*scapellatus* (Aoki, 1965)
- 2(1). Notogastral setae long, erect, barbed; ad_2 long, fine, smooth
.....*singularis* (Sellnick, 1959)

1. *Atropacarus (Hoplophorella) Scapellatus*

1965. *Hoplophorella scapellata* Aoki, *Nat. Life Southeast Asia*, 4 : 131.

1984. *Atropacarus (Hoplophorella) scapellatus*, Niedbala, *In : Phthiracaroida (Acari. Oribatida). Systematic Studies, Amsterdam*, 226.

Diagnosis : Body not much compressed laterally, genital region wide; integument with small pits; rostral setae well developed, strong, lamellar setae minute, fine; interlamellar setae long, directed upward; sensillus almost equally thick throughout its length, except distal half which is hyaline and uneven; natogastral hood absent; natogastral setae fifteen pairs, broad, spatulate; ad_1 similar to notogastral setae; ad_2 minute.

Material examined : 2 ♀♀, Rajkot Jubilee Garden, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 1 ♀, Rajkot Race Course Campus, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 2 ♀♀, Crocodile rearing farm, Sasan Gir, 22.ix.1997, coll. A.K. Bhattacharyya; 1 ♀, Agriculture University Campus, Junagadh, 23.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 4 ♀♀, Junagadh Zoo campus, 23.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 4 ♀♀, Baroda Zoo Campus, 25.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, Assam, Bihar, Manipur, Orissa, Tripura, West Bengal.

Elsewhere : Antilles, Australia, Bismark Islands, Brazil, Chad, Jamaica, Panama, Papua New Guinea, Peru, Saba, St. Eustacius, St. Martin, Uganda, Venezuela, Zaire.

Remark : The species is recorded for the first time from the state.

2. *Atropacarus (Hoplophorella) singularis*
(Sellnick)

1959. *Hoplophorella singularis* Sellnick, *Occas. Pap; Bishop. Mus.*, 22 (9) : 149.

1984. *Atropacarus (Hoplophorella) singularis*, Niedbala. In : *Phthiracaroida (Acari, Oribatida). Systematic studies*, Amsterdam, 228.

Diagnosis : Integument with shallow pits, aspis truncated behind; no carina; rostral setae bent down, smooth; lamellar setae very short, smooth; interlamellar setae long, distally barbed, directed outward; sensillus projected outwards thickens gradually to rounded knob-like head; notogastral setae fifteen pairs, moderately long, stout, barbed.

Material examined : 1 ♀, Junagadh Zoo Campus, 23.ix.1997, from litter and soil, coll. A.K.Bhattacharyya.

Distribution : India : Gujarat, Manipur, West Bengal.

Elsewhere : Australia, Flint Island.

Remark : The species is reported for the first time from Gujarat.

2. Family EUPHTHIRACARIDAE Jacot, 1930

3. Genus *Rhysotritia* Markel and Mayer

1959. *Rhysotritia* Märkel and Mayer, *Zool. Anz.*, 163 : 320.

3. *Rhysotritia ardua penicillatus* Perez Inigo

1969. *Rhysotritia ardua penicillatus* Perez Inigo, *Eos, Madrid*, 44 : 378.

Diagnosis : Smaller than nominate species; sensillus apically heavily clavate; other characters same as nominate species.

Material examined : 1 ♀, Rajkot Jubilee Garden, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 1 ♀ Junagadh Zoo Campus, 23.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat.

Elsewhere : Greece, Spain.

Remark : The species is recorded for the first time from India.

3. Family LOHMANNIIDAE Berlese, 1916

Key to the genera of LOHMANNIIDAE

1(2). Genital plates with transverse suture; seven pairs of setae on ano-adanal plates
..... *Heptacarus* Piffil, 1963

2(1). Genital Plates without transverse suture; five pairs of setae on ano-adanal plates
..... *Haplacarus* Wallwork, 1962

3. Genus *Haplacarus* Wallwork

1962. *Haplacarus* Wallwork, *Acarologia*. 4 : 465.

4. *Haplacarus* sp.

Material examined : 3 ♀♀, Abadh Zoo Campus, 20.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Remark : The genus is reported for the first time from the state.

4. Genus *Heptacarus* Piffil

1963. *Heptacarus* Piffil, *Anz. Ost. Akad. Wiss.*, 2 : 24.

5. *Heptacarus hirsutus* Wallwork

1964. *Heptacarus hirsutus* wallwork, *Rev. Zool. Bot. Afr.* 70 : 358.

Material examined : 2 ♀♀ Junagadh Zoo Campus, 23.ix.1997. from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, Kerala.

Elsewhere : Africa.

Remark : The species is reported for the first time from Gujarat.

4. Family EPILOHMANNIIDAE Oudemans, 1923

5. Genus *Epilohmannia* Berlese

1916. *Epilohmannia* Berlese, *Redia*. 12 : 176.

6. *Epilohmannia* sp.

Material examined : 2♀♀, Rajkot Race Course Campus, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Remark : The genus is reported for the first time from Gujarat.

5. Family NOTHRIDAE Berlese, 1885

6. Genus *Nothrus* Koch

1836. *Nothrus* Koch, *Deutschlands Crustaceen, Myriapoden und Arachniden*, 2 : 17.

7. *Nothrus gracilis* Hammer

1916. *Nothrus gracilis* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 13 (1) : 28.

Diagnosis : Hysterosoma with parallel lateral border; rostral setae short, stiff; lamellar setae on apophyses, connected by thin straight line, thick, bushy, tips bent downwards, interlamellar setae broad, flat, feathered; sensillus equally thick throughout, with minute bristles; notogastral setae delicate, transparent, hardly discernible.

Material examined : 1♀, Abadh Zoo Campus, 20.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 1♀, Crocodile rearing farm, Sasan Gir, 22.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 1♀, Junagadh Zoo Campus, 23.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, West Bengal.

Elsewhere : Peru.

Remark : The species is reported for the first time from the state.

6. Family TRHYPOCHTHONIIDAE Willmann, 1931

7. Genus *Archegozetes* Grandjean, 1931

1931. *Archegozetes* Grandjean, *Bull. Mus. Hist. Nat. Paris*, 3 (2) : 144.

8. *Archegozetes longisetosus* Aoki

1965. *Archegozetes longisetosus* Aoki, *Nat. Life Southeast Asia*, 4 : 147.

Diagnosis : Punctate prodorsum; prodorsal and notogastral setae long, fine, densely beset with minute bristles; sensillus long, fine, densely beset with fine bristles; d_1 longer than their mutual distance; genital setae 7 pairs, $4a$ about 1/2 as long as $4b$.

Material examined : 14♀♀, Abadh Zoo Campus, 20.ix.1997, from grassland soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, Assam, Kerala, Tripura.

Elsewhere : Malaysia, South America, Tahiti Island, Thailand.

Remark : The species is recorded for the first time from Gujarat.

7. Family TECTOCEPHEIDAE Grandjean, 1954

8. Genus *Tectocepheus* Berlese

9. *Tectocepheus velatus* (Michael)

1888. *Tectocepheus velatus* (Michael), *Ray Soc.*, 65.

Diagnosis : Rough body, irregularly raised dots; rostrum trifid; large lamellae with detachable blades, lying horizontally; extended beyond the lateral margin of cephalothorax, median portion broad, cusps almost reaching the tip of rostrum, narrow or thick; translamella distinct, rostral and lamellar setae curved inwards, barbed unilaterally; interlamellar setae minute, smooth, inserted near the base of lamellae; sensillus long with slender stalk, licheniform head; interrupted dorsosejugal suture; paired *iad*; adanal plate large, placed parallel to the anterior part of the lateral side at anal field.

Material examined : 1♀, Rajkot Race Course Campus, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, Bihar, Himachal Pradesh, Orissa, Sikkim.

Elsewhere : Africa (Sahara), Central Asia, Easter Island, Europe (Bulgaria, Germany), Fiji, Indonesia, Japan, Jordan, New Zealand, North America, Pakistan, South America, Spitsbergen,

Tonga Island, Turkey.

Remark : The species is reported for the first time from the state.

8. Family OPPIIDAE Grandjean, 1954

Key to the genera of OPPIIDAE

- 1(2). 12 pairs of notogastral setae
 *Multioppia* Hammer, 1961
- 2(1). 10 or fewer pairs of notogastral setae
- 3(4). Sensillus with 1-7, sometimes more long branches arranged in either pectinate or radial positions
 *Arocoppia* Hammer, 1977
- 4(3). Sensillus without branch, not pectinate
 *Oppia* Koch, 1836

9. Genus *Arocoppia* Hammer

1977. *Arocoppia* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 21 (4) : 32.

10. *Acrocoppia mcadami* Balogh and Balogh

1986. *Acrocoppia mcadami* Balogh and Balogh, *Acta Zool. Hung.*, 32 (1-2) : 50.

Diagnosis : Rostral setae long, fine; lamellar and interlamellar setae short, fine; exobothridial setae as long as lamellar setae; interlamellar area with two pairs of rounded, pale areolae; exobothridial region granulate, translamellar part of prodorsal arch sharp, almost semicircular, lamellar part evanescent; sensillus with one long setiform branch, distal part is almost spherical; notogastral setae ten pairs, fine, smooth, extremely stout; notogastral surface circular; genital setae 6 pairs, area pori in adanal position.

Material examined : 2♀♀, Crocodile rearing farm, Sasan Gir, 20.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, Tripura.

Elsewhere : Papua New Guinea.

Remark : The species is recorded for the first time from Gujarat.

10. Genus *Multioppia* Hammer

1961. *Multioppia* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 13 (1) : 61.

11. *Multioppia stellifera* Hammer

1961. *Multioppia stellifera* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 13 (1) : 64.

Diagnosis : Proximally feathered rostral setae, distal third smooth, faint line in front of rostral setae; lamellar setae feathered, smaller than rostral setae; interlamellar setae short and erected; sensillus broadest at tip, with compressed head, 12-15 radiating smooth bristles along its outer border; notogastral setae 12 pairs, short, thin; genital setae 5 pairs.

Material examined : 1♀, Palampur, 19.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, West Bengal.

Elsewhere : Peru.

Remark : The species is reported for the first time from Gujarat.

12. *Multioppia* sp.

Material examined : 4♀♀, Rajkot Race Course Campus, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Remark : It seems to be a new species and to be confirmed later.

11. Genus *Oppia* Koch

1836. *Oppia* Koch, *Deutschlands Crustaceen, Myriapoden und Arachniden*, 1-9.

13. *Oppia kuhneli*

Material examined : 1♀, Junagadh Zoo Campus, 23.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat.

Remark : The species is recorded for the first time from India.

9. Family XYLOBATIDAE

Balogh and Balogh, 1984

12. Genus *Setoxylobates* Balogh and Mahunka1967. *Setoxylobates* Balogh and Mahunka, *Acta, Zool. Hung.*, 23 (1-2) : 59.14. *Setoxylobates foveolatus* Balogh and Mahunka1967. *Setoxylobates foveolatus* Balogh and Mahunka, *Acta Zool. Hung.*, 23 (1-2) : 59.

Diagnosis : Prodorsum, pteromorphae, notogastral and ventral plates with scattered foveolae; rostral setae shorter than lamellar setae and weakly barbed; lamellar setae extend beyond the rostrum with weakly barbed apical half; interlamellar setae weakly barbed and anterior to the dorsosejugal suture; sensillus long, fusiform, reclinate, unilaterally barbed and acutely terminated; 14 pairs of notogastral setae, very minute; 4 pairs of areae porosae of medium size; genital plate punctate with 5 pairs of genital setae; epimeral setal formula : 3:1:2:2; epimeral region foveolate.

Material examined : 1♀, Abadh Zoo Campus, 20.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 4♀♀, Rajkot Race Course Campus, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, Tripura, West Bengal.

Elsewhere : Vietnam.

Remark : The species is recorded for the first time from the state.

10. Family SCHELORIBATIDAE Grandjean, 1953

13. Genus *Scheloribates* Berlese1908. *Scheloribates* Berlese, *Redia*, 5 : 2.**Key to the species of *Scheloribates***

- 1(2). Interlamellar setae smooth; sensillus with short stalk and disc-shaped head
.....*albialatus* Hammer, 1961
- 2(1). Interlamellar setae barbed; sensillus with laceolate head
.....*thermophilus* Hammer, 1961

15. *Scheloribates albialatus* Hammer1961. *Scheloribates albialatus* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 13 (1) : 94.

Diagnosis : Rostral and lamellar setae barbed; interlamellar setae smooth; sensillus with short, round, disc-shaped head set with fine scales; notogaster without setae, with chitinous pores; genital setae 4 pairs.

Material examined : 2♀♀, Crocodile rearing farm, Sasan Gir, 22.ix.1997, from litter and soil, coll. A.K. Bhattacharyya, 1♀, Baroda Zoo Campus, 25.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, West Bengal.

Elsewhere : Peru.

Remark : The species is recorded for the first time from Gujarat.

16. *Scheloribates thermophilus* Hammer1961. *Scheloribates thermophilus* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 13 (1) : 95.

Diagnosis : Inner cuspides of lamellae rounded, outer lamellar cuspides tapering into a short and sharp point; lamellar setae equally very thick throughout, rough; interlamellar setae long, rough; sensillus club-shaped, tip pointed, beset with short setae; notogastral setae 9 pairs genital setae 4 pairs.

Material examined : 5♀♀, Rajkot Race Course Campus, 21.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : India : Gujarat, Bihar, Tripura, West Bengal.

Elsewhere : Fiji, Indonesia, New Zealand, Pakistan, Seychelles, South America (Argentina), Thailand, Tonga Tapu Island.

Remark : The species is reported for the first time from the state.

11. Family AUSTRACHTERIIDAE Luxton, 1985

14. Genus *Lamellobates* Hammer1958. *Lamellobates* Hammaer, *Biol. Skr. Dan. Vid. Selsk.*, 10(1) : 100

17. *Lamellobates palustris* Hammer

1958. *Lamellobates palustris* Hammer, *Biol. Skr. Dan. Vid. Selsk.*, 10(1) : 100

Diagnosis : Rostrum pointed with concave sides; rostral setae very long reaching far beyond the tip of rostrum, unilaterally feathered; lamellae broad plate without distal tips; inner cuspides of lamellae rounded, outer lamellae cuspides tapering into a short and sharp point; lamellar setae situated a short distance behind anterior border nearest to median side; equally very thick, throughout, rough; interlamellar setae situated where lamellae and anterior border of hysterosoma meet, very long, rough tip reaches beyond lamellar setae; sensillus long, slender, club-shaped, tip pointed, beset with short hairs; notogaster almost as broad as long, posterior end narrow; notogastral setae 9 pairs, thin, long, occupy dorsal part of notogaster; genital setae 6 pairs; tarsi monodactylous.

Material examined : 3 ♀♀, Crocodile rearing farm, Sasan Gir, 22.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Distribution : Gujarat, Bihar, Meghalaya, Tripura, West Bengal.

Elsewhere : Fiji Island, Indonesia, New Zealand, Pakistan, Seychelles, Argentina, Thailand, Tongatapu Island.

Remark : The species here is the first record from Gujarat.

12. Family GALUMNIDAE Jacot, 1925

15. Genus *Galumna* von Heyden

1826. *Galumna* von Heyden, *Isis Oken*, 18 : 611.

18. *Galumna* sp.

Material examined : 1 ♀, Palampur, 19.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 1 ♀, Abadh Zoo Campus, 20.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 3 ♀♀, Crocodile rearing farm, Sasan Gir, 22.ix.1997, from litter and soil, coll. A.K. Bhattacharyya; 2 ♀♀, Baroda Zoo Campus, 25.ix.1997, from litter and soil, coll. A.K. Bhattacharyya.

Remarks : The specimens could not be identified upto species level due to lack of literature. These should be published in other publication.

SUMMARY

The present study is considered to be the first attempt on investigation of oribatid mites of Gujarat. The paper includes 18 species under 15 genera and 12 families and all are reported here for the first time from Gujarat. The work records 2 genera and 2 species for the first time from India. Key to the identification of families, genera and species are dealt in the paper. The diagnostic features of the species wherever necessary have also been incorporated.

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REFERENCES

- Balogh, J. 1965. A synopsis of the world oribatid (Acari) genera. *Acta. Zool. Acad. Sci. Hung.*, 11 (1-2) : 5-99.
- Hermann, J.F. 1804. *Memoire Apterologique* : Strassbourg.

- Pearce, N.D.F. 1906. On some oribatidae from the Sikkim Himalaya. *Jour. Roy. Micr. Soc.*, **1906** : 269-273.
- Sanyal, A.K. 1992. Oribatid mites (Acari). *Fauna of West Bengal, State Fauna Series 3, Part-3* (Arachnida and Acari). (Ed. Director, Zoological Survey of India) : 213-256.
- Sanyal, A.K. 1995. Oribatid mites (Acari : Cryptostigmata). *In : Fauna of Meghalaya, State Fauna Series 4, Part-2* (Arachnida and Acari) (Ed. Director, Zoological Survey of India) : 51-91.

ACARI : METASTIGMATA (TICKS)

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INTRODUCTION

The ticks are small group of acarines occurring throughout the world. The two families of ticks found in India are Argasidae or soft ticks and Ixodidae or hard ticks. The ticks live as host on bodies of domestic and wild animals and in vegetation. They surpass all other arthropods in the number and variety of diseases of man and domestic animals. Many serious diseases of man and animals involving protozoa, rickettsiae, spirochaetae, bacteria and viruses are transmitted by ticks. Considering the medical importance of ticks scientists took up the study of this group of acarina since the days of Linnaeus (1746-1767). Later several workers throughout the world made extensive studies on ticks and published large number of papers and monographs.

The Indian ticks were taken up for research as early as 1758 when Linnaeus described *Acarus elephantius* from India.

The most extensive and comprehensive study of Indian ticks was done by Sharif (1928). Later Sen (1938) published a check-list of Indian ticks.

The Indian ixodid ticks were extensively studied by Hoogstraal, Trapido, Verma, Mcarthy, Kohls, Rebello, Elkammah, Mitchell and others (1962-1971). Advani and Vazirani (1981) described and recorded ectoparasitic argasid and ixodid ticks from India. De and Sanyal (1964, 1985) Nandi and De (1984), Sanyal *et al.* (1987), Sanyal and De (1991, 1992, 1995) and many others studied the tick fauna of different states of India.

Though the ticks of India were surveyed and studied by many scientists but very little work was so far done on the ticks from the state of

Gujarat. Sen and Fletcher (1962) first reported *Ornithodoros savignyi* from Baroda. Next year Hoogstraal and Trapido (1963) described one new species from Kutch. Later Hiregauder (1968a, 1968b, 1971, 1976a, 1976b, 1976c), Advani and Vazirani (1981) and Geeverghese and Dhanda (1987) described and recorded several species from different districts of Gujarat.

The present work is based on a few tick specimens collected from Gujarat by the members of survey party of the zoological Survey of India, which are available in National Zoological Collection. The work also includes the species which have not been studied by the authors but are described and reported from the state by the earlier workers.

A complete list of 19 species under 7 genera and 2 families of tick hitherto known from Gujarat has been incorporated in the paper. The original and most recent references, diagnostic features and distribution of each species and key to the identification of families, genera and species wherever needed have also been incorporated.

The collection and preservation methods for the tick specimens and their general morphology have been discussed in details by Sanyal and De (1992).

LIST OF TAXA OF TICKS KNOWN FROM GUJARAT

1. Family ARGASIDAE

1. Genus *Argas* Latreille

1. *A. (C) gujaratensis* Advani and Vazirani
2. *A. (Carios) hoogstraali* Advani and Vazirani

2. Genus *Ornithodoros* Koch
3. *O. savignyi* (Audouin)
2. Family IXODIDAE
3. Genus *Boophilus* Curtice
4. *B. microplus* (Canestrini)
4. Genus *Haemaphysalis* Koch
5. *H. bispinosa* Neumann
6. *H. doenitzi* Warburton and Nuttall
7. *H. indica* Warburton
8. *H. kutchensis* Hoogstraal and Trapido
5. Genus *Hyalomma* Koch
9. *H. anatolicum anatolicum* Koch
10. *H. brevipunctata* Sharif
11. *H. dromedarii* Koch
12. *H. hussaini* Sharif
13. *H. marginatum isaaci* Sharif
14. *H. turanicus* Pomerantzev
6. Genus *Nosomma* Schulze
15. *N. monstrosus* (Nuttall and Warburton)
7. Genus *Rhipicephalus* Koch
16. *R. arakeri* Hiregoudar
17. *R. haemaphysaloides haemaphysaloides* (Supino)
18. *R. sanguineus sanguineus* (Latreille)
19. *R. turanicus* Pomerantzev

SYSTEMATIC ACCOUNT

Key to the families of Ticks known from Gujarat

- 1(2) Scutate with terminal capitulum and spiracles posterior to coxa IV; sexual dimorphism marked, males entirely covered by scutum and anteriorly covered by scutum in female; porose areas present in female capitulum; eyes when present situated laterally on scutum IXODIDAE
- 2(1) Non-scutate with leathery integument; sexual dimorphism slight; palps being free and leg-like, with their articles subequal in length; spiracles small and anterior to coxa

IV; pulvillae, festoons, porose areas absent; eyes lateral on supracoxal folds ARGASIDAE

1. Family ARGASIDAE

Key to the Genera of ARGASIDAE

- 1(2) Body periphery flattened and usually structurally different from dorsum; lateral suture usually present *Argas* Latreille
- 2(1) Body periphery undifferentiated; lateral suture absent *Ornithodoros* Koch

1. Genus *Argas* (*Carios*) Latreille

1796. *Argas* Latreille, *Precis des Caracteres generiques des insects, disposes dans un ordre naturel*, 177.

Key to the species of *Argas* (*Carios*) Larvae

- 1(2) Posteroexternal setae not fringed, strongly tapering apically *gujaratensis* Advani and Vazirani
- 2(1). Posteroexternal setae fringed, not tapering apically *hoogstraali* Advani and Vazirani

1. *Argas* (*Carios*) *gujaratensis* Advani and Vazirani

1981. *Argas* (*Carios*) *gujaratensis* Advani and Vazirani, *Rec. zool. Surv. India*, Occ. Paper No. 22 : 101.

Diagnosis : Larva-Basis capituli widely subtriangular; hypostome-a narrowly elongate inverted 'V', apex sharply pointed, extending upto the level of apex of palpal segment 4; dental formula 2/2, 6 denticles on each file; post palpal setae small, palpi narrow, all segments subequal in width; 14 or 15 pairs of setae on dorsal surface.

Distribution : India : Gujarat (Baroda).

Remarks : The species was described from Gujarat by Advani and Vazirani (1981) from *Scotophilus heathi heathi* Horsefield.

2. *Argas* (*Carios*) *hoogstraali* Advani and Vazirani

1981. *Argas* (*Carios*) *hoogstraali* Advani and Vazirani, *Rec. zool. Surv. India*, Occ. Paper, No. 22 : 103.

Diagnosis : Larva-Basis capituli wider,

subtriangular; hypostome a narrow elongate inverted 'V', apex sharply pointed; dental formula 2/2; post-palpal setae slightly longer than post-hypostomal setae; palpi narrow, all segments subequal in width; on dorsal surface 14 setae.

Distribution : India : Gujarat (Baroda).

Remarks : The species was described by Advani and Vazirani (1981) from Baroda, Gujarat from *Taphozus longimanns longimanns* Hardwicke.

2. Genus *Ornithodoros* Koch

1844. *Ornithodoros* Koch, *Arch. f. Naturg.*, Berlin, 10 (1) : 219.

3. *Ornithodoros savignyi* (Audouin)

1827. *Argas savignyi* Audouin, p. 183.

1844. *Ornithodoros savignyi* Koch. *Arch. f. Naturg.*, Berlin, 10 (1) : 219.

Diagnosis : Integument thick and covered by distinct mammillae; supracoxal fold well marked, bearing four eyes of equal size; one pair above coxa I and one pair between coxae III and IV; capitulum stout and free; palpi tapering, segment 1 and 2 equal; dentition 3/3; male and female resemble each other except smaller size of male and genital orifice.

Material examined : 3 (F), 5(N), Dwarka, from buffalo, 4.xii.1973, coll. S.K. Gupta.

Distribution : Gujarat (Baroda, Dwarka), Andhra Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu.

Remarks : Christopher (1906) first recorded the species from South India. Sen and Fletcher (1962) reported the species from Baroda.

2. Family IXODIDAE

Key to the genera of IXODIDAE

- 1(2) Eyes absent.....*Haemaphysalis* Koch
 2(1) Eyes present
 3(4) Capitulum long with long narrow palps....
*Hyalomma* Koch

4(3) Capitulum short with short broad palps

5(6) Basis capituli rectangular dorsally, lateral saliences absent; scutum ornate; ventral shields when present six in male.....
 *Nosomma* Schulze

6(5) Basis capituli hexagonal dorsally, lateral saliences present; scutum inornate; ventral shields four in male

7(8) Spiracle oval; festoons and groove faint or obsolete; setiferous ventral plate on palpal article I absent *Boophilus* Curtice

8(7) Spiracle sub-triangular or comma-shaped; festoons and anal groove well developed; setiferous ventral plate on palpal article I present *Rhipicephalus* Koch

3. Genus *Boophilus* Curtice

1891. *Boophilus* Curtice, *Journ. Compr. Med. Veter. Arch.*, 12 : 313.

4. *Boophilus microplus* (Canestrini)

1887. *Haemaphysalis micropla* Canestrini, *Atti. Soc. Veneto trent. Sci. Nat.*, 11 : 104.

1890. *Rhipicephalus micropla* Canestrini, *Padova*, 4 : 493.

1899. *Rhipicephalus australis* Fuller, *Qd. Agric. J.*, 4 (5) : 389.

1901. *Boophilus australis*, Sharif, *Rec. Indian Mus.*, 30 (3) : 284.

1943. *Boophilus microplus*, Fairchild, *Am. J. Trop. Med.*, 23 (6) : 586.

Diagnosis : Male-Scutum quite hirsute, caudal appendage short, tapering; dentition 4/4; inner margin of basal palpal segment ventrally concave.

Female Coxa I with deep, inverted 'V' shaped cleft; inner margin of basal palpal segment ventrally short, deeply concave; dentition 4/4.

Distribution : Gujarat (Kaira), Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Madhya Pradesh, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Remark : This specie is widely distributed and common cattle infesting tick.

4. Genus *Haemaphysalis* Koch

1844. *Haemaphysalis* Koch, *Arch. Naturg.*, 10 (1) : 217-239.

5. *Haemaphysalis bispinosa* Neumann

1897. *Haemaphysalis bispinosa* Neumann. *Mem. Soc. Zool. France*, 10 : 341.

1915. *Haemaphysalis bispinosa*, Nuttall and Warburton, *Ticks*, part 3 : 426.

1928. *Haemaphysalis bispinosa*, Sharif, *Rec. Indian Mus.*, 30 (3) : 255.

Diagnosis : Male-Scutum elongated-oval in shape; cervical grooves with convergent depressions; lateral grooves long, well marked, ending behind spiracles; festoons twice as long as broad, palps slightly salient, segment 2 and 3 subequal, segment 3 bluntly conical and bears a prominent dorsal retrograde spur in the mid-dorsal line and a similar but larger ventral spur; dentition 4/4; a moderate sharp spur on coxa I; a very slight protrubance on coxae II and IV.

Female Scutum sub-cordiform, punctations little larger than male; basis capituli broader; cronua short; porose areas oval; palpi as in male.

Material examined : 1 (F), Jitpur, Rajkot, from cow, 30.xi.1973, coll. S.K. Gupta.

Distribution : Gujarat (Kaira, Rajkot), Andaman and Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh.

Remarks : Neumann (1897) described this species from Tamil Nadu but as the specimen was lost, Trapido (1965) selected a neotype female from Chennai from the collection of Nuttall.

6. *Haemaphysalis doenitzi* Warburton and Nuttall

1909. *Haemaphysalis doenitzi* Warburton and Nuttall, *Parasitology*, 2 : 64-65.

Diagnosis : Male-Scutum elongate-oval, cervical grooves shallow, straight, lateral grooves

deep, distinct; palpi long, segment 2 strongly salient at the base, segment 3 without dorsal process but with small ventral spur; dentition 4/4 or 5/5; coxae each with small blunt spurs.

Female Scutum oval, cervical grooves sub-parallel, cornua poorly developed, palpal segment 2 boot-shaped, segment 3 subtriangular dorsally.

Distribution : Gujarat, Maharashtra, Karnataka, Punjab.

7. *Haemaphysalis indica* Warburton

1910. *Haemaphysalis leachi* var. *indica* Warburton, *Parasitology*, 3 : 402.

Diagnosis : Male-Scutum 1.5 to 1.7 times as long as broad; posterior margin of basis capituli with short cornua, broadly triangular; palpi broadly salient, segment 2 approximately 2 times as broad as long; coxae each with broadly triangular spur; dentition 4/4.

Female The female differs from male only in sexual characters. Other characters more or less similar to male.

Distribution : Gujarat, Bihar, Karnataka, West Bengal, Orissa, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh.

8. *Haemaphysalis kutchensis* Hoogstraal and Trapido

1963. *Haemaphysalis kutchensis* Hoogstraal and Trapido, *J. Parasit.*, 49 (3) : 489-497.

Diagnosis : Male-Basis capituli 1.4 as wide as long (including cornua); palpi triangular in outline, segment 3 dorsally with inner margin convex and recurved at basal juncture, and ventrally a heavy, elongately triangular spur; scutum pyriform in outline, punctations numerous, distinct and variable in size, dentition 4/4; coxae each with large widely triangular spur, cervical grooves short, deep; lateral grooves deep and distinct.

Female-Scutum subequal, posterior margin broadly rounded; cervical grooves shallow, straight, punctations large and small in size; palpi with basal margin of segment 2 not so acutely angled as in male; legs as in male.

Distribution : Gujarat : Kutch (Kuar Bet), Hingolgaḍ), Himachal Pradesh, Maharashtra, Rajasthan, Uttar Pradesh.

5. Genus *Hyalomma* Koch

1884. *Hyalomma* Koch. *Arch.f.Naturgesch*, 10 (1) : 220.

9. *Hyalomma anatolicum anatolicum* Koch

1844. *Hyalomma anatolicum anatolicum* Koch, *Arch. f. Naturgesch*, 10 (1) : 220.

Diagnosis : Male Scutum lightly punctated; lateral grooves short but distinct; postero-median groove not reaching the parma; subanal shields small, situated directly posterior of adanals; basis capituli dorsally slightly concave; posterior margin never angular; legs without ring.

Female Scutum longer than wide with narrowly rounded posterior margin; punctations large in scapular areas; operculum short, small.

Material examined : 14 (F), 6 (M), Jitpur, Rajkot, from cow, 30.11.1973 coll. S.K. Gupta; 15(N), Jamnagar, from cow, 14.ix.1969; coll. T.G. Vazirani.

Distribution : Gujarat (Kaira, Kutch, Bhavnagar, Rajkot, Jamnagar), Andhra Pradesh, Assam, Delhi, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh.

10. *Hyalomma brevipunctata* Sharif

1928. *Hyalomma hussaini* var. *brevipunctata* sharif, *Rec. Indian Mus.*, 30 (3) : 318.

1963. *Hyalomma brevipunctata*, Kaiser and Hoogstraal. *J. Parasit.*, 49 : 130.

Diagnosis : Male-Punctations few in central area, lateral grooves deep, distinct, reaching level of the eyes; cervical grooves deep, short pits; basis capituli broader than long; adanal shields broad, subanal shields lacking; spiracular plates comma-shaped.

Female Punctations fine, numerous in lateral and cervical fields and in the anteromedian field; genital operculum elongate oval; others more or less same as in male.

Distribution : Gujarat, (Junagadh, Kachchh, Surat). Andhra Pradesh, Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

11. *Hyalomma dromedarii* Koch

1844. *Hyalomma dromedarii* Koch, *Arch. f. Naturgesch*, 10 : 220.

Diagnosis : Male Scutum wide, narrowed anteriorly; subanal shields displaced laterally; lateral grooves limited to posterior third of scutum; punctations large, scattered over the scutum.

Female Genital operculum elongately triangular in outline; cervical grooves deep, tough like; punctations few and large; legs typical, light tanned with whitish bands at joints.

Distribution : Gujarat, (Kutch, Kaira), Andhra Pradesh, Delhi, Himachal Pradesh, Jammu and Kashmir, Himachal Pradesh, Maharashtra, Orissa, Punjab, Uttar Pradesh.

Remarks : The chief host of this species is camel. It is mainly an arid area tick.

12. *Hyalomma hussaini* Sharif

1928. *Hyalomma hussaini* Sharif, *Rec. Indian Mus.*, 30 (3) : 314.

Diagnosis: Male-Punctations large in scapular and cervical areas, rare in central and caudal areas; lateral grooves deep and well developed; cervical grooves shallow rounded, extended to the scutal mid length.

Female Genital operculum shield-shaped; scutum slightly longer than wide; punctations large, shallow and scattered over the scapular and cervical areas.

Distribution : Gujarat (Kaira), Andhra Pradesh, Bihar, Delhi, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Sikkim.

Remark : The species is widely distributed under varied ecological situations.

13. *Hyalomma marginatum isaaci* Sharif

1928. *Hyalomma aegyptium isaaci* Sharif. *Rec. Indian Mus.*, **30** (3) : 307.

1963. *Hyalomma marginatum isaaci*, Kaiser and Hoogstraal. *J. Parasit.*, **49** (1) : 130.

Diagnosis : Male Lateral grooves long, distinct; punctations few, large; cervical grooves rounded and extend to the anterior third of scutal length; posteromedian and paramedian grooves extend to the festoons; anal shields large, subanals small, situated to the mid axis of the adanals; parma absent; legs with sharply defined rings near joints.

Female Scutum slightly longer than wide; cervical grooves smoothly rounded extending to and breaking the posterior margin of the scutum; genital operculum profile, slightly bulging; legs with white narrow, sharply defined rings.

Distribution : Gujarat, Andhra Pradesh, Arunachal Pradesh, Bihar, Delhi, Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Remarks : The species is widely distributed and adapted to different climates but rare in coastal areas.

14. *Hyalomma marginatum turanicus* Pomerantzev

1946. *Hyalomma marginatum turanicus* Pomerantzev. *Opred. Fauna SSSR Zool. Inst. Akad. Nauk, SSSR.* **26** : 1-28.

Diagnosis : Male Scutum with dense non-contiguous punctations; subanal shields situated on the mid-axis of the adanals; legs usually ringed and striped dorsally.

Female Operculum widely triangular in outline; scutum as long as wide; punctations more in the scapular areas than the cervical areas.

Distribution : Gujarat (Kutch), Maharashtra, Uttar Pradesh.

Remark : The species is restricted to arid region.

6. Genus *Nosomma* Schulze

1919. *Nosomma* Schulze, *Sitzungsb. Ges. Naturf. Freunde, Berlin. Jahrg.*, 191.

15. *Nosomma monstrosum*
(Nuttall and Warburton)

1908. *Hyalomma monstrosum* Nuttall and Warburton, *Proc. Cambridge Phil. Soc.*, **XIV** : 414.

1919. *Nosomma monstrosum* Schulze, *Sitzungsb. Ges. Naturf. Freunde, Berlin, Jahrg.*, (5) : 191.

1928. *Nosomma monstrosum*, Sharif. *Rec. Indian Mus.*, **3** : 398.

1962. *Nosomma monstrosum*, Nagar, *Bull. Ent.*, **3** : 59.

Diagnosis : Male-Scutum with whitish ornamental secretion; cervical grooves short, deep and slightly convergent depressions; punctations unequal; lateral groove narrow lying with a row of punctation, subanal shield trilobed, coxae with two unequal spurs, palpi one and half times as long as broad, segment 2 twice as long as segment 3 and broader than long, segment 3 with ventral retroverted spur; dentition 3/3.

Female Scutum chestnut-brown with diffused whitish ornamentation; cervical grooves narrow, deep; punctations fine, numerous and unequal; obsolete lateral salience on palpal segment 3; porose areas long and oval; spiracle sub-triangular; dentition 3/3.

Distribution : Gujarat (Kaira), Bihar, Maharashtra, Delhi, Uttar Pradesh, West Bengal, Orissa.

Remark : This is only species of the genus recorded in India.

7. Genus *Rhipicephalus* Koch

1844. *Rhipicephalus* Koch, *Arch. Naturgesch.* **10** : 238.

16. *Rhipicephalus arakeri* Hiregauder

1975. *Rhipicephalus arakeri* Hiregaudar, *Mysore J. agric. Sci.*, **9** : 473.

Diagnosis : Male-Scutum elongate, oval and wider in level with spiracles; cervical grooves shallow and extends up to level of anterior fourth of body margin; lateral grooves not well marked; palpi short, dentition 3/3; adanal plate large, pear-shaped and its posterior border rounded; coxa deeply cleft and spatulate, coxae II-IV with medium triangular spur.

Distribution : Gujarat (Anand).

Remark : The species was described by Hiregauder (1975) from Anand, Gujarat from *Mus rattus*.

17. *Rhipicephalus haemaphysaloides*
haemaphysaloides (Supino)

1897. *Rhipicephalus haemaphysaloides* Supino, *Atti. Soc. Veneto-Trent. Sci. Nat.*, **26** (3) : 234.

1928. *Rhipicephalus haemaphysaloides*, Sharif, *Rec. Indian Mus.*, **30** (3) : 280.

Diagnosis : Male-Cervical grooves short, deep, posteromedian groove well represented; punctations of larger and smaller types; palpi longer than broad, adanal shields sickle-shaped; spiracle comma-shaped; dentition 3/3.

Female Cervical grooves deep, shallow; punctations few, large; spiracle subtriangular with a large macula, cornua short, blunt; palpi twice as long as broad.

Distribution : Gujarat (Kaira), Arunachal Pradesh, Assam, Bihar, Madhya Pradesh, Himachal Pradesh, Orissa, Uttar Pradesh, Maharashtra, Karnataka, Kerala, Tamil Nadu, West Bengal.

Remark : Sharif (1938) suspected that this species plays some important role in transmission of tick fever in India.

18. *Rhipicephalus sanguineus sanguineus*
(Latreille)

1806. *Ixodes sanguineus* Latreille, *Genera Crustaceorum, Insectorum*, **1** : 157.

1844. *Rhipicephalus sanguineus* Koch, *Arch. Naturgesch.*, **10** (1) : 238.

1897. *Rhipicephalus sanguineus*, Neumann, *Mem. Soc. Zool. France*, **10** : 385.

1928. *Rhipicephalus sanguineus*, Sharif, *Rec. Indian Mus.*, **30** (3) : 275.

Diagnosis : Male Cervical grooves elongated, semicircles; lateral grooves narrow, deep, punctations comparatively numerous, unequal, irregularly arranged; basis capituli 3 times as broad as long; adanal shields triangular with internal margin almost straight; spiracle comma-shaped; palpi twice as long as broad with segment 2 and 3 subequal; dentition 3/3.

Female Scutum sub-hexagonal; cervical grooves deep; punctations as in male; spiracle subtriangular with a postero-dorsal angle.

Material examined : 2 (F), Sasangir, 8.ix.1969, coll. T.G. Vazirani.

Distribution : Gujarat (Kaira), Andhra Pradesh, Assam, Maharashtra, Orissa, Bihar, Madhya Pradesh, Tamil Nadu, Haryana, Jammu and Kashmir, Uttar Pradesh, West Bengal.

Remark : The species has a great importance in human pathology because it transmits rickettsiosis and spirochaetes.

19. *Rhipicephalus turanicus* Pomerantzev

1940. *Rhipicephalus turanicus* Pomerantzev, *Matkashvily and Lototzky, Mag. Parasit*, Moscow, **8** : 113.

1968. *Rhipicephalus turanicus*, Mitchell & Spillett, *J. Med. Ent.*, **5** (1) : 5.

1969. *Rhipicephalus turanicus*, Dhanda and Rao, *J. Bombay nat. Hist. Soc.*, **66** (1) : 211.

Diagnosis : Male Cervical grooves small, oval, semicircular; punctations small basic one and large scattered one; adanal shields long and narrow with a small conical spur-like projection on the internal margin.

Female Scutum slightly elongated, posterior margin wavy, punctations large and sparse, small superficial covers evenly on the central field of scutum; lateral grooves distinct; spiracular plate short, oval.

Distribution : Gujarat (Kutch), Andhra Pradesh, Jammu and Kashmir, Madhya Pradesh, Maharashtra, Tamil Nadu, West Bengal.

Remark : Dhanda and Rao (1969) reported the species from Kutch district.

SUMMARY

The paper deals with the tick fauna of Gujarat. A total of 19 species distributed over 7 genera and 2 families hitherto known from the state have been recorded. Out of these 19 species one species and one genus have been reported here

for the first time from the state. The first and important references, diagnostic features, distribution of each tick species in India and Key to the identification of families and genera have also been incorporated in the paper.

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REFERENCES

- Advani, R. and Vazirani, T.G. 1981. Studies on ectoparasites of bats of Rajasthan and Gujarat (India), *Rec. zool. Surv. India*, Occ. paper, No. 22, 155 pp.
- Geeverghese, G. and Dhanda, V. 1987. The Indian *Hyalomma* ticks (Ixodoidea : Ixodidae). *ICAR publication*, New Delhi, 119 pp.
- Hiregoudar, L.S. 1968a. Parasitic scheme in Gujarat State. *Parasitic Disease Bulletin*, **1** (1) : 2-4.
- Hiregoudar, L.S. 1968b. Tick fauna of domestic animals in Gujarat state. *Parasitic Disease Bulletin*, **1** (1) : 7-8.
- Hiregoudar, L.S. 1971. Ticks of wild animals in Gir sanctuary of Gujarat state. *Parasitic Disease Bulletin*, **3** : 21.
- Hiregoudar, L.S. 1975. On *Rhipicephalus* ticks of Gujarat, together with a description of new species- *Rhipicephalus arakeri* from a common Indian rat. *Mysore J. Agric. Sci.*, **9** : 473-479.
- Hiregoudar, L.S. 1976a. Additional records of ticks from Gujarat, *Curr. Res.*, **5** (4) : 62-63.
- Hiregoudar, L.S. 1976b. Some parasites of wild ruminants in Gir forest of India. *Indian Vet. J.*, **53** (3) : 237.
- Hiregoudar, L.S. 1976c. On the habits of ticks of domestic animals in Kaira district (Gujarat). *Acarology Newsletter (India)*, **3** : 7-8.
- Hoogstraal, H. and Trapido, H. 1963. *Haemaphysalis kutchensis* sp.n., a common larval and nymphal parasite of birds in Northwestern India (Ixodidae). *J. Parasit.*, **49** (3) : 489-497.
- Neumann, L.G. 1987. Revision de la famille des ixodides, 20 memoire. *Mem. Soc. zool. France*, **10** : 224-420.
- Sen, S.K. and Fletcher, T.B. 1962. *Veterinary entomology and acarology for India*, New Delhi, 668 pp.
- Trapido, H. 1965. Notes on critical *Haemaphysalis* specimens in European museum collections, with designations of lectotypes and neotype (Acarina : Ixodidae). *Proc. Ent. Soc. Wash.*, **67** : 152-165.

INSECTA : ODONATA

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INTRODUCTION

Odonata (Damsel and dragonflies) Fauna of Gujarat State is inadequately known at present. Besides a few scattered references, no comprehensive account on the Odonata Fauna of this State is available. Morton (1907) has reported 8 species. Fraser (1933, 1934 and 1936) in Fauna of British Indian Volumes has mentioned only a few species from Gujarat. Recently Prasad and Thakur (1984) have recorded 13 species and subspecies from the State.

The present study was undertaken to prepare a consolidated account of the Odonate Fauna of Gujarat, together with keys, distribution records, and variations noted from the published descriptions of the species/subspecies. The work is based on the study of collections present in the National Zoological Collection of the Zoological Survey of India (Headquarters), Calcutta as well as on collections present at its Desert Regional Station, Jodhpur.

Altogether 48 species of Odonata belonging to 30 genera, under 7 families and 2 suborders, have been reported from Gujarat. Species recorded earlier have also been included in the text, so as to make the account more comprehensive. Details of material studied along with references are indicated under each species and subspecies in the systematic account of present contribution. A brief diagnostic character of each species and subspecies is given in the key. A consolidated list of odonata of Gujarat, together with important relevant references, has been provided in the paper. Classification given in Fraser (1957) is followed. All keys are based on adult specimens. Out of 48 species/subspecies, 23 species and subspecies are recorded for the first time from the State. It was

further observed that 20 species and subspecies belonging to 15 genera under 4 families were reported earlier Odonata of Rajasthan (Adams, 1899; Agrawal, 1957, Bose and Mitra, 1976 and Prasad and Thakur, 1981).

STUDY AREA

Gujarat is situated in the Western part of India. It has a varied topography therefore, the State has been classified into three separate ecological zones viz., wet, semiarid and arid zones. The ecological niches provide excellent habitats including hill streams as well as permanent and temporary waterbodies for the breeding of Odonata.

Gujarat lies between 20°10' and 24°45' North latitude and 74°30' East longitude and covers an area of approximately 1,11,568 sq. kms. There are 19 administrative districts in the State. The major portion of the State has a flat topography, excepting the low ranges of the northern-most portions of the Sahyadri Hills and the portion of Aravalli mountain ranges which lie in the north-east to south-west directions. The rivers Narmada, Tapti, Mahi, Sabarmati and Setrunji flow into the Gulf of Khambhat, white rivers Banas and Saraswati flow into the little Runn of Kachchh. The area comprising of the Great and the Little Ranns of Kachchh covers about 12,400 sq. kms. and is almost near the sea level.

The south and South-west portion of the State is moist with a rainfall of approximately 150 cms., but the north-eastern portion is dry with a rainfall of about 50 cms. Depending on the variations of rainfall from South to north, the vegetation also changes from the subtropical evergreen forests to the tropical thorn forests in the north. The cultivated crops are generally cotton, wheat,

Ground nut, Banana, Coconut, Jawar, Bajari and Sugar cane etc. Soils of Gujarat can be broadly classified into black and alluvial soil. Patches of red and yellow soils are also found.

SYSTEMATIC ACCOUNT

Order ODONATA

Suborder ZYGOPTERA

Superfamily COENAGRIONOIDEA

Family PLATYCNEMIDIDAE

Genus *Copera* Kirby

1. *Copera ciliata* (Selys)

1863. *Psilocnemis annulata* Selys, *Bull. Acad. Belg.*, (2) 16 : 172.

1933. *Copera annulata*, Fraser, *Fauna Brit. India Odon.*, 1 : 203-206.

1991. *Copera ciliata*, Tsuda, *A Distributional list of world Odonata*, : 52.

Material examined : 2 ♀♀, Vadodra, district Vadodara, 29.10.1991; coll. N. Radha Krishnan.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Female</i> :	36.00 mm	23.00 mm	22.00 mm

Distribution : India (Assam and West Bengal), Malaysia, Indo-China and China.

Remarks : 2 ♀♀, of this species were studied, collected from Vadodara, dated 29.10.1991, by Dr. N. Radha Krishnan of Department of Zoology, M.S. University, Vadodara 390002.

Both the females agree well with the published descriptions of the species. The species is recorded from the Gujarat State for the first time.

Family COENAGRIONIDAE

Genus *Pseudagrion* Selys

2. *Pseudagrion decorum* (Rambur)

1842. *Agriion decorum* Rambur, *Ins. Neurop.*, 258.

1933. *Pseudagrion decorum*, Fraser, *Fauna Brit. India Odon.*, 1 : 268-269.

Material examined : 1 ♂, Fuljas dam ca. 33 kms. South-east of Khambhalia district Jamnagar, coll. N.S. Rathore; 1 ♂, Hajira and its vicinity, district Surat, 10.1.1989, coll. R.K. Singh; 1 ♂, Khambhat (Cambay) district Kheda, 22.2.1991, coll. N.S. Rathore; 6 ♂♂, 2 ♀♀, Nal Sarovar, district Ahmedabad, 4.2.1974, coll. B. Dutta; 2 ♂♂, 1 ♀, Nal Sarovar, district Ahmedabad, 14.2.1991, coll. N.S. Rathore; 1 ♂, Pariej village 23 kms. South of Kheda, district Kheda, 23.2.1991, coll. N.S. Rathore; 2 ♀♀, Upardal, district Ahmedabad, 8.2.1974, coll. B. Dutta and 1 ♀, Vautha, district Ahmedabad, 18.2.1991, coll. N.S. Rathore.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	28.50 mm- 29.00 mm	20.00 mm	19.00 mm- 19.50 mm
<i>Female</i> :	28.00 mm- 29.00 mm	20.00 mm- 21.00 mm	20.00 mm

Distribution : India (Bilaspur, Sirmaur, Una, Dehra-Dun, Nainital, West Bengal, Bihar, Otacamund, Nilgiris, Coorg, Gujarat and West coast), Nepal, Myanmar and Sri Lanka.

Remarks : Pterostigma covers 1 1/2 cells in both the sexes. There are 10 postnodal nervures in forewings and 8 to 9 in hindwings of male, while 11 postnodal nervures in forewings and 9 in hindwings of female.

3. *Pseudagrion hypermelas* Selys

1876. *Pseudagrion hypermelas* Selys, *Bull. Acad. Belg.*, 2 (42) : 519.

1933. *Pseudagrion hypermelas*, Fraser, *Fauna Brit. India Odon.*, 1 : 289-292.

Material examined : 1 ♂, Daniwala, district Surat, 24.11.1972, coll. P.T. Cherian.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Female</i> :	22.50 mm	16.50 mm	16.00 mm

Distribution : India (Punjab, Madhya Pradesh, Bihar, Deccan area of the Maharashtra and Gujarat).

Remarks : Ten postnodal nervures in forewings and 8 in hindwings of female. Pterostigma in both the wings covers less than a cell. Nervures AC situated nearer to the first antenodal nervure.

4. *Pseudagrion rubriceps rubriceps* Selys

1876. *Pseudagrion rubriceps* Selys, *Bull. Acad. Belg.*, (2) 42 : 510.

1933. *Pseudagrion rubriceps*, Fraser, *Fauna Brit. India Odon.*, 1 : 296-299.

1991. *Pseudagrion rubriceps rubriceps*, Tsuda, *A Distributional list of world Odonata* : 46.

Material examined : 1 ♂, Gandhinagar, district Gandhinagar, 25.2.1991, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	29.00 mm	19.00 mm	18.50 mm

Distribution : Widely distributed throughout continental India (Bilaspur, Hamirpur, Sirmaur, Dehra Dun, Nainital, Pauri Garhwal, Tehri Garhwal and Bihar), Nepal, Myanmar, Indonesia, Malaysia and Taiwan.

Remarks : Eight postnodal nervures in forewings and 7 in hindwings. Nervure AC situated in between 1st and 2nd antenodal nervures. Arc present just in the middle of 1st and 2nd antenodal nervures. Nervure Ab present at the point from where nervure AC originate. Pterostigma covers approximately 1-1/2 cells. It is first time recorded from Gujarat State.

5. *Pseudagrion laidlawi* Fraser

1922. *Pseudagrion laidlawi* Fraser, *Mem. Dep. Agric. India (Eng.)*, 7 (7) : 48-50.

1933. *Pseudagrion laidlawi*, Fraser, *Fauna Brit. India Odon.*, 1 : 294-296.

Material examined : 1 ♂, Gandhinagar, district Gandhinagar, 25.2.1991, coll. N S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	24.00 mm	16.00 mm	15.00 mm

Distribution : India (Dehra Dun), Pakistan (Lahor Sindh and Karachi).

Remarks : Nine postnodal nervures in forewings and 7 in hindwings. Nervure AC situated nearer to first antenodal nervure. Pterostigma covers less than a cell. It is first time recorded from Gujarat State.

6. *Pseudagrion bidentatum* Morton (Map 8)

1907. *Pseudagrion bidentatum* Morton, *Trans. Ent. Soc. Lond.*, : 308.

1916. *Pseudagrion bidentatum*, Laidlawi, *Rec. Indian Mus.*, 12 : 21-45.

Distribution : India (Deesa, Gujarat).

Genus *Ceriagrion* Selys

7. *Ceriagrion coromandelianus* (Fabricius)

1798. *Agrion coromandelianum* Fabricius, *Ent. Syst. Suppl.*, : 287.

1933. *Ceriagrion coromandelianum*, Fraser, *Fauna Brit India Odon.*, 1 : 315-316.

Material examined : 2 ♂♂, Fuljasdam, Ca 33 kms. South-east of Khambhalia, district Jamnagar, 8.2.1990, coll. N.S. Rathore and 1 ♀, Pariej village, Ca 23 kms. South of Kheda, district Kheda, 23.2.1991, coll. N.S., Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	29.50 mm	20.50 mm	20.00 mm
Female :	28.00 mm	21.00 mm	20.50 mm

Distribution : Throughout India (Bilaspur, Kangra, Hamirpur, Simla, Sirmaur, Una, Chamoli, Dehra Dun, Nainital, Uttarkashi, Bihar, West Bengal and Gujarat), Nepal, Myanmar, Sri Lanka, Malaysia and China.

Remarks : It is one of the most common species found throughout India. There are 11 postnodal nervures present in forewings and 10 in hindwings. Pterostigma dark brown in colour and covers approximately a cell.

Genus *Ischnura* Charpentier

8. *Ischnura senegalensis* (Rambur)

1842. *Agrion senegalensis* Rambur, *Ins. Neurop.*, : 276.

1933. *Ischnura senegalensis*, Fraser, *Fauna Brit. India Odon.*, 1 : 348-351.

Material examined : 1 ♂, 4 ♀♀, Barkot, Sarswati river near Patar, district Mahesana, 27.1.1974, coll. B. Dutta; 3 ♂♂, 3 ♀♀, Desalpur village Ca 25 kms. South west of Bhuj. District Bhuj, 25.2.1989, coll. N.S. Rathore; 3 ♂♂, 1 ♀, Dholka Reserve Forest, district Ahmedabad, 16.2.1991, coll. N.S. Rathore; 1 ♂, Dwarka Rly. Stn., Dwarka, district Jamnagar, 13.12.1973. coll. S.K. Gupta; 1 ♂, Dwarka Rly. Stn., Dwarka, district Jamnagar, 14.12.1973, coll. S.K. Gupta; 1 ♀, Gandhinagar, district Gandhinagar, 25.2.1991, coll. N.S. Rathore; 2 ♂♂, 1 ♀, Munsar Tank, Viramgam, district Ahmedabad, 29.1.1974, coll. B. Dutta; 12 ♂♂, 5 ♀♀, Nal Sarovar, district Ahmedabad, 4.2.1974, coll. B. Dutt; 2 ♂♂, Nal Sarovar, district Ahmedabad, 14.2.1991, coll. N.S. Rathore; 3 ♂♂, 3 ♀♀, Pariej village, 23 kms. South of Kheda, district kheda, 23.2.1991, coll. N.S. Rathore; 1 ♂, Saputara, district The Dangs, 14.1.1989, coll. R.K. Singh; 6 ♂♂, 4 ♀♀, Sanand (1 km. from the rest house), district Ahmedabad, 6.2.1974, coll. B. Dutta; 1 ♀, Upardal, district Ahmedabad, 8.2.1974, coll. B. Dutta; 1 ♀, Vautha, district Ahmedabad, 18.2.1991, coll. N.S. Rathore; 1 ♀, Viramgam, district Ahmedabad, 29.1.1974, coll. B. Dutta and 1 ♂, Viramgam (Surroundings of rest house), district Ahmedabad, 3.2.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
<i>Male</i> :	22.00 mm- 24.00 mm	17.00 mm- 19.00 mm	16.50 mm- 18.00 mm
<i>Female</i> :	21.00 mm- 23.00 mm	16.50 mm- 19.00 mm	16.00 mm- 18.00 mm

Distribution : Throughout India (Bilaspur, Sirmaur, Dehra Dun, Tehri, Garhwal, Bihar, West Bengal and Gujarat), France (Monaco), Africa, Myanmar, Sri Lanka, Philippines, Indonesia (Java, Boreno, Sumba, Timor, Bali, Sumbawa, Lombok, Moluccas and Sunda Island) and Japan.

Remarks : It is also a very common species. Eight to nine postnodal nervures in forewings and 7 to 8 in hindwings. *Arc* present in both the sexes.

9. *Ischnura aurora aurora* (Brauer)

1858. *Agrion delicatum* Hagen, *Verh. zool. bot. Ges. Wien.*, 8 : 479.

1865. *Agrion aurara*, Brauer, *Verh. zool. bot. Ges. Wien.*, 15 : 510.

1933. *Ischnura delicata*, Fraser, *Fauna Brit. India Odon.*, 1 : 360-362.

1955. *Ischnura aurora*, Lieftinck, *Trubia*, 22 : 74.

1991. *Ischnura aurora aurora*, Tsuda, *A Distributional list of world Odonta*, : 34.

Material examined : 10 ♂♂, Anandpura, Viramgam, district Ahmedabad, 31.1.1974, coll. B. Dutta; 3 ♂♂, Baborano, district Ahmedabad, 11.2.1974, coll. B. Dutta; 3 ♂♂, 5 ♀♀, Chawra village, 19 kms. from Dholka, district Ahmedabad, 19.2.1991, coll. N.S. Rathore; 1 ♂, Gandhinagar, district Gandhinagar, 25.2.1991, coll. N.S. Rathore; 1 ♀, Kolak and its vicinity, district valsad, 18.1.1989, coll. R.K. Singh, 2 ♂♂, Lakhtar tank, district Surendranagar, 15.2.1991, coll. N.S. Rathore; 1 ♂, 2 ♀♀, Lakhtar, district Surendranagar, 13.2.1991, coll. N.S. Rathore; 1 ♂, 1 ♀, Lasundra, district kheda, 21.2.1991, coll. N.S. Rathore; 3 ♂♂, 1 ♀♀, Magodi, district Gandhinagar, 26.2.1991, coll. N.S. Rathore; 3 ♂♂, Munsar Tank, Viramgam, district Ahmedabad, 29.1.1974, coll. B. Dutta; 14 ♂♂, Sanand (1 km. from rest house), district Ahmedabad, 6.2.1974, coll. B. Dutta; 9 ♂♂, Sarswati river near Patar, district Mahesana, 27.1.1974, coll. B. Dutta; 3 ♂♂, Upardal, district Ahmedabad, 3.2.1974, coll. B. Dutta; 7 ♂♂, Viramgam (Surrounding areas of the rest house), district Ahmedabad, 3.2.1974, coll. B. Dutta and 6 ♂♂, Viramgam (93 kms. away from the rest house), district Ahmedabad, 29.1.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	16.00 mm- 17.00 mm	11.00 mm- 12.00 mm	10.00 mm- 12.00 mm
Female :	21.00 mm- 23.00 mm	16.50 mm- 19.00 mm	10.00 mm- 11.00 mm

Distribution : India (Bilaspur, Kangra, Hamirpur, Solan, Una, Dehra Dun, Nainital, Tehri Garhwal, Bihar, West Bengal and Gujarat), Myanmar, Sri Lanka, Malaysia, Philippines, Indonesia (Borneo and Samoa), Sondaic Archipelago, Papua and Australia.

Remarks : It is most common species of the genus and occurring throughout the India.

10. *Ischnura elegans elegans*
(Vander Linden)

1823. *Agrion elegans* Vander Linden, *Opusc. Sci.*, 4 : 104.

1933. *Ischnura elegans*, Fraser, *Fauna Brit. India Odon.*, 1 : 351-354.

1991. *Ischnura elegans elegans*, Tsuda, *A Distributional list of world Odonata*, : 34.

Material examined : 1 ♂, Kolak, district Valsad, 18.1.1989, coll. R.K. Singh; 1 ♂, Pariej village Ca, 23 kms. south of Kheda, district kheda, 23.2.1991, coll. N.S. Rathore and 1 ♀ Viramgam (3 kms. west of rest house), district Ahmedabad, 29.1.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	21.50 mm	14.50 mm	14.00 mm
Female :	23.00 mm	16.50 mm	16.00 mm

Distribution : Europe to East Asia.

Remarks : Seven postnodal nervures in forewings and 6 postnodals in hindwings. It is recorded for the first time from Gujarat State.

Genus *Rhodischnura* Laidlaw

11. *Rhodischnura nursei* (Morton)

1907. *Ischnura nursei* Morton, *Trans. Ent. Soc. Lond.*, : 306-307.

1933. *Rhodischnura nursei*, Fraser, *Fauna Brit. India Odon.*, 1 : 369-371.

Material examined : 2 ♂♂, Anandpura, Viramgam, district Ahmedabad, 31.1.1974, coll. B. Dutta; 1 ♂, Aligarh, Viramgam, District Ahmedabad, 7.2.1975, coll. V.D. Srivastava; 4 ♂♂, Chawra village, 19 kms. from Dholka, district Ahmedabad, 19.2.1991, coll. N.S. Rathore; 1 ♂, Cholka Reserve forest, district Ahmedabad, 16.2.1991, coll. N.S. Rathore; 2 ♂♂, Khambhat (Cambay), district Kheda, 22.2.1991, coll. N.S. Rathore; 3 ♂♂, Lakhtar, 4 kms. on road to Surendranagar, district Surendranagar, 13.2.1991, coll. N.S. Rathore; 1 ♂, Lakhtar tank, district Surendranagar, 15.2.1991, coll. N.S. Rathore; 4 ♂♂, Mondal, district Ahmedabad, 4.12.1973, coll. P.T. Cherian; 2 ♂♂, 3 ♀♀, Nal Sarovar, district Ahmedabad, 14.2.1991, coll. N.S. Rathore; 2 ♂♂, Pariej village, 23 kms. south of Kheda on road to Tarapur, district Kheda, 23.2.1991, coll. N.S. Rathore; 2 ♂♂, Vautha, district Ahmedabad, 18.2.1991, coll. N.S. Rathore and 1 ♂, Viramgam, district Ahmedabad. 3.2.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	15.00 mm- 16.00 mm	9.50 mm- 10.00 mm	9.50 mm- 10.00 mm
Female :	15.00 mm	12.00 mm	11.50 mm

Distribution : India (Dehra Dun, Nainital, Pauri Garhwal, Bihar, Madhya Pradesh, West Bengal and Gujarat) and Pakistan (Karachi, Sind and Hyderabad).

Remarks : It is very common throughout Gujarat.

Genus *Enallagma* Charpentier

12. *Enallagma parvum* Selys

1876. *Enallagma parvum* Selys, *Bull. Acad. Belg.*, (2) 41 : 537.

1933. *Enallagma parvum* Fraser, *Fauna Brit. India Odon.*, 1 : 376-378.

Material examined : 1 ♂, 1 ♀, Anandpura, Viramgam, district Ahmedabad, 31.1.1974, coll.

B. Dutta; 1 ♂, Mondal, district Ahmedabad, 4.12.1973, coll. P.T. Cherian; 1 ♀, Munsar Tank, Viramgam, district Ahmedabad, 29.1.1974, coll. B. Dutta; 1 ♂, Sarswati river, near Patar, district Mahesana, 27.1.1974, coll. B. Dutta; 1 ♀, Upardal, district Ahmedabad, 8.2.1974, coll. B. Dutta; 2 ♀♀, Viramgam (3 kms. of rest house), district Ahmedabad, 31.1.1974, coll. B. Dutta and 2 ♀♀, Viramgam (Surroundings of the rest house), district Ahmedabad, 3.2.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	16.50 mm- 17.50 mm	11.50 mm- 12.00 mm	10.50 mm- 11.00 mm
Female :	17.00 mm	11.50 mm	10.50 mm- 11.00 mm

Distribution : Throughout India, Nepal, Myanmar and Sri Lanka.

Remarks : It is occurring throughout the year near weedy water bodies.

13. *Enallagma cyathigerum cyathigerum*
Charpentier

1840. *Enallagma cyathigerum* Charpentier, *Lib. Europe.* : 163.

1933. *Enallagma cyathigerum*, Fraser, *Fauna Brit. India Odon.*, 1 : 373-375.

Material examined : 1 ♀, Anandpura, Viramgam, district Ahmedabad, 31.1.1974, coll. B. Dutta and 1 ♀, Nal Sarovar, district Ahmedabad, 4.2.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Female :	23.50 mm	19.50 mm	19.00 mm

Distribution : India (Kashmir), Europe, British Isles, Central Asia, Tibet and North America.

Remarks : It is recorded for the first time from Gujarat State.

Genus *Agriocnemis* Selys

14. *Agriocnemis pygmaea pygmaea*
(Rambur)

1842. *Agriocnemis pygmaea* Rambur, *Ins. Neurop.* : 278.

1933. *Agriocnemis pygmaea*, Fraser, *Fauna Brit. India Odon.*, 1 : 398-401.

Material examined : 1 ♀, Chawra village, 19 kms. from Ahmedabad, district Ahmedabad, 19.2.1991, coll. N.S. Rathore, 2 ♂♂, 1 ♀, Dholka Reserve Forest, district Ahmedabad, 16.2.1991, coll. N.S. Rathore; 1 ♂, Fuljas dam, Ca 33 kms. South-east of Khambhalia district Jamnagar, 8.2.1990, coll. N.S. Rathore; 1 ♂, 1 ♀, Gandhinagar, district Gandhinagar, 25.2.1991, coll. N.S. Rathore; 1 ♂, Hajira and its vicinity district Surat, 10.1.1989, coll. R.K. Singh; 2 ♂♂, Kharad and its vicinity, district Valsad, 20.1.1989, coll. R.K. Singh; 2 ♂♂, 2 ♀♀, Lakhtar tank, district Surendranagar, 15.2.1991, coll. N.S. Rathore; 1 ♀, Lakhtar, 4 kms. on road to Surendranagar, district Surendranagar, 13.2.1991, coll. N.S. Rathore; 2 ♀♀, Megodi, district Gandhinagar, 26.2.1991, coll. N.S. Rathore; 1 ♂, 1 ♀, Nal Sarovar, district Ahmedabad, 14.2.1991, coll. N.S. Rathore; 6 ♂♂, 7 ♀♀, Pariej village, 23 kms. south of Kheda district kheda 23.2.1991, coll. N.S. Rathore; 1 ♂, 2 ♀♀, Sihor, district Bhavnagar, 26.12.1973, coll. S.K. Gupta; 6 ♂♂, 7 ♀♀, Vautha, district Ahmedabad, 18.2.1991, coll. N.S. Rathore and 2 ♂♂, 2 ♀♀, Viramgam (Surrounding of the rest house) district Ahmedabad, 3.2.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	16.50 mm- 17.50 mm	9.50 mm- 10.00 mm	9.50 mm- 10.00 mm
Female :	16.50 mm 17.50 mm	9.50 mm 10.00 mm	9.50 mm- 11.00 mm

Distribution : Throughout India, Nepal, Myanmar, Sri Lanka, Singapore, Philippines (Manila), Seychelles (Indian Ocean), Taiwan), Indonesia (Java, North Celebes, Suadn Island), China, Papua (New Guinea) and Australia.

Remarks : It is one of the most common damselfly and occurring throughout the year near waterbodies. 6 postnodal nervures in forewing and 5-6 in hindwings of male, while 8 postnodals in forewings and 7 in hindwings of female.

15. *Agriocnemis splendidissima* Laidlaw

1919. *Agriocnemis splendidissima* Laidlaw, *Red. Indian Mus.*, 16 : 180-182.

1933. *Agriocnemis splendidissima*, Fraser, *Fauna Brit. Ind. Odon.*, 1 : 392-394.

Material examined : 4 ♂♂, Kolak and its vicinity, district Valsad, 18.1.1989, coll. R.K. Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	18.00 mm- 19.00 mm	11.00 mm 12.00 mm	10.00 mm- 11.00 mm

Distribution : India (Western Ghats, Madhya Pradesh, and Bihar).

Remarks : Seven postnodal nervures in forewings and 6 in hindwings. It is recorded for the first time from Gujarat State.

Genus *Cercion* Navas16. *Cercion calamorum dyeri* (Fraser)

1919. *Agriocnemis dyeri* Fraser, *Rec. India Mus.*, 16 : 451-452.

1933. *Coenagrion dyeri dyeri*, Fraser, *Fauna Brit. India Odon.*, 1 : 413-415.

1991. *Cercion calamorum*, Tsuda, *A Distributional list of world Odonata*, : 25.

Material examined : 1 ♀, Anandpura, Viramgam, district Ahmedabad, 31.1.1974, coll. B. Dutta and 1 ♂, Pariej village, 23 kms. South of Kheda, District Kheda, 23.2.1991, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	23.00 mm	15.50 mm	15.00 mm
Female :	22.00 mm	15.00 mm	15.00 mm

Distribution : India (Throughout peninsular India including Madhya Pradesh, Western Ghats and Bihar) and Upper Myanmar.

Remarks : It is recorded for the first time

from Gujarat. 8 Postnodal nervures in forewings and 6 in hindwings. Pterostigma covers more than one cell.

Genus *Onychargia* Selys17. *Onychargia atrocyana* (Selys)

1865. *Onychargia atrocyana* Selys, *Bull. Acad. Belg.*, (2) 20 : 416.

1933. *Onychargia atrocyana*, Fraser, *Fauna Brit. India Odon.*, 1 : 417-418.

Material examined : 1 ♂, Viramgam (Surroundings of the rest house), district Ahmedabad, 3.2.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	23.00 mm	17.50 mm	16.50 mm

Distribution : India (West Bengal, Bihar, Assam, North Coorg, Malabar and Annaimalai Hills), Myanmar and Sri Lanka.

Remarks : It is recorded for the first time from Gujarat. There are 10 postnodal nervures in both the wings.

Superfamily LESTINOIDEA

Family LESTIDAE

Genus *Lestes* Leach18. *Lestes thoracicus* Laidlaw

1920. *Lestes thoracica* Laidlaw, *Rec. Indian Mus.*, 19 : 152-153.

1933. *Lestes thoracica*, Fraser, *Fauna Brit. India Odon.*, 1 : 56-57.

1991. *Lestes thoracicus*, Tsuda, *A Distributional list of world Odonata*, : 63.

Material examined : 1 ♂, Dodagram, Sanand, district Ahmedabad, 8.11.1973, coll. P.T. Cherian.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	33.00 mm	21.00 mm	20.50 mm

Distribution : India (Dehra Dun, Bihar, West Bengal, Orissa and Gujarat).

Remarks : Apices of both the wings creamy brown. Pterostigma covers 2 cells, abdominal segments 7 to 10 are entirely black. 10 postnodal nervures in forewings and 11 in hindwings.

19. *Lestes umbrinus* Selys (Map 2)

1891. *Lestes umbrina*, Selys, *Ann. Mus. Cir., Genova*, (2) 10 : 497-498.

1933. *Lestes umbrina*, Fraser, *Fauna Brit. India Odon.*, 1 : 53-55.

1991. *Lestes umbrinus*, Tsuda, *A Distributional list of world Odonota* : 63.

Material examined : 1 ♂, Botanical garden Junagarh, district Junagarh, 5.12.1973, coll. S.K. Gupta; 1 ♀, Jamnagar, district Jamnagar, 19.12.1973, coll. S.K. Gupta; 1 ♂, Omwora, Rajkot, district Rajkot, 29.12.1973, coll. S.K. Gupta, 1 ♀, Rajkot, district Rajkot, 29.12.1973, coll. S.K. Gupta and 2 ♂♂, 1 ♀, Sanand Rest House, district Ahmedabad, 6.2.1974, coll. B. Dutta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	31.50 mm- 32.50 mm	20.00 mm- 21.00 mm	20.00 mm

Female :	29.00 mm	21.50 mm	21.00 mm
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Distribution : India (Uttar Pradesh, Bihar, West Bengal, Gujarat and Maharashtra), China and Myanmar.

20. *Lestes viridulus* Rambur

1842. *Lestes viridula* Rambur, *Hist. Nat. Ins. Neurop.*, : 252-253.

1933. *Lestes viridula*, Fraser, *Fauna Brit. India Odon.*, 1 : 45-46.

1991. *Lestes viridulus*, Tsuda, *A Distributional list of world Odonata*, : 64.

Material examined : 1 ♂, 4 ♀♀, Khambhat (Cambay), district Kheda, 22.2.1991, coll. N.S. Rathore; 1 ♂, 1 ♀, Lakhtar 4 kms. on road to Surendranagar, district Surendranagar. 13.2.1991, coll. N.S. Rathore; 1 ♀, Lasundra, district Kheda, 21.2.1991, coll. N.S. Rathore and 1 ♂, Saputara, district The Dangs, 14.1.1989, coll. R.K. Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	32.00 mm- 34.50 mm	21.50 mm- 23.50 mm	20.50 mm- 23.00 mm

Female :	29.00 mm 34.00 mm	21.00 mm 23.50 mm	21.00 mm- 23.50 mm
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Distribution : India (Bilaspur, Kangra, Dehra Dun, Nainital, Bihar, Pauri Garhwal, Deccan, Western India, South Coorg and Bombay).

Remarks : It is recorded for the first time from Gujarat. 9-11 postnodal nervures in forewings and 10-11 in hindwings of male. Male collected from Saputara, The Dangs is interesting because it has 11 postnodals in both the wings. Pterostigma covers 2 cells. *Arc* situated at the level of 2nd antenodal nervure. Nervure *Ab* situated just in the middle of 1st and 2nd antenodal nervures.

Family PROTONEURIDAE

Genus *Disparoneura* Selys

21. *Disparoneura quadrimaculata*
(Rambur)

1842. *Agria quadrimaculata* Rambur, *Ins. Neurop.*, : 255.

1860. *Disparoneura quadrimaculata*, Selys, *Bull. Acad. Belg.*, (2) 10 : 446.

Material examined : 2 ♂♂, Dandi, district Valsad, 19.1.1989, coll. R.K. Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	31.50 mm	23.00 mm	22.50 mm

Distribution : India (Madhya Pradesh, Maharashtra, Karnataka and Western Ghats).

Remarks : 15-18 Postnodal nervures present in forewings, while 13-14 postnodals in hindwings. Pterostigma covers more than a cell. Brown markings present in-between 1st to 8th postnodals in left side of forewings, while 1st to 10th postnodals in right side of forewings, but in hindwings it confinds inbetween 5th to 14th postnodal nervures. In another specimens brown

marking present inbetween 4th postnodal and pterostigma. It is first time recorded from Gujarat.

Suborder ANISOPTERA

Superfamily AESHNOIDEA

Family GOMPHIDAE

Genus *Paragomphus* Cowley

22. *Paragomphus lineatus* (Selys) (Map 6)

1850. *Gomphus lineatus* Selys, *Rev. Odon.*, 386.

1934. *Mesogomphus lineatus*, Fraser, *Fauna Brit. India Odon.*, 2 : 230-234.

1985. *Paragomphus lineatus*, Davies & Tobin, *Soc. Int. Odonatol. rapid comm. (Suppl.)*, No. 5 : 47.

Material examined : 1 ♂, Lasundra, district Kheda, 21.2.1991, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	34.00 mm	27.00 mm	26.00 mm

Distribution : India (Kangra, Nainital, Dehra Dun, West Bengal, Maharashtra, Karnataka and Tamil Nadu), Nepal and Myanmar.

Remarks : It is recorded for the first time from Gujarat. Only one cubital nervure in both pair of wings and pterostigma covers 5 cells. Nodal index :

$$\frac{7-14/14-7}{9-10/11-8}$$

Genus *Anormogomphus* Selys

23. *Anormogomphus kiritschenkoi*
Bartenef

1913. *Anormogomphus kiritschenkoi* Bartenef, *Revue, Russe, d' Ent.*, 13 : 179.

1934. *Anormogomphus kiritschenkoi*, Fraser, *Fauna Brit. India Odon.*, 2 : 176-177.

Material examined : 1 ♂, Desalpur, district Bhuj, 25.2.1989, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	Damaged	24.00 mm	23.00 mm

Distribution : India (Dehra Dun), Iran, Persian Gulf, Mesopotamia and Pakistan.

Pakistan : It is recorded for the first time from Gujarat. Anal triangle entire, membrane narrow, long and creamy white in colour. Discoidal field begins with 2 rows of cells, pterostigma covers approximately 2 cells. Nodal index :

$$\frac{6-8/8-6}{6-6/7-6}$$

Family AESHNIDAE

Genus *Hemianax* Selys

24. *Hemianax ephippiger* (Burmeister)

1839. *Aeshna ephippiger* Burmeister, *Handb. Ent. Band 2* : 840.

1936. *Hemianax ephippiger*, Fraser, *Fauna Brit. India Odon.* 3 : 147-149.

Distribution : India (Kangra, Afzalgarh, Maharashtra and Gujarat), S.E. Europe, Iraq, Egypt, Mesopotamia, Morocco and Sri Lanka.

Superfamily LIBELLULOIDEA

Family LIBELLULIDAE

Genus *Tetrathemis* Brauer

25. *Tetrathemis platyptera* Selys

1878. *Tetrathemis platyptera* Selys, *Mitt. Mus. Dresden.* 316.

1936. *Tetrathemis platyptera*, Fraser, *Fauna Brit. India Odon.* 3 : 250-251.

Material examined : 1 ♂, Pipri, district The Dangs, 16.1.1989, coll. R.K. Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	Damaged	20.50 mm	20.00 mm

Distribution : Throughout submountaine wet areas of India (Dehra Dun, Nainital, Tamil Nadu, Karnataka, Kerala and Andhra Pradesh), Myanmar, Thailand, Malacca and Indonesia (Java, Sumatra).

Remarks : It is recorded for the first time from Gujarat. Face, frons and occiput brilliant metallic blue. Two cubital nervures present in hindwings and only one in forewings. Discoidal cell entire. One row of cells present inbetween *IR* iii and *Rspl*. Pterostigma covers 1 cells.

Genus *Potamarcha* Karsch

26. *Potamarcha congener* (Rambur) (Map 3)

1842. *Libellula Obscura* Rambur, *Ins. Neurop.*, 64.

1842. *Libellula congener*, Rambur, *Ins. Neurop.*, : 70.

1890. *Potamarcha obscura*, Karsch, *Berlin Ent. Zeit.*, 33 : 371.

1891. *Potamarcha congener*, Selys, *Ann. Soc. Espan.*, 20 : 221.

Material examined : 2 ♂♂, 4 ♀♀, Kharad, district Valsad, 20.1.1989, coll. R.K. Singh and 1 ♀, Timbi, district Amreli, 30.12.1988, coll. R.K. Singh.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	30.00 mm- 31.00 mm	34.00 mm- 34.00 mm	34.00 mm
<i>Female</i> :	30.00 mm 34.50 mm	34.00 mm	33.50 mm

Distribution : India (Kangra, Dehra Dun, Bihar, Madhya Pradesh, West Bengal, Andhra Pradesh, Tamil Nadu, Karnataka and Maharashtra), Nepal, Myanmar, Sri Lanka, Philippines, Taiwan, Malaya Archipelago, Indonesia (Java and Sumatra), Papua (New Guinea) and North Australia.

Remarks : It is recorded for the first time from Gujarat

Genus *Orthetrum* Newman

27. *Orthetrum taeniolum* (Schneider)

1845. *Libellula taeniolum* Schneider, *Stett. Ent. Zeit.*, 6 : 111.

1936. *Orthetrum taeniolum*, Fraser, *Fauna Brit. India Odon.*, 3 : 296-298.

Material examined : 2 ♂♂, 4 ♀♀, Ahwa, district. The Dangs, 15.1.1989, coll. R.K. Singh; 1 ♂, Chhota Udepur, district Vadodara, 5.1.1989, coll. R.K. Singh; 1 ♂, Dandi, district Valsad, 19.1.1989, coll. R.K. Singh; 5 ♀♀, Pipri, district the Dangs, 16.1.1989, coll. R.K. Singh; 1 ♂, 1 ♀, Saputara, district the Dangs, 14.1.1989, coll. R.K. Singh and 1 ♂, Timbi, district Amreli, 30.12.1989, coll. R.K. Singh.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	23.00 mm- 24.50 mm	25.50 mm- 27.00 mm	25.00 mm 26.00 mm
<i>Female</i> :	23.00 mm 24.00 mm	25.00 mm 26.50 mm	25.50 mm 27.00 mm

Distribution : India including dry zones and hot plains (Bilaspur, Kangra, Kinnaur, Una, Chamoli, Dehra Dun, Nainital, Tehri and Pauri Garhwal, Uttar Kashi, Madhya Pradesh, Bihar, West Bengal, Sikkim and Gujarat), Nepal and countries bordering Mediaterranean.

Remarks : It is a common species in Gujarat and occurring throughout the year.

28. *Orthetrum sabina sabina* (Drury)

1770. *Libellula sabina* Drury, *Ill. Exot. Ins.*, 1 : 114.

1936. *Orthetrum sabina*, Fraser, *Fauna Brit. India Odon.*, 3 : 300-302.

Material examined : 1 ♀, Adipur about 40 kms. on road to Ahmedabad, district Ahmedabad, 12.10.1988, coll. R.K. Singh; 1 ♂, Dandi, district Valsad, 19.1.1989, coll. R.K. Singh; 1 ♂, 1 ♀, Desalpur Ca 25 kms. South West of Bhuj, District Bhuj, 25.2.1989, coll. N.S. Rathore; 1 ♂, Nal Sarovar, district Ahmedabad, 14.2.1991, coll. N.S. Rathore; 1 ♂, Pipri, district The Dangs, 16.1.1989, coll. R.K. Singh; 1 ♂, Surat, district Surat, 10.11.1972, coll. G.M. Yazdani; 1 ♂, Vautha, district Ahmedabad, 18.2.1991, coll. N.S. Rathore and 4 ♂♂, Verdah, District Junagarh, 3.12.1973, coll. S.K. Gupta.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	30.00 mm- 33.00 mm	30.00 mm-	29.50 mm 30.00 mm
<i>Female</i> :	30.00 mm 34.00 mm	30.00 mm 34.50 mm	30.00 mm 35.00 mm

Distribution : India (Bilaspur, Kangra, Sirmaur, Solan, Una, Dehra Dun, Nainital, Pauri Garhwal, Bihar, West Bengal and Gujarat), Iraq, Iran, Nepal, Myanmar, Sri Lanka, Thailand, Micronesia (Oceania), Samoa Island (Pacific Ocean), Indonesia (Java, Sumba and Timor), Papua (New Guinea), Australia, Egypt, Angola and most of African continent.

29. *Orthetrum glaucum* (Brauer)

1865. *Libellula glauca* Brauer, *Verh. Zool. Bot. Ges. Wien.*, 15 : 1012.

1936. *Orthetrum glaucum*, Fraser, *Fauna Brit. India Odon.*, 3 : 307-309.

Material examined : 1 ♂, Timbi, district Amreli, 30.12.1988, coll. R.K. Singh.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	33.00 mm	36.50 mm	36.00 mm

Distribution : Throughout India except in the plains & above altitudes 1200 (Kangra, Solan, Chamoli, Dehra Dun, Nainital, Pauri and Tehri Garhwal), Nepal, Sri Lanka, Philippines, Malaya Archipelago, Indonesia (Sumbawa, Sumba and Timor), Papua (New Guinea) and South China).

Remarks : It is a teneral specimen, body colour not developed Agree fairly well with the published discription of the species. It is recorded for the first time from Gujarat.

30. *Orthetrum pruinsum neglectum* (Rambur)

1842. *Libellula neglecta* Rambur, *Ins. Neurop.*, : 86.

1936. *Orthetrum pruinsum neglectum*, Fraser, *Fauna Brit. India Odon.*, 3 : 311-313.

Material examined : 1 ♀, Adipur, about 40 kms. on road to Ahmedabad, district Ahmedabad, 12.10.1988, coll. R.K. Singh; 1 ♂, Dandi, district Valsad, 18.1.1989, coll. R.K. Singh and 1 ♂, Pipri, district. The Dangs, 16.1.1989, Coll. R.K. Singh.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	26.50 mm	32.50 mm	32.00 mm
<i>Female</i> :	27.00 mm	32.00 mm	32.00 mm

Distribution : India (Bilaspur, Kangra, Kinnaur, Kulu, Sirmaur, Solan, Chamoli, Dehra Dun, Nainital, Pauri and Tehri Garhwal, Uttar Kashi, Bihar, West Bengal, Eastern Himalayas and Gujarat), Nepal, Myanmar, Sri Lanka, Hong Kong, Thailand and Malaysia.

Genus *Acisoma* Rambur31. *Acisoma panorpoides panorpoides* Rambur

1842. *Acisoma panorpoides* Rambur, *Ins. Neurop.* : 28.

1936. *Acisoma Panorpoides panorpoides*, Fraser, *Fauna Brit India Odon.*, 3 : 330-331.

Material examined : 1 ♂, 1 ♀, Nal Sarovar, district Ahmedabad, 4.2.1974, coll. B. Dutta.

Measurements :

	<i>Abdomen</i>	<i>Forewing</i>	<i>Hindwing</i>
<i>Male</i> :	17.50 mm	21.00 mm	20.00 mm
<i>Female</i> :	16.50 mm	20.50 mm	20.00 mm

Distribution : India (Kangra, Sirmaur, Dehra Dun, Nainital, Pauri Garhwal). Uttar Kashi, Bihar, Madhya Pradesh, West Bengal, Sikkim and Assam), Nepal, Sri Lanka, Philippines, Singapore, Malayan Archipelago, Indonesia (Java, Bali, Sumatra, Celebes, Sumba, Lesser Sunda Island). China Thailand and Japan.

Remarks : It is recorded for the first time from Gujarat. Only one cubital nervure in both the wings, Discoidal cell entire, one row of cells

inbetween *IR* iii & *Rspl*. Pterostigma covers more than a cell. Nodal Index varies from :

$$\frac{7 - 7/8 - 7}{7 - 6/7 - 7} \text{ to } \frac{7 - 7/6 - 7}{7 - 5/5 - 7}$$

Genus *Diplacodes* Kirby

32. *Diplacodes trivialis* (Rambur)

1842. *Libellula trivialis* Rambur, *Ins. Neurop.*, : 115.

1936. *Diplacodes trivialis*, Fraser, *Fauna Brit. India Odon.*, 3 : 336-338.

Material examined : 1 ♀, Ahwa, district The Dangs, 15.1.1989, coll. R.K. Singh; 1 ♂, Dwarka, Rly. Stn., district Jamnagar, 13.12.1973, coll. S.K. Gupta; 1 ♀, Fuljasdam Ca 33 kms. South east of Khambhalia, district Jamnagar, 8.2.1990, coll. N.S. Rathore; 1 ♂, 1 ♀, Gir Forest, district Junagarh, 10.12.1973, coll. S.K. Gupta; 1 ♀, Keslior, district Junagarh, 8.12.1973, coll. S.K. Gupta; 1 ♂, Somnath, district Junagarh, 12.12.1973, coll. S.K. Gupta and 1 ♂, Veraval, on way to Chorward Road, district Junagarh, 11.12.1973, coll. S.K. Gupta.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	20.00 mm	23.00 mm- 24.00 mm	22.00 mm
Female :	19.00 mm- 19.50 mm	23.50 mm	21.00 mm 21.50 mm

Distribution : Throughout India in wet and semi-wet areas (Kangra, Dehra Dun, Nainital, Bihar, Madhya Pradesh, West Bengal, Eastern Himalayas, Karnataka, Maharashtra and Gujarat), Nepal, Myanmar, Sri Lanka, Thailand, West Malaysia and Indonesia.

33. *Diplacodes lefebvrei* (Rambur)

1842. *Libellula lefebvrei* Rambur, *Ins. Neurop.*, : 112.

1936. *Diplacodes lefebvrei*, Fraser, *Fauna Brit. India Odon.*, 3 : 333-335.

Distribution : India (West coast of India, Gujarat), Africa and Mesopotamia.

Genus *Crocothemis* Brauer

34. *Crocothemis servilia servilia* (Drury)

1770. *Libellula servilia* Drury, *Ill. Ex. Ins.*, 1 : 6.

1936. *Crocothemis servilia servilia*, Fraser, *Fauna Brit. India Odon.*, 3 : 345-347.

Material examined : 1 ♂, 1 ♀♀, Ahwa, district The Dangs, 15.1.1989, coll. R.K. Singh; 3 ♂♂, Dadu ki Khori, Ca 6 kms. east of Bharuch, district Bharuch, 13.11.1972, coll. G.M. Yazdani; 1 ♂, 2 ♀♀, Dandi, district Valsad, 19.1.1989, coll. R.K. Singh; 2 ♀♀, Fuljas dam Ca 33 kms. South-east of Khambhalia, district Jamnagar, 11.2.1990, coll. N.S. Rathore; 1 ♀, Gadu, Ca 62 kms. South east of Junagarh, district Junagarh, 1.2.1990, coll. N.S. Rathore; 1 ♂, Khodinar temple Ca 6 kms. West of Khambhalia, district Jamnagar, 11.2.1990, coll. N.S. Rathore; 1 ♀, Gadu Ca 62 Kms. South-east of Junagarh, district Junagarh, 1.2.1990, coll. N.S. Rathore; 1 ♂, Khodinar temple Ca 6 kms. west of Khambhalia, dist. Jamnagar, 11.2.1990, coll. N.S. Rathore; 1 ♀, Kolak, district Valsad, 18.1.1989, coll. R.K. Singh; 1 ♂, Kukama village ca 11 kms. East of Bhuj, District Bhuj, 24.2.1989, coll. N.S. Rathore; 2 ♂♂, 2 ♀♀, Lodai Ca 30 kms. North or Bhuj, district Bhuj, 10.10.1988, coll. R.K. Singh; 1 ♀, Munsar Tank, Viramgam, district Ahmedabad, 29.1.1974, coll. B. Dutta; 1 ♀, Nal Sarovar, district Ahmedabad, 4.2.1974, coll. B. Dutta; 3 ♀♀, Pipri, district The Dangs, 16.1.1989, coll. R.K. Singh, 1 ♀, Sanand Ca 1 km. from rest house, district Ahmedabad, 6.2.1974, coll. B. Dutta; 2 ♂♂, Saputara, district The Dangs, 14.1.1989, coll. R.K. Singh and 1 ♂, Sihan dam Ca 12 kms. North-east of Khambhalia, district Jamnagar, 1.2.1990, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	28.00 mm- 28.50 mm	33.50 mm- 34.00 mm	32.00 mm
Female :	22.00 mm- 23.00 mm	29.00 mm	28.50 mm- 29.50 mm

Distribution : Throughout India (Kangra, Chamoli, Dehra Dun, Nainital, Pauri Garhwal,

Madhya Pradesh, Bihar, West Bengal, Eastern Himalayas, South India and Gujarat), Iraq, Nepal, Myanmar, Sri Lanka, Philippines, Indonesia, Australia, Sundaic Archipelago and Japan.

Genus *Bradinopyga* Kirby

35. *Bradinopyga geminata* (Rambur) (Map 3)

1842. *Libellula geminata* Rambur, *Ins. Neurop.* : 90

1936. *Bradinopyga geminata*, Fraser, *Fauna Brit. India Odon.*, 3 : 349-350.

Material examined : 3 ♀♀, Chaukhand Mahadeo, Bhadreswar, district Bhuj, 10.10.1988, coll. R.K. Singh and 2 ♂♂, Lasundra, district Kheda, 21.2.1991, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	29.00 mm- 30.00 mm	33.00 mm- 34.00 mm	33.00 mm

Female : 28.00 mm 34.50 mm 34.00 mm

Distribution : India (Dehra Dun, Nainital, Delhi, Madhya Pradesh, Bihar, West Bengal, Eastern Himalayas and Peninsular India) and Sri Lanka.

Remarks : It is recorded for the first time from Gujarat. Descoidal cells begins with 3 rows of cells. Two rows of cells inbetween IRiii and Rspl. Nodal index :

$$\frac{11-12\frac{1}{2}/12\frac{1}{2}-9}{10-10/9-10}$$

Genus *Brachythemis* Brauer

36. *Brachythemis contaminata* (Fabricius)

1793. *Libellula contaminata* Fabricius, *Ent. Syst.*, 2 : 382.

1936. *Brachythemis contaminata*, Fraser, *Fauna Brit. India Odon.*, 3 : 365-366.

Material examined : 2 ♂♂, Ankleshwar, district Bharuch, 25.11.1972, coll. G.M. Yazdani, 1 ♀, Ankleshwar, district Bharuch, 23.11.1972, coll. G.M. Yazdani, 1 ♂, Hajira, district Surat, 10.1.1989, coll. R.K. Singh, 1 ♀, Honsot, district

Bharuch, 21.11.1972, coll. G.M. Yazdani, 1 ♂, Khambhat, district kheda, 22.2.1991, coll. N.S. Rathore; 1 ♀, Lakhtar Ca, 4 kms. on road to Surendranagar, district Surendranagar, 13.2.1991, coll. N.S. Rathore and 1 ♀, Pariej village Ca 23 kms. South of Kheda, districts Kheda, 23.2.1991, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	18.00 mm	25.00 mm	24.00 mm
Female :	15.50 mm	24.00 mm	23.00 mm

Distribution : India (Bilaspur, Kangra, Sirmaur, Una, Dehra Dun, Nainital, Pauri Garhwal, Madhya Pradesh, Bihar, West Bengal, Eastern Himalayas and Gujarat), Nepal, Myanmar, Sri Lanka, Thailand, Malaya, Taiwan, Philippines, Indonesia and China.

Remarks : Nodal Index varies from :

$$\frac{8-8/8-7}{6-5/5-6} \text{ to } \frac{7-8/8-8}{7-5/7-5}$$

Genus *Neurothemis* Brauer

37. *Neurothemis intermedia intermedia* (Rambur)

1842. *Libellula intermedia* Rambur, *Ins. Neurop.* : 91.

1936. *Neurothemis intermedia intermedia*, Fraser, *Fauna Brit India Odon.*, 3 : 357- 358.

Material examined : 1 ♂, 2 ♀♀, Papri, district The Dangs, 16.1.1989, coll. R.K. Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	23.50 mm	26.00 mm	26.00 mm
Female :	23.00 mm	25.50 mm	25.00 mm

Distribution : India (Kangra, Dehra Dun, Madhya Pradesh, Bihar, West Bengal, Maharashtra and Eastern Himalayas), Nepal, Myanmar, Sri Lanka, West Malaysia (Malacca) and China.

Remarks : It is recorded for the first time from Gujarat.

38. *Neurothemis tullia tullia* (Drury)1773. *Libellula tullia* Drury, *Ill. Exot. Ins.*, 2 : 85.1936. *Neurothemis tullia tullia*, Fraser, *Fauna Brit. India Odon.*, 3 : 360-362.*Material examined* : 1 ♂, Daniwala, district Surat, 24.11.1973, coll. P.T. Cherian.*Measurements* :

	Abdomen	Forewing	Hindwing
Male :	19.00 mm	24.50 mm	24.00 mm

Distribution : India (Kangra, Sirmaur, Una, Dehra Dun, Madhya Pradesh, Rajasthan, Bihar, West Pradesh, East Himalayas, West Coast, Maharashtra, Karnataka and Tamil Nadu), West Malaysia, Thailand and China.*Remarks* : It is recorded for the first time from Gujarat. Membrane of the wings black; black markings on forewings extended upto 1st postnodal nervure, beyond node, while in hindwings extended up to 4th postnodal nervure. Nodal index :

$$\frac{7 - 11\frac{1}{2} / 11\frac{1}{2} - 7}{9 - 7/9 - 8}$$

Genus *Sympetrum* Newman39. *Sympetrum commixtum* (Selys)1884. *Diplax commixta* Selys *Ann. Soc. Ent. Belg.*, : 38.1936. *Sympetrum commixtum*, Fraser, *Fauna Brit. India Odon.*, 3 : 372-373.*Distribution* : India (Kashmir, Bilaspur, Manali, Solan, Dehra Dun, Nainital, Pauri Garhwal and Gujarat), Nepal, and Sri Lanka.Genus *Trithemis* Brauer40. *Trithemis aurora* (Brumeister)1839. *Libellula aurora* Brumeister, *Handb. Ent.*, 2 : 859.1936. *Trithemis aurora*, Fraser, *Fauna Brit. India Odon.*, 3 : 383-385.*Material examined* : 3 ♂♂, Ahwa, District The Dangs, 15.1.1989, coll. R.K. Singh; 1 ♀, Bardoli,

district Surat, 11.1.1989, coll. R.K. Singh, 3 ♂♂, 1 ♀, Dandi, district Valsad, 19.1.1989; Coll. R.K. Singh, 3 ♂♂, 2 ♀♀, Fuljas dam Ca 33 kms. South-east of Khambhalia, district Jamnagar, 8.2.1990, coll. N.S. Rathore; 2 ♂♂, 1 ♀, Gadu, Ca 62 kms. South-west of Junagarh, district Junagarh, 1.2.1990, coll. N.S. Rathore; 1 ♂, Hajira, district Surat, 10.1.1989, coll. R.K. Singh; 6 ♂♂, Kharad, district Valsad, 20.1.1989, coll. R.K. Singh; 4 ♀♀, Khodinar temple Ca 6 Kms. West of Khambhalia, district Jamnagar, 11.2.1990, coll. N.S. Rathore; 11 ♂♂, 3 ♀♀, Pipri district The Dangs, 16.1.1989, coll. R.K. Singh and 1 ♂, Surat, District Surat, 10.11.1972, coll. G.M. Yazdani.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	23.00 mm- 28.00 mm	25.00 mm- 26.50 mm	25.00 mm- 26.00 mm
Female :	23.00 mm- 27.00 mm	25.00 mm- 27.00 mm	25.00 mm- 27.00 mm

Distribution : Throughout India (Bilaspur, Hamirpur, Kangra, Dehra Dun, Nainital, Pauri and Tehri Garhwal, West Bengal, Bihar, Western Ghats, Kerala, Karnataka, Maharashtra and Gujarat), Nepal, Myanmar, Sri Lanka, West Malaysia, Indonesia and Philippines.41. *Trithemis festiva* (Rambur)1842. *Libellula festiva* Rambur, *Ins. Neurop.*, : 92.1936. *Trithemis festiva*, Fraser, *Fauna Brit. India Odon.*, 3 : 388-389.*Material examined* : 2 ♂♂, Dandi, District Valsad, 19.1.1989, coll. R.K. Singh; 2 ♂♂, 1 ♀, Kharad, district Valsad, 20.1.1989, coll. R.K. Singh; 1 ♂, Pipri, District The Dangs. 16.1.1989, coll. R.K. Singh and 1 ♂, Saputara, district. The Dangs, 14.1.1989, coll. R.K. Singh.*Measurements* :

	Abdomen	Forewing	Hindwing
Male :	24.00 mm- 25.00 mm	28.00 mm	27.00 mm- 27.50 mm
Female :	21.50 mm- 23.50 mm	26.00 mm-	25.00 mm- 25.50 mm

Distribution : India (Bilaspur, Hamirpur, Kangra, Sirmaur, Solan, Chamoli, Dehra Dun, Nainital, Pauri and Tehri Garhwal, Uttar Kashi, Bihar, West Bengal, Assam, Eastern Himalayas, Maharashtra and Gujarat), Nepal, Myanmar, Sri Lanka, West Malaysia, Singapore, Indonesia, Philippines, Taiwan and Papua (New Guinea).

42. *Trithemis pallidinervis* (Kirby)

1889. *Sympetrum pallidinervis* Kirby, *Trans. Zool. Soc. Lond.*, : 327.

1936. *Trithemis pallidinervis*, Fraser, *Fauna Brit. India Odon.*, 3 : 389-391.

Material examined : 2 ♀♀, Pariej village Ca 23 kms. South of Kheda, district Kheda, 23.2.1991, coll. N.S. Rathore.

Measurements :

	Abdomen	Forewing	Hindwing
Female :	26.50 mm	33.50 mm	32.50 mm- 33.00 mm

Distribution : Throughout India (Kangra, Dehra Dun, Nainital, Pauri Garhwal, Bihar, West Bengal, Eastern Himalayas, Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Gujarat), Nepal, Myanmar, Sri Lanka, Philippines, Taiwan, Thailand, Malaysia and Singapore.

43. *Trithemis kirbyi kirbyi* Selys

1886. *Trithemis aurora* Kirby (Pars.), *Proc. Zool. Soc. Lond.*, : 327.

1891. *Trithemis kirbyi*, Selys, *Ann. Mus. Civ. Genova*, 30 : 465.

1936. *Trithemis kirbyi kirbyi*, Fraser, *Fauna Brit. India Odon.*, 3 : 385-387.

Material examined : 2 ♂♂, 2 ♀♀, Timbi village, district Amreli, 30.12.1988, coll. R.K. Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	24.00 mm- 25.00 mm	28.00 mm-	27.00 mm- 27.50 mm
Female :	21.50 mm- 23.50 mm	26.00 mm-	25.00 mm- 25.50 mm

Distribution : India (Kangra, Dehra Dun, Maharashtra, Karnataka and Tamil Nadu) and Sri Lanka.

Remarks : It is recorded for the first time from Gujarat. Only one cubital nervure present in both the wings. Discoidal cell traversed only once. Discoidal field begins with 3 rows of cells, Membrane slightly dirty white in colour, 2 rows of cells present inbetween IRiii & Rspl. Apices of both the wings in female marked with blackish brown upto middle of Pterostigma. Pterostigma covers 1 1/2 cells. Nodal index varies from :

$$\frac{8 - 10^{1/2} / 8^{1/2} - 8}{9 - 7/7 - 9}, \quad \frac{8 - 11^{1/2} / 12^{1/2} - 8}{9 - 7/7 - 10}$$

$$\frac{7 - 10^{1/2} / 9^{1/2} - 6}{8 - 7/7 - 8}$$

in both male and female.

Genus *Tholymis* Hagen

44. *Tholymis tillarga* (Fabricius)

1798. *Libellula tillarga* Fabricius. *Ent. Syst. Suppl.*, : 285.

1936. *Tholymis tillarga*, Fraser, *Fauna Brit. India Odon.*, 3 : 411-413.

Material examined : 1 ♀, Daniwala, District Surat, 24.11.1973, coll. P.T. Cherian.

Measurements :

	Abdomen	Forewing	Hindwing
Female :	26.00 mm	31.50 mm	31.00 mm

Distribution : Throughout India, Myanmar, Sri Lanka, Thailand, West Malaysia, Indonesia, Micronesia, Australia and Tropical Africa.

Remarks : One cubital nervure present in both the wings. Pterostigma yellowish brown in colour and covers approximately 2 cells. Membrane brown in colour, two rows of cells inbetween IRiii & Rspl. Nodal index :

$$\frac{7 - 10^{1/2} / 10^{1/2} - 8}{9 - 8/8 - 9}$$

Genus *Pantala* Hagen45. *Pantala flavescens* (Fabricius)1898. *Libellula flavescens* Fabricius, *Ent. Syst. Suppl.*, : 285.1936. *Pantala flavescens*, Fraser, *Fauna Brit. India Odon.*, 3 : 414-416.

Material examined : 2 ♂♂, Ahwa, district The Dangs, 15.1.1989, coll. R.K. Singh; 2 ♂♂, Bardoli, district Surat, 11.1.1989, coll. R.K. Singh; 1 ♀, Barkot near Patar, district Mahesana, 27.1.1974, coll. B. Dutta; 1 ♂, Bank of Narmada River, Bharuch, District Bharuch, 14.11.1972, coll. G.M. Yazdani; 1 ♂, Jamnagar, district Jamnagar, 23.12.1973, coll. S.K. Gupta; 1 ♀, Pipri, district The Dangs. 16.1. 1989, coll. R.K. Singh and 1 ♂, Sehor, district Valsad, 6.1.1989, coll. R.K.Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	30.00 mm- 33.00 mm	41.00 mm- 42.50 mm	40.00 mm- 41.50 mm
Female :	32.00 mm	42.00 mm	41.00 mm

Distribution : Circumtropical and subtropical in distribution (Throughout India, N.W. Africa, Nepa, Myanmar, Sri Lanka, Micronesia, Thailand, West Malaysia, Indonesia and China.

Genus *Tamea* Hagen46. *Tamea virginia* (Rambur) (Map 7)1773. *Libellula chinensis* De Geer, *Mem. Ins.*, 3 : 556.1842. *Libellula virginia*, Rambur, *Ins. Neurop.*, : 33.1936. *Tamea virginia*, Fraser, *Fauna Brit. India Odon.*, 3 : 435-436.

Material examined : 1 ♀, About 40 kms. on Ahmedabad road from Adipur, district Ahmedabad, 12.10.1988, coll. R.K. Singh.

Measurements :

	Abdomen	Forewing	Hindwing
Female :	34.00 mm	49.50 mm	48.50 mm

Distribution : India (Kangra, Dehra Dun, Bihar and West Bengal), Myanmar, Taiwan, Thailand, Micronesia, Indonesia, China and South Japan.

Remarks : It is recorded for the first time from Gujarat.

Genus *Urothemis* Brauer47. *Urothemis signata signata* (Rambur)1839. *Libellula sanguinea* Burmeister, *Handb. Ent.*, 2 : 858.1842. *Libellula signata*, Rambur, *Ins. Neurop.*, : 117.1936. *Urothemis signata signata*, Fraser, *Fauna Brit. India Odon.*, 3 : 442-444.

Material examined : 1 ♀, Ankleshwar, district Branch, 24.11.1972, coll. G.M. Yazdani.

Measurements :

	Abdomen	Forewing	Hindwing
Female :	27.00 mm	38.00 mm	36.00 mm

Distribution : India (Uttar Pradesh), Bihar, West Bengal, Coorg, South Malabar, Bombay and Madras), Myanmar, Sri Lanka, Malaysia and China.

Remarks : It is recorded for the first time from Gujarat. One Cubital nervure in both the wings. Pterostigma deep yellow in colour and covers 1/ 1/2 cells. One row of cells inbetween *IRiii* & *Rspl*. Nodal index :

$$\frac{6 - 7/7 - 7}{7 - 5/5 - 7}$$

Genus *Aethriamanta* Kirby48. *Aethriamanta brevipennis* (Rambur) (Map 7)1842. *Libellula brevipennis* Rambur, *Ins. Neurop.*, : 114.1936. *Aethriamanta brevipennis brevipennis* Fraser, *Fauna Brit. India Odon.*, 3 : 445-447.1991. *Aethriamanta brevipennis*, Tsuda, *A Distributional list of world Odonata*, : 144.

Material examined : 3 ♂♂, Watergate Vadodara, district Vadodara, 27.11.1973, coll. P.T. Cherian.

Measurements :

	Abdomen	Forewing	Hindwing
Male :	16.00 mm- 16.50 mm	21.50 mm- 22.00 mm	21.00 mm- 24.00 mm

Distribution : India (West Bengal, Bihar, Assam, Coorg and Malabar), Sri Lanka and Myanmar.

Remarks : It is recorded for the first time from Gujarat. Nodal index

Key to species and subspecies in Gujarat

Key to the Suborders

1. Eyes well separated; forewing and hindwing more or less similar in shape and breadth; wings petiolate *Zygoptera*
- Eyes not well separated, meeting only at a point or broadly confluent; forewing and hindwing not similar in shape and breadth; wings never petiolate *Anisoptera*

Key to the Superfamilies of ZYGOPTERA

1. Vein IRiii and RIV + V beginning much nearer to the node than the arculus COENAGRIOIDEA
- Veins IRiii + V arising nearer to the arculus than the node LESTINOIDEA, LESTIDAE, *Lestes* Leach

Key to the families of Superfamily COENAGRIOIDEA

1. The anal vein absent or greatly reduced; cup varying from a vein to normal length to only 1 cell or so long PROTONEURIDAE
Genus *Disparoneura* Selys
D. quadrimaculata (Selys)
- The anal vein and cup of normal length 2
2. Discoidal cell elongate; anal vein separating from wing border proximal to AC; MA and IRiii nervures mostly straight and zigzagged apically or not at all; legs bright orange to dull reddish in colour PLATYCNEMIDIDAE
Genus *Copera* Kirby
C. ciliata (Selys)
- Discoidal cell short; anal vein separating from wing border either proximal to AC or distal to AC; MA and IRiii nervures zigzagged for greater part of their length *Coenagrionidae*

Key to the genera and species of family COENAGRIONIDAE

1. Arc situated distal to the level of the distal antenodal nervure *Agriocnemis* Selys
- Arc situated at the level of the distal antenodal nervure 2
2. Vein ab arising from the hind border of the wing at the point where ac meets it 3
- Vein ab arising from the hind border of the wing more or less proximal to the point where ac meets it 4
3. A prominent ridge on the frons present; no postocular coloured spot on the head; head and thorax uniform colour *Ceriagrion* Selys
C. coromandelianum (Fabr.)
- No ridge on the frons; postocular coloured spots always present; head and thorax not of uniform colour *P. seudagrion* Selys
4. Pterostigma of the same colour and shape in forewing and hindwing of male; dorsal apical tubercle of segment 10 of male absent 6
- Pterostigma differing in shape and size in fore and hindwings of male; dorsal apical tubercle on segment 10 of male present 5
5. Postocular coloured spot always present in adult stage; tubercles on apical border of segment 10 closely opposed *Ischnura* Charp.
- Postocular coloured spot absent in the adult stage; tubercles on apical border of segment 10 widely separated by a shallow notch
..... *Rhodischnura* Laidlaw
[*R. nursei*] (Morton)
6. Female with a robust ventral apical spine on segment 8 *Enallagma* Charp.
- Female without a ventral apical spine on segment 8 7
7. Tarsal claw-hook of equal length; postocular coloured spots absent *Onychargia* Selys
O. atrocyana (Selys)

- Tarsal claw-hooks unequal in length; postocular coloured spots present; only 8-10 postnodal nervure in forewing *Cercion* Navas
C. calamorum dyeri (Fraser)

**Key to the species of the genus
Pseudagrion Selys**

1. Frons reddish or reddish orange 2
 — Frons not reddish or reddish orange 3
 2. Vertex reddish orange *P.r. rubriceps* Selys
 — Vertex black *P. bidentatum* Morton.
 3. Face, frons and vertex black
 *P. hypermelas* Selys
 — Face, frons and vertex may be blue or green
 and marked with black 4
 4. Thorax pale blue *P. decorum* (Rambur)
 — Thorax sky blue or green *P. laidlawi* Fraser

Key to the species of *Ischnura* Charp.

1. Abdominal segments 3-6 lemon-colour on dorsal side; segment 2 not steely metallic blue on dorsal side *I. a. aurora* (Brauer)
 — Abdominal segments 3-6 black on dorsal side; segment 2 steely metallic blue on dorsal side 2
 2. Posterior lobe of prothorax greatly prolonged at the middle *I. e. elegans* (Vander Lind.)
 — Posterior lobe of prothorax not prolonged at the middle *I. senegalensis* (Ramb.)

Key to the species of genus *Agriocnemis* Selys

- 1 Labrum metallic-blue; anal appendages brick-red *A.p. pygmaea* (Ramb.)
 — Labrum non-metallic; anal appendages black *A. splendidissima* Laid.

Key to the species of genus *Enallagma* Charp.

1. Very small species, with abdomen not more than 17 mm in length *E. parvum* Selys

- Longer species, with abdomen more than 20 mm in length
 *E. cyathigerum cyathigerum* Charp.

Key to the species of genus *Lestes* Leach

1. Thorax with green metallic antehumeral stripes *L. viridulus* Ramb.
 — Thorax without metallic markings 2
 2. Vertex of head pale-brown
 *L. umbrinus* Selys
 — Vertex of head mat-black
 *L. thoracicus* Laidlaw

Key to the Superfamilies of ANISOPTERA

1. Discoidal cells approximately of the same size and shape in fore and hindwings and situated equal distance from the arc; costal and subcostal antenodal nervures not coinciding with the two robust primary antenodal present; middle lobe of labium large and fissured
 *Aeshnoidea*
 — Discoidal cell differing in size and shape in fore and hindwings; that of forewings situated far distal of the arc; costal and subcostal antenodal nervure coinciding the robust primary antenodals absent; middle lobe of labium very small, not fissured, broadly overlapped by the lateral lobes *Libelluloidea* (Libellulidae)

Key to the families of AESHNOIDEA

1. Eyes broadly confluent above; Ovipositor present anal triangle absent *Aeshnidae*

Genus *Hemianax* Selys

H. ephippiger (Burm.)

- Eyes separately; ovipositor absent; anal triangle present *Gomphidae*

Key to the genera and species of GOMPHIDAE

1. Hindwing not excavated at base with tornus rounded in the male; head and thorax without markings *Amormogomphus* Selys
A. kiritschenkoi Bart.

— Hindwing more or less excavated at base; with tornus more or less with angulated; head and thorax with brownish black lines.....
 *Paragomphus* (Cowley)
P. Lineatus (Selys)

Key to the genera and species of Libellulidae

1. Base of discoidal cell in hindwing widely distal to level of arc; costal side of discoidal cell in forewingx markdly angulated, so that the cell is four sided; anal loop present but very small; discoidal field beginning with only 1 row of cells; discoidal cell in hindwing entire
 *Tetrathemis* Brauer
T. platyptera Selys
- Base of discoidal cell in hindwing at the level of arc or but a shade distal; costal side of discoidal cell in forewing not angulated; anal loop elongate; discoidal field beginning with 2 or more rows of cells..... 2
2. Sectors of arc separated from origin; feebly developed primary antenodal nervure present 3
- Sectors of arc fused at their origin; primary antenodal nervures absent..... 4
3. Subtrigone in forewing entire; small size specimens *Aethriamanta* Kirby
A. brevipennis (Rambur)
- Subtrigone in forewing 3 celled; large size specimens
 *Urothemis* Brauer
U.s. Signata (Rambur)
4. Apex of loop in the wings open; an apalescent white spot in the middle of the hindwing present *Tholymis* Hagen
T. tillarga (Fabr.)
- Apex of loop in the wings closed; an apalescent white spot in middle of the hindwing absent 5
5. Distal antenodal nervure in forewing complete 6
- Distal antenodal nervure in forewing incomplete 7

6. Small size specimens; only 6 antenodal nervures in forewings *Acisoma* Rambur
A. p. panorpoides Rambur.
- Medium size specimens, not less than 12 antenodal nervures in forewing.....
 *Orthetrum* Newman
7. Lobes of prothorax with long hairs..... 8
- Lobes of prothorax without long hairs 9
8. Borders of discoidal field in forewings (Nervures MA and CUii) converging strongly at wing border *Sympetrum* Newman
S. commixtum (Selys)
- Borders of discoidal field (Nervures MA and CUii) in forewing diverging widely at wing border *Diplacodes* Kirby
9. Discoidal field converging at wing border ... 10
- Discoidal field parallel or divergent at wing border 11
10. Nervure IRiii present inbetween Rii and Riii *Rantala* Hagen
P. flavescens (Fabr.)
- Nervure IRiii absent inbetween Rii and Riii *Trithemis* Brauer
11. Pterostigma unequal in forwing and hindwing; large blackish- brown spot present at the base of wings *Tramea* Hagen
T. virginia (Ramb.)
- Pterostigma equal in size in fore and hindwings 12
12. Pterostigma bicoloured (Black with White end) *Bradinopyga* Kirby
B. geminata (Ramb.)
- Pterostigma unicoloured 13
13. More than one cubital nervure present in all wings..... *Neurothemis* Brauer
- Only one cubital nervure present in all wings 14
14. Variable coloured specimens; base of wings

- rarely marked with pale yellow; 2 rows of cells present in between IRiii and Rspl
 *Potamarcha* Karsch
P. congener (Ramb.)
- Red or pale yellow specimens; basal or medial yellow marking present on wings 15
15. Broad reddish yellow medial marking present on the wings *Brachythemis* Brauer
B. contaminata (Fabr.)
- Small basal yellow marking present at the base of the wings *Crocothemis* Brauer
C.S. servilia (Drury)

Key to the species of genus *Orthetrum* Newman

1. Males coloured some shade of red or violaceous red due to a thin overlying pruinescens; frons blue black anteriorly
 *O. pruinorum neglectum* (Ramb.)
- Males coloured brown or black with yellow markings; often pruinose 2
2. Abdomen enormously swollen at base and then abruptly slimmed and compressed laterally to the end; black marked with greenish-yellow; never pruinose *O. s. sabina* (Drury)
- Abdomen variable but never very slim nor compressed laterally; mostly with pruinose abdomen and thorax 3
3. Moderately large species with face black or frons blackish anteriorly; membrane black ...
 *O. glaucum* (Brauer)
- Smallest species of the genus, with face and frons greyish-green or bluish; membrane dark brown bordered with black
 *O. taeniolatum* (Schn.)

Key to the species of genus *Neurothemis* Brauer

1. An opalescent white band in the wings absent; base of wings pale yellow
 *N. in intermedia* (Ramb.)
- An opalescent white band in the wings present; base of wings broadly black
 *N. t. tullia* (Drury)

Key to the species of genus *Trithemis* Brauer

1. Legs very long and spidery; pterostigma bicolorous; body yellow marked with black
 *T. pallidinervis* (Kirby)
- Legs ordinary length; pterostigma unicolorous; body colour variable 2
2. Thorax and abdomen bright vermilion-red; base of hindwing bright orange. *T.K. Kirbyi* Selys
- Thorax and abdomen may be violaceous - black or violaceous crimson 3
3. Base of hindwings with a small dark-brown spot; neuration black *T. festiva* (Ramb.)
- Base of hindwings with small reddish-brown spot; neuration crimson *T. aurora* (Burm.)

Key to the species of genus *Diplacodes* Kirby

1. Anal appendages black
 *D. lefebvrei* (Rambur)
- Anal appendages yellow
 *D. trivialis* (Rambur)

A CLASSIFIED LIST OF ODONATA SO FAR RECORDED FROM GUJARAT

A classified list of Odonata known from Gujarat is provided and is arranged systematically. Species marked with an asterisk (*) are recorded for the first time from the state.

Order ODONATA

Suborder ZYGOPTERA

Superfamily COENAGRIOIDEA

Family PLATYCENEMIDIDAE

Genus *Copera* Kirby

1. **Copera ciliata* (Selys)

Family COENAGRIONIDAE

Genus *Pseudagrion* Selys

2. *Pseudagrion decorum* (Rambur)
 3. *P. hypermelas* Selys

4. **P.r. rubriceps* Selys
 5. **P. laidlawi* Fraser
 6. *P. bidentatum* Morton
 Genus *Ceriagrion* Selys
 7. *Ceriagrion coromandelianum* (Fabr.)
 Genus *Ischnura* Charpentier
 8. *Ischnura senegalensis* (Rambur)
 9. *I.a. aurora* (Brauer)
 10. **I.e. elegans* (Vander Linden)
 Genus *Rhodischnura* Laidlaw
 11. *Rhodischnura nursei* (Morton)
 Genus *Enallagma* Charpentier
 12. *Enallagma parvum* Selys
 13. **E.c. cyathigerum* Charpentier
 Genus *Agriocnemis* Selys
 14. *Agriocnemis p. pygmaea* (Rambur)
 15. **A. splendidissima* Laidlaw
 Genus *Cercion* NAVAS
 16. **Cercion calamorum dyeri* (Fraser)
 Genus *Onychargia* Selys
 17. **Onychargia atrocyana* (Selys)
 Superfamily LESTINEOIDEA
 Family LASTIDAE
 Genus *Lestes* Leach
 18. *Lestes thoracicus* Laidlaw
 19. *L. umbrinus* Selys
 20. **L. viridulus* Rambur
 Family PROTONEURIDAE
 Genus *Disparoneura* Selys
 21. **Disparoneura quadrimaculata* (Rambur)
 Suborder ANISOPTERA
 Superfamily AESHNOIDEA
 Family GOMPHIDAE
 Genus *Paragomphus* Cowley
 22. **Paragomphus lineatus* (Selys)

- Genus *Anormogomphus* Selys
 23. **Anormogomphus kirritschenkoi* Bartenev
 Family AESHNIDAE
 Genus *Hemianax* Selys
 24. *Hemianax ephippiger* (Burmeister)
 Superfamily LIBELLULOIDEA
 Family LIBELLULIDAE
 Genus *Tetrathemis* Brauer
 25. **Tetrathemis platyptera* Selys
 Genus *Potamarcha* Karsch
 26. **Potamarcha congener* (Rambur)
 Genus *Orthetrum* Newman
 27. *Orthetrum taeniolatum* (Schneider)
 28. *O.s sabina* (Drury)
 29. **O. glaucum* (Brauer)
 30. *O. pruinatum neglectum* (Rambur)
 Genus *Acisoma* Rambur
 31. **Acisoma panorpoides panorpoides* Rambur
 Genus *Diplacodes* Kirby
 32. *Diplacodes trivialis* (Rambur)
 33. *P. lafebvrei* (Rambur)
 Genus *Crocothemis* Brauer
 34. *Crocothemis s. servilia* (Drury)
 Genus *Bradinopyga* Kirby
 35. **Bradinopyga geminata* (Rambur)
 Genus *Brachythemis* Brauer
 36. *Brachythemis contaminata* (Fabricius)
 Genus *Neurothemis* Brauer
 37. **Neurothemis is. intermedia* (Rambur)
 38. **N.t. tullia* (Drury)
 Genus *Sympetrum* Newman
 39. *Sympetrum commixtum* (Selys)
 Genus *Trithemis* Brauer
 40. *Trithemis aurora* (Burmeister)

41. *T. festiva* (Rambur)
 42. *T. pallidinervis* (Kirby)
 43. **T. k. Kirbyi* Selys
 Genus *Tholymis* Hagen
 44. *Tholymis tillarga* (Fabricius)
 Genus *Pantala* Hagen
 45. *Pantala flavescens* (Fabricius)
 Genus *Tramea* Hagen
 46. **Tramea virginia* (Rambur)
 Genus *Urothemis* Brauer
 47. **Urothemis s. signata* (Rambur)
 Genus *Aethriamanta* Kirby
 48. **Aethriamanta brevipennis* (Rambur)

SUMMARY

Altogether 48 species and subspecies of Odonata belonging to 30 genera under 7 families and 2 suborders are recorded from Gujarat. Of these, 23 species and subspecies belonging to 4 families of suborder Zygoptera and 3 families of

suborder Anisoptera are recorded for the first time from the State. Family Coenagrionidae (Zygoptera) representing 16 species and subspecies and family Libellulidae (Anisoptera) representing 27 species and subspecies, have largest representation. Keys have been formed for various categories of taxa. A comprehensive classified list of taxa of Odonata known from Gujarat is also provided.

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REFERENCES

- Adam, A. 1899. Western Rajputana States. xi + 455. *Junior Army and Navy Store, Ltd. London.*
 Agrawal, J.P. 1957. Contribution towards the Odonata fauna of Pilani. *Proc. 44th Indian Sci. Congr., Calcutta, (Abstract) Part. III. N. 28 : 309.*
 Bose, G. Mitra, T.R. 1976. The Odonata fauna of Rajasthan. *Rec. zool. Surv. India, 71 : 1-11.*
 Fraser, F.C. 1933. The Fauna of British India, including Ceylon & Myanmar, Odonata, Vol. I. *Taylor & Francis Ltd., London 423.*
 Fraser, F.C. 1934. The Fauna of British India, including Ceylon & Myanmar, Odonata, Vol. II. *Taylor & Francis Ltd., London : 398.*
 Fraser, F.C. 1936. The Fauna of British India, including Ceylon & Myanmar, Odonata, Vol. III. *Taylor & Francis Ltd., London : 461.*
 Fraser, F.C. 1957. A Reclassification of order Odonata. *Royal zoological Society New South Wales, Sydney, 1-133.*
 Morton, K.J. 1907. On Odonata collected by Lt. Col. Nurse, chiefly in N.W. India, *Trans. Ent. Soc. Lond., 19 : 306-308.*
 Prasad, M. and Thakur, R.K. 1981. Further addition to the Odonata (Insecta) fauna of Rajasthan. *Jantu, 1 : 26-28.*
 Prasad, M. and Thakur, R.K. 1984. On a collection of Odonata from Gujarat State, India. *Fraseria, No. 6 : 24-25.*

INSECTA : ISOPTERA (TERMITES)

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INTRODUCTION

Termites are known to us from olden times as "Kashtaharika" (Wood Feeders) in ancient Sanskrit literature. They are commonly called white ants, which is a misnomer, since they are classified under order Isoptera and not under Hymenoptera. They are small to medium sized, soft bodied, social and polymorphic forms (workers, soldiers, king and queen), which exhibit division of labour, performing different biological functions, live in highly organised integrated units the societies or colonies.

They cause extensive damage to agriculture crops, vegetables, horticulture, plants and forest trees. They also cause serious damage to stores, library books, timber and bamboo depots, wood work in houses and buildings, furniture, plastic and electric cables, in air fields etc. The annual losses so caused by their depredation amount to crores of rupees.

Out of about 2865 different species of termites known from the world, 348 have been reported from Indian region.

Gujarat is the western most pocket state on the west coast of India lying between Lat. 20°1' -24°6'N and Long. 68°2' - 75°0' E approximately. It has about 1,95,984 sq km of area, including nearly 62,180 sq km of desert portion. Gujarat state includes wide variation in the topographical, climatic and edaphic conditions and offers an interesting area for faunal diversity.

The termite fauna of Gujarat have been worked out time-to-time and earliest known record is perhaps that of Holmgren (1913), who described 5 species. Chatterjee and Thakur (1968) recorded

3 species. Roonwal (1973) described the mound structure, fungus camb and primary reproductives of *Odontotermes brunneus* (Hagen). Thakur (1976, 1981), has reported 5 species of genus *Odontotermes*. Later Thakur (1989, 1991) added 33 species to the already known composition, out of these 6 new species are described.

The authors carried out intensive and extensive surveys covering all the 19 districts of Gujarat state from year 1988 to 1993 and collected about 300 lots of termite material. The recent study and identification of collections further added one new species, 13 new records and extension of range of many species within the state. Altogether now 60 species of termites belonging to 16 genera under 4 families and 8 sub families have been reported from Gujarat state. Species recorded earlier have also been included in the text, so as to make the account more comprehensive. Details of material studies along with reference, diagnostic characters, body measurements and distributions are indicated under each species in the systematic accounts of present contribution. Running keys to family, genera and species are also provided.

A CLASSIFIED LIST OF TERMITE (ISOPTERA) SO FAR RECORDED FROM GUJARAT STATE

Family I KALOTERMITIDAE Froggatt

1. *Neotermes fletcheri* Holmgren & Holmgren
2. *Cryptotermes bengalensis* Snyder
3. *Cryptotermes daulti** Rathore

Family II HODOTERMITIDAE Desneux

Subfamily (i) HODOTERMITINAE Desneux

4. *Anacanthotermes macrocephalus* Desneux

Family III RHINOTERMITIDAE Froggatt

Subfamily (ii) PSAMMOTERMITINAE
Holmgren5. *Psammotermes rajasthanicus* Roonwal & BoseSubfamily (iii) COPTOTERMITINAE
Holmgren6. *Coptotermes heimi* (Wasmann)7. *Coptotermes kishori* Roonwal & ChhotaniSubfamily (iv) HETEROTERMITINAE
Froggatt8. *Heterotermes gertrude** Roonwal9. *Heterotermes indicola* (Wasmann)10. *Heterotermes malabaricus* Snyder

Family IV TERMITIDAE Westwood

Subfamily (v) AMITERMITINAE Kemner

11. *Speculitermes cyclopes* Wasmann12. *Speculitermes dharwarensis** Roonwal &
Chhotani13. *Speculitermes sinhalensis* Roonwal & Sen-
Sarma14. *Speculitermes triangularis* Roonwal & Sen-
Sarma15. *Synhamitermes labioangulatus* Thakur16. *Synhamitermes quadriceps* Wasmann17. *Amitermes belli* (Desneux)18. *Eremotermes dehraduni** Roonwal & Sen-
Sarma19. *Eremotermes fletcheri* Holmgren & Holmgren20. *Eremotermes neoparadoxalis* Ahmad21. *Eremotermes paradoxalis* Holmgren22. *Eremotermes sanyuktae* Thakur23. *Microcerotermes beelsoni* Snyder24. *Microcerotermes cameroni* Synder25. *Microcerotermes dumasensis* Thakur26. *Microcerotermes heimi* Wasmann27. *Microcerotermes palestinensis* Spaeth28. *Microcerotermes raja** Roonwal & Bose29. *Microcerotermes sakesarensis** Ahmad30. *Microcerotermes tenuignathus* Holmgren

Subfamily (vi) TERMITINAE Sjostedt

31. *Angulitermes dehraensis** (Gardner)32. *Dicuspiditermes incola** (Wasmann)Subfamily (vii) MACROTERTERMITINAE
Kemner33. *Odontotermes anamallensis** Holmgren &
Holmgren34. *Odontotermes assmuthi* Holmgren35. *Odontotermes bellahunisensis* Holmgren &
Holmgren36. *Odontotermes bhagwathi** Chatterjee &
Thakur37. *Odontotermes brunneus* (Hagen)38. *Odontotermes distans* Holmgren & Holmgren39. *Odontotermes feae** (Wasmann)40. *Odontotermes giriensis* Roonwal & Chhotani41. *Odontotermes girnarensis* Thakur42. *Odontotermes gurdaspurensis* Holmgren &
Holmgren43. *Odontotermes horai** Roonwal & Chhotani44. *Odontotermes indicus* Thakur45. *Odontotermes kushwahi** Roonwal & Bose46. *Odontotermes latiguloides* Roonwal & Verma47. *Odontotermes lokanandi* Chatterjee & Thakur48. *Odontotermes malabaricus** Holmgren &
Holmgren49. *Odontotermes microdentatus* Roonwal &
Sen-Sarma50. *Odontotermes obesus* (Rambur)51. *Odontotermes paralatiguloides* Thakur52. *Odontotermes redemanni* (Wasmann)53. *Odontotermes sasangirensis* Thakur54. *Odontotermes wallonensis* (Wasmann)55. *Microtermes incertoides* Holmgren56. *Microtermes mycophagus* (Desneux)57. *Microtermes obesi* Holmgren58. *Microtermes unicolor* Snyder

Subfamily (viii) NASUTITERMITINAE Hare

59. *Trinervitermes biformis* (Wasmann)60. *Trinervitermes fletcheri* Chatterjee & Thakur

(*) Asteriks are marked as new records

**Key to the families of the ISOPTERA
(Termites) of Gujarat**

Key to *Imago Caste*

1. Fontanelle absent 2
- Fontanelle present 3
2. Ocelli absent; right mandible with a small subsidiary tooth at the base of the anterior cutting edge of the first marginal teeth; left mandible with three marginal teeth; cerci long, with 3-8 segments HODOTERMITIDAE
- Ocelli present; right mandible never with a subsidiary tooth; left mandible with two marginal teeth; Cerci short, with 2 segments KALOTERMITIDAE
3. Fontanelle without plate; right mandible with a distinct subsidiary tooth at the base of the anterior cutting edge of the first marginal teeth; left mandible always with three marginal teeth; forewing scales large overlapping the hindwing scales; wing membrane reticulate RHINOTERMITIDAE
- Fontanelle with plate; right mandible with a minute subsidiary tooth; left mandible with 1-2 marginal teeth; forewing scales small, not overlapping the hindwing scales; wing membrane not reticulate TERMITIDAE

Key to *Soldier Caste*

1. Head without Fontanelle and frontal gland; eyes present; mandibles with prominent marginal teeth 2
- Head with Fontanelle and frontal gland; eyes if present dot like; mandibles with or without marginal teeth 3
2. Cerci long, with 3-8 segments; antennae with 22-32 segments HODOTERMITIDAE
- Cerci short, with 2 segments; antennae with 10-18 segments. KALOTERMITIDAE
3. Pronotum flat RHINOTERMITIDAE
- Pronotum saddle-shaped TERMITIDAE

Key to the genera

- 1 (2). Head-capsule longish; not phragmotic; mandible comparatively long *Neotermes*
- 2 (1). Head-capsule short, phragmotic, truncated in front, almost black anteriorly, with comparatively short mandibles *Cryptotermes*
- 3 (4). Larger species (10–16 mm long) eye spots prominent *Anacanthotermes*
- 4 (3). Smaller species (7.4–8.3 mm long) eye spot absent; mandible with several large to small well defined teeth on the inner margin, soldiers trimorphic *Psammotermes*
- 5 (6). Head-capsule oval shaped; Fontanelle large, circular and lying medially at the anterior margin *Coptotermes*
- 6 (5). Head-capsule subrectangular; Fontanelle small lying at the middle of head dorsum *Heterotermes*
- 7 (8). Mandibles with inner margin serrated *Microcerotermes*
- 8 (7). Mandibles with inner margin not serrated 9
- 9(10). Head-capsule with frontal protuberance; mandibles slender, weakly incurved apically *Eremotermes*
- 10(9). Head-capsule without protuberance; mandibles strongly built 11
- 11(12). Clypeus bilobed, frontal projection absent *Amitermes*
- 12(11). Clypeus not bilobed, frontal projection present *Angulitermes*
- 13(14). Soldier caste rare; pronotum strongly saddle-shaped; anterior lobe larger than posterior lobe; worker and alates with large prominent circular ocellus like mid-dorsal spot on head *Speculitermes*
- 14(13). Soldier caste common; pronotum rather

weakly saddle-shaped; anterior lobe smaller than posterior lobe; worker and alates without mid-dorsal spot on head.

.....*Synhamitermes*

15(16). Mandible short, thin, delicate; soldier smaller than worker, smaller species

..... *Microtermes*

16(15). Mandible strongly asymmetrical, antero-lateral corners of head produced into tubercle like projection

.....*Dicuspiditermes*

17(18). Mandibles large and generally strong, left mandible with tooth, soldier usually larger than worker. Larger species

..... *Odontotermes*

18(17). Mandibles degenerated, non-functional, head-capsule produced into a nasus; soldier dimorphic

..... *Trinervitermes*

Key to the species of genus

Heterotermes Froggatt

Soldiers

1(4). Generally larger in size. Head strongly diverging in front. Pronotum flat, anterior and posterior margins with a weak notch in middle. Antennal segments 12-17. Head-length to base of mandibles 1.50-1.78 and width of head 0.97-1.05 mm

..... *H. gertrudae* Roonwal

2(3). Pronotum distinctly notched both at anterior and posterior margin; antennal segments generally more than 14. Head-length to the base of mandibles 1.33-1.77 mm Head-width 0.83-1.00 mm

..... *H. indicola* (Wasmann)

3(2). Posterior margin of pronotum nearly straight or with an imperceptible emargination; antennal segments 12-14. Head-length to base of mandibles 1.23-1.54 mm Head-width 0.77-0.95 mm Smaller species

H. malabaricus (Snyder)

4(1). Generally smaller species. Head either not or very weakly diverging in front.

Head-length 1.3-1.77 mm Head-width 0.83-1.00 mm

1

Key to the species of genus

Coptotermes Wasmann

Soldiers

1(2). Waist of postmentum lying in the middle of line connecting the level of maximum width and the hind margin. Postmentum with minimum width larger (0.25-0.34 mm) ...

..... *C. heimi* (Wasmann)

2(1). Waist of postmentum lying below the middle of line connecting the level of maximum width and the hind margin. Postmentum with minimum width smaller (0.23-0.25 mm)

C. kishori Roonwal and Chhotani

Key to the species of genus *Speculitermes*

Wasmann

Workers

1(2). Soldier caste present, mid-dorsal spot on head smaller (maximum diameter 0.075-0.11 mm)

.....*S. sinhalensis* Roonwal & Sen-Sarma

2(1). Soldier caste absent, mid-dorsal spot large, always more than 0.11 mm

3

3(4). Mid-dorsal spot circular, well defined (maximum diameter 0.15-0.18 mm

.....*S. cyclops* Wasmann

4(3). Mid-dorsal spot triangular, ill-defined and large (maximum diameter 0.21- 0.28 mm)

.... *S. triangularis* Roonwal & Sen-Sarma

5(4). Mid-dorsal spot rounded, smaller (maximum diameter 0.11-0.13 mm). Larger species. Head-width 1.20-1.40mm

.....*S. dharwarensis* Roonwal & Chhotani

Key to the species of genus

Synhamitermes Holmgren

Soldiers

1(2). Smaller species. Anterior margin of pronotum not notched in the middle. Labrum

tongue-shaped. Length of mandibles 0.45-0.50 mm .. *S. quadriceps* (Wasmann)

- 2(1). Larger species. Anterior margin of pronotum notched in the middle. Labrum pentagonal. Length of mandibles 0.68-0.70 mm.....
.....*S. labioangulatus* Thakur

**Key to the species of genus
Eremotermes Silvestri**

Soldiers

- 1(2). Tooth prominent, straight and pointed. Third segment of antenna shortest
..... *E. sanyuktae* Thakur
- 2(1). Tooth backwardly directed, not straight. Second segment of antenna shortest 3
- 3(4). Mandibles distinctly larger than head-capsule (head-mandibular index 1.12 and above); mandibles tooth weak to absent; when present placed below the middle of mandible
E. neoparadoxalis Ahmad
- 4(3). Mandibles either subequal or shorter than head-capsule (Head-mandibular index usually 1.00 or below); mandibular tooth prominent and placed in the middle of mandible 5
- 5(6). Larger species (maximum head-width 0.80-0.85 mm; pronotum maximum width 0.50-0.55 mm); mandibles subequal to head-length (head-mandibular index 1.00-1.05 mm).....
..... *E. fletcheri* Holmgren & Holmgren
- 6(5). Smaller species (maximum head-width 0.68-0.75 mm; maximum width of pronotum 0.40-0.45 mm); mandibles distinctly shorter than head-length (head-mandibular index 0.78-0.98 mm)...
.....*E. paradoxalis* Holmgren

**Key to the species of genus
Microtermes Wasmann**

- 1(2) Antennae with 15 segments; labrum tongue-shaped
..... *M. mycophagus* (Desneux)

2(1) Antennae with 14 segments; labrum lancet shaped, with a distinct triangular tip.

3(4) Labrum comparatively narrow at tip
..... *M. incertoides* Holmgren

4(3) Labrum comparatively broad at tip.

5(6) Head-capsule moderately hairy; second segment of antennae equal to the combined length of third and fourth segments
..... *M. obesi* Holmgren

6(5) Head-capsule densely hairy; second segment of antennae shorter than combined length of third and fourth segments
..... *M. unicolor* Snyder

**Key to the species of genus
Trinervitermes Holmgren**

Soldier major

2(1) Antennae with 14 segments; in 14 segmented condition, segment 3 about 1.5 times of 2. Pronotum markedly invaginated at anterior margin
..... *T. fletcheri* Chatterjee and Thakur

1(2) Antennae 12 to 14 segmented; in 14 segmented condition segment 3 slightly longer than 2. Pronotum weakly invaginated at anterior margin
..... *T. biformis* (Wasmann)

Soldier minor

1(2) Anterior margin of pronotum without any emargination *T. biformis* (Wasmann)

2(1) Anterior margin of Pronotum weakly to deeply emarginated
..... *T. fletcheri* Chatterjee and Thakur

**Key to the species of genus
Odontotermes Holmgren**

(*O. dehraduni* is known only from imago, and hence not included in the key)

Soldier

1(24) Antennae distinctly darker distally and paler basally.

- 2(5) Tooth on the left mandible placed near the apices; tooth-index less than 0.28 mm.
- 3(4) Head capsule densely pilose; head-mandibular index more 0.60-0.68 mm
..... *O. sasangirensis* Thakur
- 4(3) Head capsule moderately pilose; head-mandibular index less 0.50-0.59 mm
..... *O. giriensis* Roonwal & Chhotani
- 5(2) Tooth on left mandible placed near apical third; tooth-index always more than 0.28 mm.
- 6(11) Postmentum extraordinarily wide; sides strongly arched (broad postmentum group).
- 7(8) Mandible shorter (0.55-0.89 mm); head-mandibular index lower (0.54-0.63 mm) ..*O. lokanandi* Chatterjee & Thakur
- 8(7) Mandible longer (0.74-0.89 mm); head-mandibular index higher (0.68-0.79 mm).
- 9(10) Mandible longer (0.79-0.89 mm); head-mandibular index higher (0.75-0.79 mm)..*O. latiguloides* Roonwal & Verma
- 10(9) Mandible shorter (0.74-0.78 mm); head-mandibular index lower (0.66-0.76 mm)
..... *O. paralatiguloides* Thakur
- 11(6) Post-mentum not wide; sides sub-parallel to weakly arched.
- 12(13) Head and body less hairy; antennae with 16-17 segments; mandible comparatively less stout and long; labrum narrowing anteriorly; post-mentum laterally substraight
..... *O. bellahunisensis* Holmgren & Holmgren
- 13(14) Left mandibular tooth minute, rudimentary; mandible substraight, long, slender and very slightly bent inwards near distal tip; post-mentum laterally weakly arched
..... *O. microdentatus* Roonwal & Sen-Sarma
- 14(15) Head capsule subrectangular laterally, almost parallel upto the base of antennae
..... *O. gurdaspurensis* Holmgren & Holmgren
- 15(16) Head capsule oval, distinctly narrowed anteriorly.
- 16(17) Mandible longer; outer margin strongly bent near the basal third; index mandible length/ head length to base of mandible 0.69-0.79 mm
..... *O. redemanni* (Wasmann)
- 17(18) Mandible short, slender, with weakly curved outer margin; index mandible length/ head length 0.59-0.68 mm; labrum short, broadly rounded anteriorly
..... *O. obesus* (Rambur)
- 18(19) Head capsule sub-rectangular; tooth on left mandible placed near the distant end of the middle one-third portion
- 19(20) Head-capsule with sides almost parallel in the middle; inner margin of left mandible beyond the tooth strongly incurved; index mandible length/ head length to base of mandible 0.56-0.62 mm, tooth on left mandible forwardly placed (tooth distance 0.33-0.45 mm); mandible tooth index 0.34-0.42 mm.
- 20(21) Head-capsule with sides convex in the middle; inner margin of left mandible beyond the tooth sickle-shaped; index mandible length/ head length to base of mandible 0.61-0.67 mm; tooth on left mandible not much forwardly placed (tooth distance 0.43-0.50 mm); mandible tooth index 0.41-0.44 mm
..... *O. kushwahi* Roonwal & Bose
- 21(22) Head-capsule with sides almost parallel in the middle; inner margin of left mandible beyond the tooth strongly incurved
..... *O. brunneus* (Hagen)
- 22(23) Tooth distance from the tip of left mandible 0.34-0.38 mm; tooth index less (0.34-0.39 mm); antennae 16-segmented
..... *O. girnarensis* Thakur
- 23(24) Tooth distance from the tip of left mandible 0.43-0.53 mm; tooth index high (0.43-0.53 mm); antennae 16-17 segmented
..... *O. wallonensis* (Wasmann)

- 24(1) Antennae uniformly coloured, not darker distally.
- 25(26) Inner margin anterior to tooth on the left mandible wavy, parrot's beak-like; smaller species; distance of tooth from the tip of mandible 0.28-0.35 mm; mandible tooth index 0.33-0.37 mm *O. assmuthi* Holmgren
- 26(27) Inner margin anterior to tooth on the left mandible not wavy; comparatively larger species; distance of tooth from the tip of mandible 0.38-0.50 mm; mandible tooth index 0.34-0.43 mm *O. malabaricus* Holmgren & Holmgren
- 27(28) Angle between the tooth and inner margin of left mandible much wider (nearly 90°); tips weakly incurved; tooth sharply pointed.
- 28(29) Angle between the tooth and inner margin of left mandible distinctly acute; tips strongly incurved; tooth bluntly pointed *O. anamallensis* Holmgren & Holmgren
- 29(30) Tooth on left mandible placed a little below the middle; mandible tooth index 0.51-0.55 mm; smaller species *O. bhagwathi* Chatterjee & Thakur
- 30(31) Tooth on left mandible rudimentary and placed near the basal third; mandible tooth index 0.58-0.66; comparatively larger species; antennae 17-segmented *O. distans* Holmgren & Holmgren
- 31(32) Tooth on left mandible minute and placed at basal third of mandible; antennae 16-17 segmented.
- 32(33) Head capsule with sides almost parallel; tooth distance from tip of mandible 0.63-0.68 mm; mandible tooth index 0.60-0.66 mm; head length with mandible 2.70-3.30 mm; tooth on left mandible prominent *O. horai* Roonwal & Chhotani
- 33(34) Head capsule with sides not parallel; tooth distance from tip of mandible 0.62-0.80 mm; mandible tooth index 0.50-0.55 mm; head length with mandible 3.45-4.35 mm; tooth on left mandible very prominent *O. indicus* Thakur
- 34(35) Tooth on left mandible placed near the proximal end of middle one-third; mandible tooth-index 0.56-0.60; head-capsule widest in the middle.
- 35(34) Tooth on left mandible placed near the middle; mandible tooth-index 0.50-0.54; head-capsule widest near the posterior third *O. feae* (Wasmann)

SYSTEMATIC ACCOUNT

Class INSECTA

Order ISOPTERA

Family I KALOTERMITIDAE

1. *Neotermes fletcheri* Holmgren & Holmgren

Calotermes / Kalotermes (Neotermes) fletcheri Holmgren & Holmgren :

1917. *Calotermes / Kalotermes (Neotermes) fletcheri* : K. Holmgren and N. Holmgren. *Mem. Dept. Agric. India (Ent.)*, Calcutta, 5(3) : 139. Imago, soldier and pseudoworker. Type-locality : South India : Coimbatore (Tamilnadu).

1934. *Calotermes / Kalotermes (Neotermes) fletcheri* : V. Margabandhu. *J. Bombay nat. Hist. Soc.*, 37(3) : 702.

Neotermes fletcheri Holmgren & Holmgren

1949. *Neotermes fletcheri* : T. E. Snyder. *Smiths. Misc. Coll.*, Washington, 112 : 25.

1989. *Neotermes fletcheri* : M. L. Roonwal and O. B. Chhotani. *The Fauna of Indian and the adjacent countries. Isoptera (Termites)*. Vol. I : 231-236.

Caste known : Imago, soldier and pseudoworker.

Material examined : One vial with 3 soldiers and several pseudoworkers from a mango tree, in Kunta village, Valsad (Bulsar), Gujarat, coll. M. L. Thakur, 8.10.1965.

Diagnostic characters : *Soldiers* : Head-capsule castaneous brown, antennae and labrum brownish,

mandible black, reddish brown basally; pronotum paler than head. Head and body sparsely hairy. Total body length 7.90-9.0 mm; Y-suture present, eyes whitish, oval, ocelli absent, mandible short and stout, length 1.50-1.65 mm. Left mandible with 5 and right with 2 tooth.

Distribution : India : Tamilnadu; Coimbatore, Kerala : Nilambur; Gujarat : Kunta village, Valsad.

Elsewhere : Bangladesh.

Remarks : The Specimens from Valsad (Gujarat) are distinctly smaller in size.

2. *Cryptotermes bengalensis* (Snyder)

1934. *Kalotermes (Cryptotermes) bengalensis* : T. E. Snyder, *Indian For. Rec.*, 20(2) : 4-6. Imago, Soldier. Type-locality : Sunderbans (Bengal).

1949. *Cryptotermes bengalensis* : T. E. Snyder, *Smiths. Misc. Coll.*, 112 : 38.

1989. *Cryptotermes bengalensis* : M. L. Roonwal and O. B. Chhotani, *The Fauna of India and the adjacent countries, Isoptera (Termites)*. Vol. I : 373-377.

Caste known : Imago, soldier and pseudoworker.

Material examined : two vials with soldiers and pseudoworkers from Kaprada Teak plantation near water tank (Valsad district). N.S. Rathore coll., 27.12.1980.

Diagnostic characters : *Soldier* : Head-capsule generally dark brown almost black in front, short, thick and phragmotic. Eyes present, smaller and oval. Antennae with 11-15 segments. Mandibles short stout, triangular and prominently humped, each mandible with 2 weak to prominent marginal teeth. Total body length 3.8-6.2 mm and maximum Head-width 1.08-1.37 mm Pronotum weakly narrower to somewhat broader than head (length 0.70-0.90 and width 1.00-1.30 mm). Abdomen hairy, oblong. *Pseudoworker* : Head and body pale yellowish, thinly hairy. Total body length 4.4-6.0 mm. Head-capsule subcircular. Eye-spots present. Antennae 12-14 segmented. Pronotum narrower than head-casule (length 0.53-0.66 and width 0.97-1.00 mm).

Distribution : From the Indian sub region it is reported from India : Assam, Tripura, West Bengal, Orissa, Madhya Pradesh, Uttar Pradesh, Gujarat, Karnataka states and Andaman and Nicobar Islands.

Elsewhere : Sri Lanka and Bangladesh.

3. *Cryptotermes daulti* Rathore

1994. *Cryptotermes daulti* : N.S. Rathore, *Hexapoda*, 6(1) : 19-32, Imago, Soldiers and Pseudoworker. Type-locality : Taranga hills, Danta, Mahesana, Gujarat, India.

Caste known : Imago, soldier, pseudoworker.

Material examined : One vial with 5 imagoes, many soldiers, pseudoworkers from a tree trunk of Dhak, Taranga hills, 32 km south of Danta, NE of Mahesana, Gujarat, N.S. Rathore coll., 23.ii.1992.

Diagnostic characters : *Imago* : Head and body pale brown. Head oval, dorsum with very faint epicranial suture or sometimes not at all clear but a white mid-dorsal, V-shaped mark clearly visible on mid-dorsum at level of compound eyes or slightly above. Ocelli some what broader, minimum diameter 0.07-0.09 mm and widely separated from antennae (minimum Ocellus-antennal distance 0.17-0.20 mm. Antennae with 14 segments. *Soldier* : Head reddish brown in posterior region and forehead almost black. Head sparsely and body moderately pilose. Head-capsule subrectangular, short thick and truncated in front, Frontal ridge prominent, concave and strongly pushed back, not overhanging the frons. Frons prominently incurved, vertex with a median depression just behind the frontal ridge; 2 knob-like tubercles present on either side; epicranial sutures present. Fontanelle and ocelli absent but two lateral oval eye-spots present one on either side. Antennae with 10-13 segments.

Distribution : Known only from type-locality. India : Gujarat, Taranga hills 32 kms south from Danta and 60 kms NE of Mahesana district.

Remarks : 7 species including the present one are known from Indian region.

Family II HODOTERMITIDAE

Subfamily (i) HODOTERMITINAE

4. *Anacanthotermes macrocephalus* (Desneux)

1906. *Hodotermes macrocephalus* : J. Desneux, *Ann. Soc. Entomol. Belg.*, Brussels, 49(12) : 344-348. Imago soldier and worker. Type-locality : Karachi (Sind, Pakistan).

1949. *Anacanthotermes macrocephalus* : T. E. Snyder, *Smiths. misc. Coll.*, 112 : 62.

1989. *Anacanthotermes macrocephalus* : M.L. Roonwal and O.B. Chhotani, *The Fauna of India and adjacent countries, Isoptera (Termites)*. Vol. I : 147-155 *Zool. Surv. India.* .

Caste Known : Imago, Soldier and Worker.

Material examined : Two vials, 1989 from Kachchh district as follows :

Lot (A) - One vial with 2 soldiers and workers from ground, Kukama village 11 kms E of Bhuj, N.S. Rathore coll., 24.2.1989. Ex. Mound.

Lot (B) One vial with workers from rocky area, Ratanpur village 4 kms W of Rapar taluka, Bhuj, N.S. Rathore coll., 2.3.1989. Ex. Mound.

Diagnostic characters : *Soldier* : Sparsely pilose. Head yellow to brownish yellow. Very large species, total length with mandibles 10.5-15.3 mm. Head subsquarish, slightly longer than broad (head length with mandibles 6.3 -7.3 mm and length of head to lateral base of mandibles 3.00-4.90 mm), posterior margin rounded. Fontanelle absent. Eyes small, subcircular. Ocelli subrounded spot like. Antennae 25-31 segments; segment 1 longest; 4 smallest. Mandibles long, stout and incurved at apex; each with two large marginal teeth. Pronotum weakly saddle-shaped much broader than long (width 2.00-3.23; length 0.98-1.80 mm). Legs long stout, apical tibial spur formula 3:4:4. *Worker* : Head brownish yellow. Total length 6.1-10.6 mm Head subsquarish, somewhat broader than long (width 1.6-3.3; length 1.40-2.85 mm. Fontanelle absent. Eyes rounded, moderately large. Ocelli very small. Antennae with 25-31 segments; segment 1 longest and 5 smallest. Pronotum much narrower than head. Legs long slender; tarsi 4 jointed; apical tibial spur formula 3 : 4 : 4. Cerci short, faintly 3-jointed.

Distribution : India : Rajasthan : Western desert area : Districts of Bikaner, Jaisalmer, Barmer, Jodhpur, Jalore. Gujarat : Kachchh (Chavda, 26 km from Bhuj, Kukama village, Ratanpur village, Rapar taluka).

Elsewhere : Pakistan : Punjab : Districts of Montgomery, Sargodha, Shahpur and Mianwali. Sindh : Karachi, Hyderabad, SE of Hyderabad between Hyderabad and Badin. Baluchistan : Quetta, Sariah and Chaman. Also Pasni (on coast) N.W.F.P. : Peshawar. Afghanistan : SE part (1045-1240 m) : Char Safa between Kalat and Kandhar; Kadjhakai, 70 km N of Gureck; and Arghandah.

Remarks : It is a foraging termite and pest of grassland and also attacks sapling of wheat and chillies. It lives underground in thin, smooth-walled rounded chamber of various shapes and sizes. It builds low conical mounds of loose, granular earth about 60-300 mm height. Parties of workers (only rarely accompanied by soldiers) forage out on the ground, early morning and late evening.

Family III RHINOTERMITIDAE

Subfamily (ii) PSAMMOTERMITINAE

5. *Psammotermes rajasthanicus*

Roonwal and Bose

1960. *Psammotermes rajasthanicus* : M. L. Roonwal and G. Bose, *Sci. and Cult.*, Calcutta, 26(1) : 38-39. Soldiers minor and worker. Type-locality : India : Rajasthan : Balana, Jaisalmer district.

1989. *Psammotermes rajasthanicus* : M. L. Roonwal and O. B. Chhotani, *The Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. I : 410-415.

Caste known : Soldier and Worker.

Material examined : 1 vial with soldiers (major, minor and median), workers, from Thordoi near Khavda on coast of the Great Rann of Kachchh 102 kms from Bhuj, N.S. Rathore coll., 16.1.1989, ex. Cow-dung covered with soil.

Diagnostic characters : *Soldier* : Polymorphic with 3 types, major, medium and minor soldiers. Mandible with several large to small well defined teeth on the inner margin. *Soldier major* : Total

body length with mandibles 7.43-8.16 mm. Head-capsule subrectangular; flat, longer than broad (length to base of mandibles 1.8-2.00; maximum width of head 1.35-1.50 mm). Fontanelle distinct, rounded; situated a little distal to middle. Length of mandibles left and right 1.43-1.80 mm. Antennae with 14-15 segments; segment 2 shortest, 3 large. Labrum subpentagonal, crown-shaped (median length 0.70-0.93, maximum width 0.73-0.95 mm). Postmentum club-shaped (length 1.25-1.48; maximum width 0.53-0.58 mm). Pronotum flat, subtrapezoidal, narrow than head and wider than long (length 0.78-0.95), width 1.13-1.35 mm. Cerci 2-jointed; styli single-jointed. *Soldier medium* : Resembles soldier major but is smaller in size (Total length of body 5.9-6.80 mm), head-length to mandible-base 1.50-1.65, maximum head-width 1.20-1.25, pronotum width 0.98-1.10 mm). Antennae as in soldier major with 14-15 segments. *Soldier minor* : resembles soldier major and medium but is smaller (total body length 4.00-5.57, head-length to mandible base 1.08-1.40, maximum head-width 0.85-1.23; pronotum length 0.49-0.56 and width 0.63-0.91 mm). Antennae as in soldier major and medium; with 14-15 segments. Labrum tongue-shaped and not crown-shaped as in soldiers major and medium.

Distribution : North-western India and Pakistan, mostly in arid areas as follow :

India : Arid districts of Rajasthan and Gujarat e.g., Barmer district (Pachpadra, Tamlone village near Gadra road railway station, Girab area, Turvi village), Jaisalmer district (Nokha, Mohangarh, Ramgarh, Balana, being the type-locality, Sam, Nahar Singh ki Dhani), Jodhpur district (West of Jodhpur and vicinity) and Bikaner district (Pugal). Kachchh district of Gujarat state, Thordoi near Khavda on coast of Great Rann of Kachchh 102 km from Bhuj and Radhanpur, Palanpur district.

Elsewhere : Pakistan : All over southern and western Pakistan e.g., southern Baluchistan west to Gawadar (Mekran coast), Sind and Punjab north to Lyallpur (Faizlabad), Karachi, Mirpurkhas, Rohri, Sukkur, Khanpur, Merrot (Cholistan).

Remarks : It prefers arid, low-rainfall areas and is commonly found under stones, dung and in sandy soil. It damages woodwork in huts, houses and also attack crops as well as larger trees.

Subfamily (iii) COPTOTERMITINAE

6. *Coptotermes heimi* (Wasmann)

1902. *Arrhinotermes heimi* : E. Wasmann, *Zool. Jahrb. Abt. Syst.*, Jena, 17(1) 104. Imago. Type-locality : India : Maharashtra : Wallon (Ahmednagar).

1949. *Coptotermes heimi* : T. E. Snyder, *Smiths. misc. coll.*, 112 : 79.

1989. *Coptotermes heimi* : M. L. Roonwal and O.B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. I : 451-457.

Caste known : Imago, soldier and worker.

Material examined : Nine vials 1982-1992 from Vadodara, Ahwa (Dangs), Palanpur, Mahesana districts as follows :

Lot (A) One vial with soldiers and workers was collected from Narbada Irrigation Rest House, Alkapuri, Vadodara, N.S. Rathore coll., 20.x.1982, Ex. wooden racks.

Lot (B) One vial with soldiers and workers collected from Papari village, Ahwa (Dangs), coll. R. Sewak, 10.viii.1989, Ex. under grass.

Lot (C) Six vials with soldiers and workers were collected from different places of forested area 14 km NE of Danta Palanpur (Banaskantha) district, N.S. Rathore coll., 19.ii.1992, Ex. under dung and dry log.

Lot (D) One vial with soldiers and workers collected from Taranga hill 60 km NE of Unjha, Mahesana, N.S. Rathore coll., 23.ii.1992, Ex. under tree trunk.

Diagnostic characters : *Soldier* : Head-capsule straw yellow to yellowish. Total body length 4.20-6.00 mm. Head-capsule variable in shape (length to mandible-base 1.20-1.45, width 1.05-1.35 mm; index width/length 0.77-1.04); posterior margin rounded. Antennae with 14-16

segments. Labrum subtriangular, longer than broad (length 0.28-0.35, width 0.23-0.30 mm); apex hyaline pointed and with a pair of bristles. Mandibles long (0.70-1.00 mm), sabre-shaped, sharply pointed, incurved apex. Left mandible with 4 small crenulations and a basal projection in proximal half. Right with 4 small crenulations in proximal one-third. Postmentum generally club-shaped; shape and size variable, broadest in anterior one-fourth (0.38-0.45 mm); posteriorly curving to a wide waist (0.25-0.34 mm). Pronotum flat, much broader than long (width 0.75-0.95, length 0.40-0.50 mm). Abdomen oblong, sometimes with two longitudinal rows of brown pigmented strips in middle. Cerci 2-segmented; style 1-segmented.

Worker : Head-capsule pale yellow; antennae, legs, pronotum and abdomen paler. Head-densely pilose. Total length 3.60-5.70 mm. Head-capsule subrounded, broader than long (width 0.88-1.30, length to mandible-base 0.74-1.11 mm). Antennae with 12-15 segments; segment 3 shortest or subequal to either 2 or 4. Labrum width 0.30-0.45, length 0.28-0.40 mm. Pronotum pilose, much broader than long (width 0.51-0.80, length 0.25-0.44 mm).

Distribution : it is very widely distributed species in the Indian subcontinent.

Elsewhere : Pakistan, Bangladesh, Bhutan and Nepal. Recently introduced in Oman (Chhotani).

7. *Coptotermes kishori* Roonwal and Chhotani

1960. *Coptotermes kishori* : M. L. Roonwal and O. B. Chhotani, *J. zool. Soc. India*, II(2) : 127. Soldier and worker. Type-locality : India : Behampur, 186 km N of Calcutta (West Bengal)

1989. *Coptotermes kishori* : M. L. Roonwal and O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. I : 457-461.

Material examined : One vial with several soldiers and workers from Jhear village 1 km from Danta Forest area and 32 km from Palanpur district. N.S. Rathore coll., 25.xi.1986, Ex. bamboo plant.

Diagnostic characters : *Soldier* : Head yellow;

sparsely hairy with one hair on either side of Fontanelle. Total body length 3.75-4.8 mm. Head oval, longer than broad (length to base of mandibles 1.13-1.25, width 0.95-1.12 mm). Antennae with 13-14 segments, segment 3 smallest or subequal to or longer than 2 or 4. Labrum subtriangular, little longer than broad (length 0.20-0.28, width 0.20-0.25 mm); apex hyaline, pointed, with a long bristle on either side of tip. Mandibles long (0.73-0.83 mm), sabre-shaped; incurved and sharp at tip. Left mandible with 4 crenulations and a basal projection in proximal half of inner margin; right with 3 crenulations in proximal one-third of inner margin. Postmentum long (0.70-0.80 mm), vase-shaped, broadest in anterior one-third (maximum width 0.35-0.38 mm). Pronotum broader than long (length 0.35-0.43, width 0.65-0.83 mm); narrower than head; anterior margin weakly convex. Abdominal terga with a row of hairs at posterior margin; styli one-segmented; cerci 2-segmented.

Worker : Head-capsule and mandible pale yellow; antennae, labrum, pronotum and abdomen paler than head. Total body length 3.60-4.28 mm. Head-capsule squarish, broader than long (length to mandible-base 0.80-0.88, width 1.0-1.08 mm). Fontanelle, eyes and ocelli absent. Antennae with 13-14 segments; segment 3 shortest or subequal to 2 or 4. Labrum broadly tongue-shaped, (length 0.35-0.38, width 0.38-0.40 mm).

Distribution : India : West Bengal : Behrampur (Murshidabad Dist., type locality), Kalyani (Nadia Dist.); Tripura : Agartala : Ambasa, Belonia and Choraibari; Madhya Pradesh : Jabalpur; Rajasthan : Nagaur; Gujarat : Kaprada Forest Govatka village Valsad and Banaskantha district.

Subfamily (iv) HETEROTERMITINAE

8. *Heterotermes gertrudae* Roonwal

1953. *Heterotermes gertrudae* : M. L. Roonwal, *Indian J. Ent.*, 15(2) : 115-118. S. W. Holotype : S, in AMNH. Type-locality : Almora (Uttar Pradesh, India).

1989. *Heterotermes gertrudae* : M. L. Roonwal and O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. I; Zool. Surv. India : 483-487.

Caste known : Imago, soldier and worker.

Material examined : I vial with few soldiers and workers mix with *Microtermes obesi* species material collected from Ambaji Forest area, Palanpur, N.S. Rathore coll., 24.ii.1986, Ex. Dry Bamboo.

Diagnostic characters : *Soldier* : Head-capsule yellowish brown; body pale yellow; mandibles dark brown. Total body-length 4.9-6.0 mm. Head-capsule subrectangular; length without mandibles (1.50-1.78 mm) width (0.97-1.05 mm). Fontanelle minute, circular. Mandibles sabre-shaped, 0.90-1.05 mm long; incurved at distal tip; left with a basal blunt projection and a few crenulation on broad basal portion. Antennae with 12-17 (mostly 14-15) segments; segment 2 subequal to 3 + 4; 3 shortest. Postmentum long, club-shaped; length 1.13-1.50 mm, maximum width 0.30-0.38 and width at waist 0.13-0.19 mm. Legs thin and slender; apical tibial spurs 3:2:2; tarsi 4-jointed. Abdomen oblong. *Worker* : Head pale yellow, body paler. Total body length 4.5-6.00 mm Head-capsule subsquarish; width 0.86-1.14 mm Antennae with 13-16 (mostly 15) segments. Postclypeus weakly swollen. Mandibles left and right with apical finger like, left mandible; 1st marginal a little smaller than apical 2nd as long as apical 3rd Right 1st marginal small rudimentary tooth lying at anterior base of 2nd marginal, and 2nd triangular, 3rd short.

Distribution : India : North West Himalayas : Almora and Rishikesh (Uttar Pradesh) and Melha (Himachal Pradesh), Pichola Lake area, Udaipur (Rajasthan) and Palanpur (Gujarat).

9. *Heterotermes indicola* (Wasmann)

1902. *Leucotermes indicola* : E. Wasmann, *Zool. Jahrb. Abt. Syst.*, Jena, 17(1) : 118-119. Soldier and worker.

1949. *Heterotermes indicola* : T. E. Snyder, *Smiths. misc. Coll.*, 112 : 68.

1989. *Heterotermes indicola* : M. L. Roonwal and O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites), Vol. 1 : 487-491.

Caste known : Imago, soldier and worker.

Material examined : One vial with soldiers and workers from Jhear village, Danta, Palanpur,

district, N.S. Rathore coll., 25.xi.1986, Ex. wooden log.

One vial with soldiers and workers from Magodi village 16 km from Gandhinagar district, N.S. Rathore coll., 26.ii.1991. Ex. under dry wooden log.

Diagnostic characters : *Soldier* : Head-capsule pale yellowish brown, mandibles light to dark brown, basally paler. Total length of body 3.5-6.10 mm Head length with mandibles 2.35-2.58, length to base of mandible 1.25-1.77 mm, width 0.83-1.05 mm Fontanelle small. Antennae with 14-16 (generally 15) segments; segment 3 variable either shorter or longer than 2 and either subequal to or longer than 4. Labrum triangular, with a hyaline, spine-like tip (0.08-0.10 mm in length); length much more than width. Mandible fairly long (0.73-0.95 mm), left mandible with 3-4 crenulations in basal part of inner margin. Postmentum club-shaped, fairly long, length of postmentum 0.83-1.23 mm, maximum width 0.35-0.37 mm and minimum width at waist 0.17-0.20 mm. Pronotum flat, width 0.60-0.88, length 0.35-0.60 mm. Cerci 2-jointed, styli single-jointed.

Distribution : It is very common wood-destroying termite in the Indian subcontinent and is found all over above 20°N latitude. Gujarat : Nigal village, Anjar, Megshsay tank area, Bhuj. Jhear village, Danta, Palanpur district and Magodi village Gandhinagar.

Elsewhere : Afghanistan.

10. *Heterotermes malabaricus* Snyder

1933. *Heterotermes malabaricus* : T. E. Snyder, *Proc. U. S. natnl. Mus.* 82 (Art. 16) : 4-6. Lectotype : S. in FRI, Dehradun, Type-locality : Mangalore, Karnataka, India.

1989. *Heterotermes malabaricus* : M. L. Roonwal and O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites), Vol. 1 : 491-494.

Caste known : Imago, Soldier and worker.

Material examined : One vial with soldier and worker from Kunta village, Valsad district, coll. M. L. Thakur, 8.xii.1965, Ex. Fence post.

Diagnostic characters : Soldier : Head-capsule and labrum light yellowish brown; mandibles dark brown, basally pale. Total body length 3.20-5.00 mm. Head-capsule subrectangular, much longer than broad; head length with mandibles 2.20-2.50 mm and length to base of mandibles 1.23-1.54, width 0.70-0.95 mm. Antennae with 12-14 segments; segment 3 shortest. Labrum subtriangular (length 0.35-0.43, width 0.25-0.30 mm); a hyaline, pointed, needle-like tip. Mandibles sabre-shaped, long (0.70-0.93 mm); apices weakly incurved. Left mandible with 3-4 crenulations in basal half of inner margin. Postmentum club-shaped, length 0.82-1.25, maximum width (at club) 0.32-0.43, minimum width (at waist) 0.15-0.20 mm; waist lying in Posterior one-third. Pronotum flat, trapezoidal; much broader than long, width 0.53-0.80, length 0.33-0.50 mm. Apical tibial spurs 3 : 2 : 2, tarsi 4-jointed. Cerci 2-segmented.

Distribution : Fairly wide spread in the Indian subcontinent below 20°N. Gujarat : Kunta village, Valsad district.

Family IV TERMITIDAE

Subfamily AMITERMITINAE

11. *Speculitermes cyclops* Wasmann

1902. *Speculitermes cyclops* : E. Wasmann, *Zool. Jahrb. Abt. Syst.*, Jena, 17(1) : 160-169. Imago, worker. Type-locality : India : Maharashtra : Khandala, Bombay.

1960. *Speculitermes cyclops* : M. L. Roonwal and P. K. Sen-Sarma, *Contrib. Syst. Orient. Termites (I.C.A.R.) Entom. Monogr. No. 1* : 16-23.

1997. *Speculitermes cyclops* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 44-48. *Zool. Surv. India*.

Caste known : Imago and worker.

Material examined : Lot (I) One vial with several workers only from Ambaji forested area, Palanpur, N.S. Rathore coll., 24.xi.1986, Ex. under stone.

Lot (II) One vial with workers mix with *Microtermes unicolor* from Anidam submergence area, Chhota Udaipur, Vadodara district, 21.x.1982, N.S. Rathore coll., Ex. under stone.

Diagnostic characters : Worker : Head-capsule dark brown; postclypeus generally paler but sometimes as dark as head; antennae and legs yellowish white; abdomen brown above and whitish below. Head and body rarely hairy. Total body length 4.30-6.50 mm. Head-capsule subcircular (head-length with mandibles 1.20-1.39 mm, length to base of mandibles 0.90-1.20, maximum width 1.20-1.40 mm). Y-suture present; mid-dorsal spot translucent white, shining, round (diameter 0.12-0.18 mm); situated at junction of Y-suture, very weakly swollen. Antennae with 14 segments; segment 2 shortest; 3 long, club-shaped, longer than 2 or 4. Postclypeus swollen, hairy; length about half or a little more than half of width. Labrum dome-shaped, hairy near distal end and on body, wider than long. Pronotum strongly saddle-shaped (length 0.40-0.50, maximum width 0.65-0.83 mm); anterior margin round. Legs long, slender, apical tibial spurs 3 : 2 : 2.

Distribution : India : Jammu & Kashmir. Maharashtra, Karnataka, Orissa, Madhya Pradesh. Rajasthan, Uttar Pradesh and Gujarat (Banskantha, Bharuch and Vadodara districts).

Elsewhere : Pakistan (Punjab) and Bangladesh.

Remarks : This species has been recorded from the most, open and scrubby areas in Gujarat state.

12. *Speculitermes dharwarensis* Roonwal & Chhotani

1964. *Speculitermes dharwarensis* : M. L. Roonwal and O. B. Chhotani, *Ind. J. agric. Sci.*, 34 : 120-125. Im and W. Holotype : Im. in ZSI. Type-locality : Dharwar, Karnataka, India.

1997. *Speculitermes dharwarensis* : O. B. Chhotani, *Fauna of India and Adjacent Countries, Isoptera (Termites)*, Vol. II, 49-52. *Zool. Surv. India*.

Caste known : Imago (Dealate) and Worker.

Material examined : One vial with 2 workers from forested area near Limbhoi village, Himatnagar (Sabarkantha), N.S. Rathore coll., 28. xl. 1986. Ex. under stone.

Diagnostic characters : Worker : Head-capsule brown; mid dorsal spot yellowish; abdominal

tergites pale brown, translucent. Total body-length 3.65-5.5 mm. Head subcircular, broader than long (length to base of mandibles 0.87-1.0, max. width 1.03-1.23 mm; Y-suture faint; mid-dorsal spot rounded (0.11-0.13 mm in diameter), not swollen. Antennae with 14 segments; segment 3 subequal to or longer than 2, faintly subdivided. Postclypeus brown swollen; length half or a slightly more than half of width (length 0.25-0.27, width 0.43-0.53 mm). Labrum dome-shaped, length 0.30-0.40, width 0.45-0.57 mm. Pronotum strongly saddle-shaped (length 0.30-0.37, maximum width 0.57-0.73 mm); notch absent.

Distribution : India : Karnataka, (Dharwar, type locality), Andhra Pradesh (Triumala), and Gujarat (Limbhoi village, Himatnagar district).

Remarks : This is the first record of the species from Gujarat State.

13. *Speculitermes sinhalensis* Roonwal & Sen-Sarma

1960. *Speculitermes cyclopes sinhalensis* : M. L. Roonwal and P. K. Sen-Sarma, *Contr. Syst. Orient. Termites (ICAR, Entom. Monogr. No. 1)* : 23-26. Worker. Type-locality : Sri Lanka : Vavuniya (North Province).

1960. *Speculitermes cyclopes sinhalensis* : M. L. Roonwal and O. B. Chhotani, *Sci. & Cult.*, Calcutta, **26**(2) : 143-144. (Soldier caste reported)

1966. *Speculitermes sinhalensis* : M. L. Roonwal and O. B. Chhotani, *Biol. Zbl.*, Leipzig, **85** : 189-210.

1997. *Speculitermes sinhalensis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. **II** : 61-67, *Zool Surv. India*.

Caste known : Imago, soldier and worker.

Material examined : One vial with 10 workers collected from under stone on Khambhalia Rajkot road, Jamnagar district, coll. R. N. Bhargava, 18.viii.1988.

Diagnostic characters : *Worker* : Head brown; postclypeus, antennae and labrum paler; body and legs translucent white. Total body-length 4.42-6.32 mm. Head subcircular (head length with mandibles 1.18-1.30 mm, length to base of mandibles

1.03-1.17, maximum width 1.25-1.46 mm; Y-suture present; a small, round (0.07-0.11 mm diameter) mid dorsal spot present at junction of Y-suture. Antennae with 14 segment; segment 3 longer than 2, club-shaped and subdivided. Postclypeus swollen and hairy, length half of width (length 0.29-0.33, width 0.60-0.66 mm). Pronotum saddle-shaped (length 0.37-0.49, width 0.77-0.83 mm).

Distribution : India : Very widely distributed and is recorded from Tamilnadu, Kerala, Karnataka, Andhra Pradesh, Orissa, Madhya Pradesh (Kanha National Park), Gujarat (Dang, Junagarh and Jamnagar districts).

Elsewhere : Sri Lanka.

14. *Speculitermes triangularis* Roonwal & Sen-Sarma

1960. *Speculitermes triangularis* : M. L. Roonwal and P. K. Sen-Sarma, *Contrib. Syst. Orient. Termites (ICAR Ent. Monogr. No. 1)* : 15, 26-28. W only. Holotype : W. in FRI. Type-locality : Dehradun (U.P., India).

1997. *Speculitermes triangularis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. **II** : 67-69, *Zool Surv. India*.

Caste known : Worker only.

Material examined : One vial with several workers from Kaprada Forest near Govtka village, Valsad district, N.S. Rathore coll., 28.xii.1980. Ex. Cow-dung.

Diagnostic characters : *Worker* : Head-capsule yellow to pale straw coloured; postclypeus and labrum slightly paler than head; antennae and legs yellowish white. Head and body moderately hairy. Total body-length 4.5-6.25 mm. Head subcircular (head length with mandibles 1.23-1.28 mm, length to base of mandibles 1.05-1.13, maximum width 1.30-1.38 mm); mid-dorsal spot translucent white, triangular (length 0.20, width 0.30 mm), flush with head-dorsum; Y-suture faint. Antennae with 14 segments; segment 2 shortest, 3 longer than 2; 4 subequal to 2. Postclypeus greatly swollen, pilose, medially divided into 2 halves, length about half of width; anterior and posterior margins straight. Pronotum strongly saddle-shaped; anterior and posterior margin rounded, length 0.38-0.45, width

0.75-0.81 mm. Legs long and slender; apical tibial spurs generally 2:2:2 sometimes 3:2:2, dorsal spur when present very minute.

Distribution : India : Uttar Pradesh : Bageshwar (Dehradun, type-locality), Gujarat (Kaprada Forest, Valsad district).

15. *Synhamitermes labioangulatus* Thakur

1989. *Synhamitermes labioangulatus* : R. K. Thakur, *Indian For. Rec. (N.S.) Ent.*, **15**(1) : 22-24. *Caste known* : Soldier, worker. *Holotype* : Soldier in ZSI, Calcutta. *Type-locality* : Kaprada Forest near Govatka village (Valsad district), Gujarat, India.

Caste known : Soldier and worker.

Material examined : 1 paratype soldier and workers collection examined collected from Kaprada Forest near Govatka village (Valsad district), N.S. Rathore coll., 28.xii.1980, Ex. cow-dung.

Diagnostic characters : *Soldier* : Head deep-yellow to light brown and body yellowish white. Total body-length 4.15-4.25 mm. Head sub-squarish, slightly longer than broad (length 1.0-1.06 mm, width 0.88-0.91 mm), broadest near the base of antennae. Antennae 13 segmented; 1 longest, 2 about two-third of 1; 3 shortest. Labrum pentagonal very wide at the base with few long hairs. Mandibles strongly built; tips strongly incurved, each mandibles with a large sharply pointed and a little upwardly directed tooth in the middle. Postmentum swollen and without hairs. Pronotum saddle-shaped length 0.32-0.34, width 0.50-0.64 mm, with a faint median notch; posterior margin sub-straight, with a prominent median notch. *Worker* : Head and pronotum yellowish white. Mandibles dark brown at inner margin. Total body-length 3.25-3.37 mm Head subsquarish, broader than long, head length to lateral base of mandibles 0.75-0.81; width 0.81-0.86 mm. Eyes and ocelli absent. Antennae with 13 segments; segment 1 largest, cylindrical; segment 3 shortest, last segment ovate. Labrum short, length 0.22-0.25 mm and width 0.20-0.22 with a few small hairs on the outer margin. Mandibles subsquarish, left mandible with an apical and two marginal teeth,

right mandible with an apical and two marginal teeth. Pronotum saddle-shaped; width 0.50-0.55; length 0.25-0.28 mm.

Distribution : India : Gujarat (Kaprada Forest near Govatka village (Valsad district).

16. *Synhamitermes quadriceps* (Wasmann)

1902. *Amitermes quadriceps* : Wasmann, *Zool. Jb. Abt. Syst.*, **17**(1) : 123, Pl.4. Soldier and worker and Ny. *Holotype* : Soldier, in Wasmann Coll. NHM, Maastricht. *Type-locality* : Khandala near Bombay, Maharashtra, India.

1949. *Synhamitermes quadriceps* : T. E. Snyder, *Smiths. misc. coll.*, **112** : 129.

1997. *Synhamitermes quadriceps* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. **II** : 100-104, *Zool. Surv. India*.

Caste known : Soldier and worker.

Material examined : One vial with 3 soldiers and a few workers from Bokhra near Saputara 21 km from Ahwa (Dangs district), N.S. Rathore coll., 30.xii.1980, Ex. Rotten wood of *Madhuca indica*.

Diagnostic characters : *Soldier* : Head pale yellow to brownish yellow; antennae slightly paler than head; mandibles reddish brown to dark brown. Head-capsule subsquarish, (head length with mandibles 1.37-1.40 mm and length to base of mandibles 0.84-1.0 mm, maximum width 0.69-0.85 mm). Y-suture absent. Antennae with 13 segments; segment 3 shortest. Labrum broadly tongue-shaped (triangular with a narrow tip). Mandibles stout, 0.45-0.67 mm long; outer margin incurved medially; each mandible with a triangular tooth on inner margin at about middle. Postmentum club-shaped, strongly incurved at waist (length 0.52-0.62, maximum width 0.23-0.29, width at waist 0.16-0.20 mm). Pronotum saddle-shaped; anterior margin without notch, posterior margin substraight or indistinctly incurved medially (length 0.24-0.35, maximum width 0.46-0.55 mm). *Worker* : Head-capsule pale yellow to pale brown; antennae, legs and thorax pale yellowish. Total body-length 3.0-4.20 mm. Head subsquarish; head-length to tip of labrum 0.90-1.03, length to base of mandibles 0.60-0.73 and maximum width 0.70-0.83 mm. Antennae with

13 segments; segment 3 shortest. Postclypeus swollen (length 0.15-0.20, width 0.35-0.38 mm). Labrum subsquarish, hairy. Pronotum saddle-shaped (length 0.22-0.35, width 0.40-0.50 mm); notch absent at anterior and posterior margins.

Distribution : India : Maharashtra, Goa, Daman, Rajasthan, Madhya Pradesh, Karnataka, West Bengal, Assam, Gujarat, Tripura and presently reported from as far south as Trichur in Kerala.

Elsewhere : Bangladesh and Sri Lanka

17. *Amitermes belli* (Desneux)

1906. *Termes belli* : J. Desneux, *Ann. Soc. Entomol. Belg.*, Brussels, 49(12) : 352-354. Imago, soldier and worker. Type locality; Pakistan; Karachi (Sindh).

1949. *Amitermes belli* : T. E. Snyder, *Smiths. misc. Coll.*, 112 : 114.

1997. *Amitermes belli* : O. B. Chhotani, *Fauna of India and adjacent Countries, Isoptera (Termites)*, Vol. II : 108-113. *Zool. Surv. India*.

Caste known : Imago, soldier, worker.

Material examined : Nine vial examined as follows : 2 Vials with soldiers and workers, Rajgad, Modasa, Himatnagar, N.S. Rathore coll., 1.ii.1992. Ex. wooden log. Gomad village, Himatnagar, 29.xi.1986. R. C. Sharma coll., Ex Tree Trunk. 1 vial from Dam area 4 km from Lakhtar, Surendranagar, N.S. Rathore coll., 13.ii.1991, Ex, tree trunk. 1 vial from Lakhtar, Surendranagar, R. Sewak coll., 1.ix.1991. 1 vial from Khambhat 58 km S. of Kheda, 22.ii.1991. Ex. palm tree trunk. 1 vial from Parej village 23 km from Kheda, 23.ii.1991, Ex. Tree trunk of *Salvadora*. 1 vial from Aither village 13 km from Unjha, Mahesana, N.S. Rathore coll., 25.i.1992, Ex. Mound. 1 vial from Chawna village 19 km from Dholka town, Ahmedabad, N.S. Rathore coll., 19.ii.1991, Ex. *Acacia* tree. 1 vial from Gola village 24 kms W. of Danta, Palanpur, N.S. Rathore coll., 20.ii.1992, Ex. Dry stump.

Diagnostic characters : *Soldier* : Head, thorax and legs pale yellow. Total body length 3.50-5.60

mm. Head oval, narrowed in front, thick; frons sloping in front at about 45° angle (head length with mandibles 1.82-2.31 mm and length to base of mandibles 1.07-1.44, maximum width 0.85-1.15 mm). Antennae with 14 segments, segment 3 a little shorter than 2, 4 shortest. Clypeus bilobed. Labrum broad, tongue-shaped. Mandibles thin, long and strongly incurved in distal half, more or less sickle-shaped and basally wide (length 0.58-0.98 mm); each with a backwardly directed, sharp tooth at about middle. Postmentum fairly arched; subrectangular, (length 0.70-0.90, maximum width 0.28-0.35, minimum width 0.23-0.30 mm). Pronotum saddle-shaped (length 0.28-0.40, width 0.56-0.78 mm); anterior margin faintly notched. *Worker* : Head-capsule pale yellow to pale brownish yellow; antennae, thorax and legs paler. Total body-length 4.0-5.0 mm. Head-capsule subcircular (length to tip of labrum 1.17-1.75 mm, length to base of mandibles 0.75-0.87, maximum width 0.91-1.07 mm). Antennae with 14 segments; segment 4 shortest, 3 shorter than 2. Postclypeus swollen roundly projecting behind into frons, anterior margin substraight, length half of width (length 0.23-0.25, width 0.45-0.50 mm). Pronotum saddle-shaped (length 0.25-0.35, width 0.60- 0.70 mm); anteriorly weakly notched. Apical tibial spurs 3 : 2 : 2, dorsal spur sometimes not visible.

Distribution : India : Rajasthan, Delhi, Madhya Pradesh, Gujarat (Anjar, Bhuj, Himatnagar, Surendranagar, Kheda, Mahesana, Ahmedabad and Palanpur districts).

Elsewhere : Pakistan (Sind, Punjab and Baluchistan).

18. *Eremotermes dehraduni* Roonwal and Sen-Sarma

1960. *Eremotermes dehraduni* : M. L. Roonwal and P. K. Sen-Sarma, *Contrib. Syst. Orient. Termites (ICAR Ent. Monogr. No. 1)* : 49-51, 53-63. Pls. 9,10, Imago, soldier and worker. Holotype : S. in FRI. Type-locality : Malhan Forest Range. 12 miles N-W of Dehradun. Uttar Pradesh, India.

1997. *Eremotermes dehraduni* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 123-126. *Zool. Surv. India*.

Material examined : One vial with 1 soldier

and many workers from Dantiwada Dam, hill area, Palanpur district, N.S. Rathore coll., 23.xi.1986, Ex. Under dung.

Diagnostic characters : Soldier : Head-capsule deep straw coloured, antennae paler; mandibles dark reddish brown; pronotum, legs and body creamish. Total body length 3.0-4.0 mm. Head-capsule subrectangularly oval, length to base of mandibles 0.85-0.90, maximum width 0.75-0.80, height 0.65-0.70 mm; index maximum width/length to base of mandibles 0.83-0.89. Antennae with 14 segments; segment 3 shorter than 2, subequal to or little longer than 4. Labrum tongue-shaped, narrowed in front (length 0.10-0.13, width 0.15-0.17 mm). Mandibles long, sabre-shaped, strongly incurved at apices and incurved medially at outer margin; length slightly less than head-length (length 0.80-0.85 mm index 0.89-0.98); each mandible with a sharp well-marked tooth, situated medially and pointing a little backwards. Postmentum subrectangular (length 0.45, maximum width 0.25, width at waist 0.15 mm). Pronotum saddle-shaped without any notch but sometimes feebly notched; posterior margin straight (length 0.20-0.25, width 0.40-0.50 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellow to pale straw coloured. Total body-length 3.0-3.5 mm. Head-capsule subsquarish (length to base of mandibles 0.60-0.65, maximum width 0.70-0.75 mm). Antennae with 14 segments; segment 3 and 4 subequal, but shorter than 2. Pronotum saddle-shaped (length 0.25 width 0.45 mm); anterior margin weakly notched medially. *Worker minor* : as in worker major but smaller in size. Total body-length 2.4-2.7 mm, length of head to base of mandibles 0.55-0.60, maximum width of head 0.65-0.70, length of pronotum 0.20-0.25, width of pronotum 0.40-0.45 mm.

Distribution : India : Gujarat : Dantiwara Dam area, Palanpur; Uttar Pradesh : Malhan Forest Range (Near Dehradun), Dehradun, Rajpur and Kalsi.

Remarks : This is the first record of the species from Gujarat.

19. *Eremotermes fletcheri* Holmgren and Holmgren

1917. *Eremotermes fletcheri* : K. Holmgren and N. Holmgren. *Mem. Dep. Agr. India (Ent.)*, 5(3) : 167-168. Imago, Soldier and worker. Lectotype : S, in FRI. Type-locality : Coimbatore, Tamil Nadu, India.

1997. *Eremotermes fletcheri* : O. B. Chhotani, *The Fauna of India and adjacent countries, Isoptera, (Termites)*, Vol. II : 126-129. *Zool. Surv. India*.

Caste known : Imago, soldier and worker.

Material examined : One vial with soldiers and workers from Thordai near Khavda (on coast of the Great Rann of Kachchh about 102 km from Bhuj), N.S. Rathore coll., 16.i.1981, Ex. Soil.

Diagnostic characters : Soldier : Head-capsule pale straw coloured; antennae and body creamish; mandibles brownish, straw coloured basally. Head and body hairy. Total body-length 3.5-4.6 mm. Head ovoid, thick; sides slightly convex (head length with mandibles 1.95-2.20 mm and length to base of mandibles 1.0-1.08, maximum width 0.78-0.85, height 0.60-0.65 mm). Antennae with 14 segments; segment 3 slightly shorter or subequal to 2, 4 subequal to or shorter than 3. Mandibles long, sabre-shaped, with apices slightly incurved; length subequal to head-length (length 1.0-1.08 mm, head index 1.0-1.07 mm); outer margin incurved below level of tooth; each mandible with a medially placed, sharp and prominent tooth (left mandibular tooth index, tooth distance/ mandible-length 0.52-0.57 mm). Postmentum swollen in side view (length 0.55, maximum width 0.25-0.30, minimum width at waist 0.15-0.20 mm). Pronotum saddle-shaped; anterior margin faintly and posterior margin without notch; length 0.28-0.35, width 0.50-0.58 mm. *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellow; antennae and body creamish. Head and body densely hairy. Total body-length 4.0 mm Head subsquarish (length to base of mandibles 0.75, width 0.85 mm). Fontanelle indistinct. Antennae 14 segmented. Postclypeus swollen, pilose. Pronotum saddle-shaped (length 0.25, width 0.55 mm). *Worker minor* : Very smaller to worker major.

Total body-length 3.0 mm, head-length to base of mandibles 0.65, width of head 0.75, pronotum-length 0.25 and width 0.50 mm.

Distribution : India : Tamil Nadu (Coimbatore) and Gujarat (Bhuj).

Elsewhere : Pakistan : Baluchistan : Duki; Dera Ghazi Khan; Fort Munro; Loralai, Barkhan, Kingri, Rukhney; Zhob : Fort Sandeman.

20. *Eremotermes neoparadoxalis* Ahmad

1955. *Eremotermes neoparadoxalis* : M. Ahmad, *Biologia*, Lahore, 1(2) : 252-253. Soldiers, workers. Type-locality : Pakistan : Shadadpur (Sind).

1997. *Eremotermes neoparadoxalis* : O.B. Chhotani, *Fauna of India and Adjacent Countries, Isoptera* (Termites) Voll. II : 131-134. *Zool. Surv. India*.

Caste known : Imago, Soldier and Worker.

Material examined : One vial with soldier and workers from Dantiwara, Palanpur, N.S. Rathore coll., 23.xi.1986, Ex. Dry twig. One vial with 1 soldier and workers from Gomadi village 10 km east of Himatnagar, N.S. Rathore coll., 29.xi.1986, Ex. Under heap of leaves.

Diagnostic characters : *Soldier* : Total body-length 3.5-4.0 mm. Head-capsule rectangularly oval, (head length with mandibles 1.55-1.75 mm and length to base of mandibles 0.70-0.85, maximum width 0.65-0.75, height 0.50-0.60 mm index height/width 0.71-0.85. mm). Frontal protuberance very weak; frons sharply sloping in front. Fontanelle prominent, situated at the beginning of frontal slope (occipito-Fontanelle distance 0.60-0.75 mm). Antennae 14 segmented (13 segmented vide Ahmad, 1955); Segment 3 a little shorter than 2 and subequal to or a little larger than 4; 5 longer and broader than 4 Labrum short, subsquarish, pointed distally (length 0.075-0.10, width 0.10-0.25 mm). mandibles long (0.80-1.00 mm), sabre-shaped, weakly incurved and pointed apically; outer margin strongly incurved basally behind middle; each mandible with a minute, rudimentary tooth a little behind middle (tooth-distance 0.35-0.45 mm), left mandibular tooth index i.e., tooth distance/mandible-length 0.41-0.47 mm). Postmentum

short, swollen (length 0.30-0.37, maximum width 0.20-0.25 and minimum width at waist 0.15 mm). Pronotum saddle-shaped; anterior margin with or without a median notch; posterior margin straight, without notch (length 0.25-0.27 mm, width 0.40-0.45 mm). *Worker* : Dimorphic. *Worker major* : Body elongated and narrow. Head-capsule straw coloured; antennae, labrum, pronotum and body yellowish. Head and body thickly hairy. Total body-length 3.5-4.0 mm. Head subsquarish (length to base of mandibles 0.60-0.65, maximum width 0.70-0.75 mm). Fontanelle indistinct Antennae 14 segmented; segment 2 equal to 3 and 4. Postclypeus swollen, length about half of width; anterior margin straight, posterior margin rounded. Pronotum saddle-shaped; anterior margin weakly or generally not notched; Posterior margin straight (length 0.25, width 0.40 mm). *Worker minor* : Similar to worker major except smaller in size.

Distribution : India : Rajasthan : Achhol Forest, Jaipur; Kodamdesar, Bikaner; Paota, Polo, Jodhpur; Pithla 28 km from Jaisalmer; Balewa 73 km from Barmer. Gujarat : Ahwa, Dang; Kaprada, Valsad; Dantiwara, Palanpur. Gomadi village, Himatnagar and Delhi.

Elsewhere : Pakistan, : Bara; Barkhan; Chatter Bagh; Peshawar, Shadadpur (Sind) and Thall.

Remarks : The present record of the species from Gomadi village, Himatnagar district and Dantiwara, Palanpur district is an extension of range within the Gujarat state from southern towards northern Gujarat.

21. *Eremotermes paradoxalis* Holmgren

1912. *Eremotermes paradoxalis* : N. Holmgren, *K. Svenska Vetensk. Akad. Handl.*, 48(4) : 95, Pl. 4, fig. 22 (S).

1997. *Eremotermes paradoxalis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites), Vol. II : 135-138. *Zool. Surv. India*.

Caste known : Imago, soldier and worker.

Material examined : One vial with 3 soldier and many workers from Dantiwara, Palanpur, N.S. Rathore coll., 2.xi.1986, Ex. under dung.

Diagnostic characters : *Soldier* : Head-capsule

yellow to straw-coloured. Total body-length 3.5-4.3 mm. Head-capsule rectangularly ovoid (head length with mandibles 1.65-1.68 mm and length to base of mandibles 0.80-0.95, maximum width 0.68-0.77 mm); rather thick (height 0.45-0.65 mm); frontal protuberance prominent. Antennae with 14 segments; segment 3 as long as or a little shorter than 2, 4 shorter than 3. Labrum tongue-shaped, narrowed in front (length 0.10-0.15, width 0.13-0.18 mm). Mandibles slender, long sabre-shaped; weakly incurved at tip. Length less than to as long as head (length 0.70-0.85 mm, index left mandible-length/ head length 0.78-0.98). Postmentum arched in side view; length 0.35- 0.45, maximum width 0.23-0.25, minimum width at waist 0.15-0.20 mm. Pronotum saddle-shaped (length 0.23-0.26, width 0.40-0.48 mm). *Worker* : Dimorphic. *Worker major* : Head - capsule yellowish. Total body-length 3.0-4.0 mm Head-capsule subsquarish (length to base of mandibles 0.70-0.75, maximum width 0.75- 0.80 mm). Antennae 13 to 14-segmented. Pronotum saddle-shaped; anterior margin faintly notched (length 0.25-0.35, width 0.45-0.50 mm). *Worker minor* : Generally as in worker major, but smaller in size. Total body-length 2.3-2.5, length of head to base of mandibles 0.55-0.60, maximum width of head 0.65-0.75, length of pronotum 0.25, width of pronotum 0.40 mm.

Distribution : India : Gujarat (Naswadi, Vadodara district and Dantiwara, Palanpur district), Punjab, Delhi, Bihar, Madhya Pradesh, Karnataka and Tamil Nadu, states.

Elsewhere : Pakistan : Punjab, NWFP and Sind.

22. *Eremotermes sanyuktae* Thakur

1989. *Eremotermes sanyuktae* : R. K. Thakur, *Indian Forest Rec. (N.S.) Ent.*, 15(1) : 28-30. Soldier and worker. Holotype : Soldier in ZSI, Kolkata. Type-locality : Indian : Gujarat : Magdall port area, Surat.

Caste known : Soldier and worker.

Material examined : One vial with one soldier and several workers from an agriculture field near magdall port 10 km from Surat, N.S. Rathore coll., 25.xii.1980, Ex. Dry stump and roots of Bajra plant.

Diagnostic characters : *Soldier* : Head-capsule deep straw coloured. Total body length with mandibles 3.00-3.05 mm. Head-capsule subrectangular, (head-length with mandibles 1.85-1.93 mm, length of head without mandibles 1.00-1.03 mm). Antennae 14 segmented, segment 1 longer and 3 shortest, distal segment club shaped. Labrum tongue shaped, length 0.13- 0.15 mm and width 0.18-0.20 mm, anterior margin pointed, with a few long and short hairs. Mandibles stout, gradually becoming thinner anteriorly, with strongly incurved apices. Outer margin concave just above the middle at the level of tooth; tooth prominent and straight. Pronotum saddle shaped; posterior margin sub-straight with a median notch. Legs hairy, tarsi 4-segmented; tibial spurs 3 : 2 : 2. *Worker* : Dimorphic. *Workers major* : Head-capsule pale yellow, body yellowish : white and hairy. Total body-length 3.50-3.64 mm. Antennae 14 segmented. Pronotum saddle-shaped; length nearly half the width, anterior margin concave, weakly notched. Legs short and slender, tibial spur 3 : 2 : 2; tarsi 4 segmented. *Worker minor* : Generally as in worker major except slightly smaller.

Distribution : Known only from type-locality, Magdall port area, Surat, Gujarat, India.

23. *Microcerotermes beesoni* Snyder

1933. *Microcerotermes beesoni* : T. E. Snyder, *Proc. U. S. natl. Mus* 82(16) : 12-14. Imago only. Lectotype : Imago in FRI. Type-locality : Chakrata Range, Haldwani, Uttar Pradesh, India.

1997. *Microcerotermes beesoni* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 155-159. *Zool. Surv. India*.

Caste known : Soldier and worker.

Material examined : One vial with several soldiers and workers from Thani village ca, 7 km N of Vadodara, Y. P. Sinha coll., 13.xi.1976, Ex. Bushes.

Diagnostic characters : *Soldier* : Head-capsule yellow, a littler darker anteriorly. Total body-length 4.3-5.5 mm. Head-capsule subrectangular (head length with mandibles 2.25-2.48 mm and length

to base of mandibles 1.28-1.67, maximum width 0.77-1.00 mm); width more than half of length (index width/length 0.58-0.60). Antennae 13 segmented (rarely 12); segment 3 smallest. Labrum subpentagonal; anterior margin sharply rounded; sides subparallel (length 0.17-0.20, width 0.20-0.27 mm). Mandible (length 0.75-0.92 mm), a little more than half to about two third as long as head; coarsely serrated, with a larger tooth-like serration a little behind middle; anteriorly weakly to appreciably incurved (mandibles-length/head-length index 0.58-0.66 mm). Postmentum club-shaped with waist lying posteriorly (length 0.72-0.90, maximum width 0.29-0.31, width at waist 0.16-0.17 mm). Pronotum saddle-shaped (length 0.22-0.33, width 0.47-0.63 mm). *Worker* : Head-capsule yellowish, rest of body pale yellow. Total body-length 3.8-4.5 mm. Head-capsule subsquarish (length to base of mandibles 0.70- 0.95, maximum width 0.80-0.90 mm). Fontanelle indistinct. Antennae 13 segmented; segment 3 smallest. Postclypeus swollen, hairy; length a little more than half of its width (length 0.19-0.22, width 0.32-0.41 mm). Pronotum saddle-shaped (length 0.17-0.25, width 0.39-0.57 mm).

Distribution : India ; Uttar Pradesh, Delhi, Haryana, Punjab, Madhya Pradesh, Orissa, West Bengal, Assam, Gujarat : Thani village near Rajvasna, Vadodara district.

Elsewhere : Bhutan, Pakistan and Bangladesh.

24. *Microcerotermes cameroni* Snyder

1934. *Microcerotermes cameroni* : T. E. Snyder, *Indian For. Rec*, **20** (11) : 21-22, Imago, and soldiers. Holotype; Imago in BM. Type-locality : North Vellore District, Tamil Nadu.

1967. *Microcerotermes cameroni* : S. N. Prasad et al., *Indian For. Bull.*, **246** : 5,7,27-31, Figs. 15-17

1997. *Microcerotermes cameroni* : O. B. Chhotani, *Fauna of India, Isoptera (Termites) Vol II* : 162-165. *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : One vial with 3 soldiers and 19 workers, Danta, Palanpur, N.S. Rathore coll., 19.ii.1992, Ex. From tree trunk.

One vial with soldier and worker, Gomadi village, 10 km E of Himatnagar, R. C. Sharma coll., 29.xi.1986; Ex. Under wooden log.

Diagnostic characters : *Soldier* : Head-capsule yellowish brown; mandibles brownish black; body fairly hairy. Total body-length 4.3-5.2 mm. Head-capsule subrectangular (head length with mandibles 2.38-2.55 mm and length to base of mandibles 1.40-1.67, maximum width 0.90-1.00 mm); width more than half to a little less than two third of length (index width/length 0.56-0.64 mm). Antennae with 13 segments; segment 3 smallest. Labrum with anterior margin bluntly rounded; sides parallel (length 0.20-0.25, width 0.25-0.27 mm). Mandibles less than two third of head-length (length 0.86-0.97 mm; index left mandibles-length/head-length 0.59-0.63; and markedly incurved in anterior half. Coarsely serrated with one larger tooth-like serration behind middle. Postmentum club-shaped (length 0.85-1.02, maximum width 0.29-0.35, width at waist 0.19-0.22 mm); waist lying posteriorly. Pronotum saddle-shaped (length 0.27- 0.35, width 0.63-0.68 mm). *Worker* : Head-capsule brownish yellow; body fairly hairy. Total body-length 3.6-4.8 mm Head?capsule subsquarish (length to base of mandibles 0.80- 0.87, maximum width 0.87 mm); sides subparallel. Fontanelle not visible. Antennae with 13 segments; segment 3 smallest. Pronotum saddle-shaped (length 0.17-0.25, width 0.45-0.57 mm).

Distribution : India : Tamil nadu, Kerala, Andhra Pradesh, West Bengal and Gujarat (Kachchh district), Kunta village (Valsad district), Danta (Palanpur district), Gomadi village (Himatnagar district).

25. *Microcerotermes dumasensis* Thakur

1989. *Microcerotermes dumasensis* : R. K. Thakur, *Indian Forest Records (N.S.) Ent.*, **15**(1) : 32-35. Soldier and worker. Holotype S., in ZSI, Kolkata. Type-locality : India : Gujarat, Dumas 17 km from Surat.

Caste known : Soldier and worker.

Material examined : One vial with many soldiers and workers, Dumas sea coast 17 km

from Surat, N.S. Rathore coll., 15.xii.1981, Ex. Carton nest in *Prosopis juliflora* plant.

Diagnostic characters : Soldier : Head-capsule pale brown; mandibles dark brown. Total body length 5.29-5.44 mm. Length of head with mandibles 1.81-2.94 mm and without mandibles 1.75-1.88 mm, maximum head-width 0.94-1.06. Antennae 13 segmented, segment 1 longest, 3 shortest, last 13 ovate. Mandibles well built; maximum length of right and left mandibles 1.0-1.06 mm. Pronotum saddle-shaped, length 0.38-0.44 mm, width 0.66-0.69 mm. Legs hairy, tibial spur 3:2:2; middle tibiae with 2 extra spines. Abdomen elongate and cerci 2 segmented. **Worker** : Head-capsule creamish yellow, densely hairy and subsquarish. Total body-length 4.48-4.59 mm. Head-length to lateral base of mandibles 0.98-1.05 mm, maximum width of head 0.77-0.84. Antennae 13 segmented hairy, segment 1 longest, 3 shortest, last 13 ovate. Mandibles with an apical and two marginal teeth with a basal projection. Pronotum saddle-shaped, anterior margin convex with a weak median notch. Legs hairy; tibial spur 3:2:2. Abdomen elongated, hairy, cerci 2 segmented.

Distribution : Known only from the type-locality. India : Gujarat, Dumas sea coast, Surat district.

26. *Microcerotermes heimi* Wasmann

1902. *Microcerotermes heimi* : E. Wasmann, *Zool. Jahrb. Abt. Syst.*, Jena, 17(1) : 120-121. Soldier. Type-locality : Vorderindian (Bombay, vide Holmgren, 1913 : 251).

1997. *Microcerotermes heimi* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)* Vol. II : 178-182. *Zool. Surv. India*.

Caste known : Imago, Soldier and Worker.

Material examined : Seven vials, 1989-92, from Kachchh (Bhuj), Palanpur (Banaskantha) and Mahesana district as follows :

Lot (A) Two vials with soldiers and workers, N.S. Rathore coll., Kachchh (Bhuj) district, one vial from Ratanpur village 4 km W of Rapar Taluka, Bhuj, 2.iii.1989, Ex. Dry twigs, two vials from Rav village 10 km N of Rapar taluka, Bhuj, 3.iii.1989, Ex. Dry twigs.

Lot (B) Three vials with soldiers and workers, N.S. Rathore coll., from Palanpur (Banaskantha) district, two vials from Verahi village 18 km W of Radhanpur, Palanpur district, 21.ii.1989, Ex. Dry tree stump, One vial from Dantiwara Dam area 31 km NW of Deesa, Palanpur district, 9.iii.1992, Ex. Dry bush.

Lot (C) Two vials with soldiers and workers, coll. R. Sewak from Mahesana district, One vial from Modera 26 km SW of Mahesana, 13.ix.1992, Ex. Under stone, one vial from Dharoi Dam area 56 km NE of Mahesana, 14.ix.1992, Ex. under dry dung.

Diagnostic characters : Soldier : Head-capsule, antennae and labrum yellowish; mandibles dark brown, a little paler basally, legs and body whitish. Total body-length 4.0-4.38 mm. Head-capsule subrectangular; sides slightly narrowed behind; frons gradually sloping in front; length nearly one and half of width (head length with mandibles 2.08-2.15 mm and length to base of mandibles 1.25-1.30, maximum width 0.86-0.91 mm). Antennae with 13 segments; segment 3 shortest. Labrum pentagonal, with a sharp tip; a pair of hairs near tip and 3 or 4 pairs of short and long hairs on body (length 0.20-0.25, width 0.25 mm). Mandibles thin and long, as long as three fourth of head-length and incurved in distal one third; inner margin finely serrated, length 0.90-0.95 mm; index left mandible-length/head-length to base of mandibles 0.73-0.74 mm). Postmentum short, club-shaped; weakly narrowed at waist (length 0.63, maximum width 0.33-0.38, width at waist 0.25 mm). Pronotum saddle-shaped; anterior margin weakly notched and posterior margin substriaght (length 0.30-0.35, width 0.53-0.60 mm).

Distribution : India : Assam, Karnataka, Maharashtra, Gujarat (Kheda, Khavda, Ratanpur, Rav, Bhuj, Kachchh; Varahi, Dantiwara, Palanpur; Modera, Dharoi, Mahesana.

Elsewhere : Sri Lanka.

27. *Microcerotermes palestinensis* Spaeth

1962. *Microcerotermes palestinensis* (Emerson) : R. N. Mathur and R. S. Thapa, *Indian For. Leaflet. Ent.*, 167 : 48, Nomen Nudum.

1977. *Microcerotermes palestinensis* : M. L. Roonwal and S. C. Verma, *Rec. zool. Surv. India*, **72** : 439-440.

1997. *Microcerotermes palestinensis* : O.B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)* Vol. **II** : 203-205, *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : Three vials 1979-1992, from Palanpur (Banaskantha), Kheda and Himatnagar (Sabarkantha) districts as follows :

Lot (A) One vial with soldiers and workers collected from Thara village 29 km E of Radhanpur, Palanpur district, N.S. Rathore coll., 22.ii.1989, Ex. Dry twigs.

Lot (B) One vial with soldiers and workers collected from Khambhat 58 km S of Kheda district, N.S. Rathore coll., 22.ii.1991, Ex. Trunk of mango tree.

Lot (C) One vial with soldiers and workers collected from Kheraj village 26 km NW of Khedbramha, Himatnagar district, N.S. Rathore coll., 6.iii.1992, Ex. Dry straw.

Diagnostic characters : *Soldier* : Head and pronotum yellow and moderately pilose. Total body-length 4.97-5.46 mm. Head-capsule subrectangular, sides slightly convex (head length with mandibles 2.24-2.31 mm and length to base of mandibles 1.26, width 0.87-1.00 mm). Fontanelle indistinct. Antennae with 13 segments; segment 3 shortest. Labrum subsquarish, anterior margin rounded. Mandibles long, thin and finely serrated; length a little less than head-length (length 0.93 -1.12 mm. Index 0.79-0.80 mm). Postmentum club-shaped (length 0.57 - 0.71, maximum width 0.31- 0.34, width at waist 0.23 -0.26 mm). Pronotum saddle-shaped (length 0.28 -0.39, width 0.57 - 0.70 mm). *Worker* : Head pale yellowish brown. Head and body moderately hairy. Total body-length 3.30 mm. Head subsquarish (length to base of mandibles 0.73, maximum width 0.73 mm). Antennae with 13 segments; segment 2 equal to 3 + 4, 3 shortest. Postclypeus weakly swollen, longer than half of width (length 0.25, width 0.40 mm). Pronotum weakly saddle-shaped (length 0.25, width 0.48 mm).

Distribution : India : Rajasthan, Gujarat : Kuchchh, Palanpur, Kheda and Himatnagar.

Elsewhere : Israel.

28. *Microcerotermes raja* Roonwal and Bose

1964. *Microcerotermes championi raja* : M. L. Roonwal and G. Bose, *Zoologica*, **40**(113) : 5, 25,26-28, P. 3. Soldier and worker. Holotype : S, in ZSI. Type-locality : Balsamand near Jodhpur, Rajasthan, India.

1973. *Microcerotermes raja* : M. L. Roonwal and S. C. Verma, *Ann. Arid Zone*, **12**(3&4) : 109-111.

1997. *Microcerotermes raja* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. **II** : 207-209. *Zool. Surv. India*.

Caste known : Imago, Soldier and Worker.

Material examined : One vial with few soldiers and many workers from Jhear village 1 km from Danta, Palanpur, R. C. Sharam coll., 25.xi.1986, Ex. Dry stump.

Diagnostic characters : *Soldier* : Head-capsule yellow; mandibles dark reddish brown, paler basally. Head sparsely and body moderately hairy. Total body-length 4.5-5.0 mm. Head-capsule subrectangular (length to base of mandibles 1.33, maximum width 0.83 mm); sides subparallel, slightly convex medially. Fontanelle indistinct. Antennae with 13 segments; segment 2 equal to 3+4, 3 shortest. Labrum tongue-shaped, pentagonal; a little wider than long (length 0.23, width 0.25 mm). Mandibles long, thin, sabre-shaped; length (0.83-0.85 mm) a little less than two third of head-length (index left mandible-length/ head-length 0.63); coarsely serrated. Postmentum vase-shaped, with a narrow waist in posterior third (length 0.80, maximum width 0.32, width at waist 0.18 mm). Pronotum saddle-shaped; anterior margin convex, with a prominent median notch; length 0.35, width 0.55 mm. *Worker* : Head-capsule pale yellow. Total body-length 3.25-4.70 mm. Head-capsule subsquarish (length to base of mandibles 0.65-0.88, maximum width 0.70-0.88 mm). Antennae with 12-13 segments; segment 2 equal to 3+4, 3 shortest. Postclypeus swollen, hairy; length about 1/2 of width. Pronotum saddle-shaped (length 0.20-0.28, width 0.40- 0.50 mm); anterior

margin convex, without median notch; posterior margin straight. Apical tibial spurs 3 : 2 : 2 or 2 : 2 : 2 (dorsal spur of fore tibia often weakly developed or sometimes absent).

Distribution : India; Rajasthan (Jodhpur, Nagaur, Jaisalmer, Udaipur), Gujarat (Palanpur).

Remarks : This is the first record of the species from Gujarat state.

29. *Microcerotermes sakesarensis* Ahmad

1955. *Microcerotermes sakesarensis* : M. Ahmad, *Biologia*, Lahore, 1 : 238, 247-248. Soldier only. Holotype : S. in PU. Type-locality : Sakesar (Dist : Sargodha), Punjab, Pakistan.

1997. *Microcerotermes sakesarensis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites), Vol. II : 211-212, *Zool. Surv. India*.

Caste known : Soldier and Worker.

Material examined : One vial with soldier and worker, Forest area 14 km NE of Danta, Palanpur, N.S. Rathore coll., 19.ii.1992, Ex. Under tree bark.

Diagnostic characters : *Soldier* : Head-brownish yellow; antennae paler than head; mandible dark reddish brown; rest of body yellow. Total body-length 4.3-5.3 mm. Head-capsule subrectangular, sides subparallel (length with mandibles 2.29-2.58, length to base of mandibles 1.48-1.74, maximum width 0.81-0.95 mm). Antennae with 13 segments, 2nd segment as long as 3rd and 4th combined, 3rd shortest. Labrum as long as wide, sides substraight posteriorly and narrowed in front to a broad tip. Mandibles short, strongly hooked coarsely serrated; much shorter than head (length 0.89 mm). Postmentum club-shaped (length 0.81-0.89, maximum width 0.29-0.31, width at waist 0.21 mm). Pronotum saddle-shaped; weakly to distinctly notched anteriorly and posteriorly (length 0.28-0.37, width 0.55-0.63 mm).

Distribution : India : Rajasthan, Madhya Pradesh, Gujarat (Danta, Palanpur).

Elsewhere : Pakistan : Punjab, NWFP.

30. *Microcerotermes tenuignathus* Holmgren

1913. *Microcerotermes tenuignathus* : N. Holmgren, *J. Bombay nat. Hist. Soc.*, Bombay, 22(1) : 116-117. Soldier and Worker (major and minor). Type-locality : India : Vadtal (Gujarat).

1997. *Microcerotermes tenuignathus* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites) Vol. II : 213-215, *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : Five vials 1989-1991 from Palanpur (Banaskantha), Kachchh (Bhuj) and Surendranagar districts as follows :

Lot (A) Two vials with soldiers and workers N.S. Rathore coll., Palanpur district Feb. 1989, from Verahi village 18 km W of Radhanpur, Palanpur district, 21.ii.1989, Ex. Dry twigs.

Lot (B) Two vials with soldiers and workers N.S. Rathore coll., Bhuj district March 1989 from Kandhoka dunger village 7 km E of Rapar Taluka, Bhuj, 4.iii.1989, Ex. Dry wooden log.

Lot (C) One vial with soldiers and workers from Dam area 4 km of Lakhtar, Surendranagar district, N.S. Rathore coll., 13.ii.1991, Ex. Wooden tree stump.

Diagnostic characters : *Soldier* : Head-capsule yellow; mandibles dark reddish brown, paler basally. Total body-length 4.0-5.0 mm. Head-capsule subrectangular, sides weakly convex (head length with mandibles 2.07-2.15 mm and length to base of mandibles 1.0-1.27, maximum width 0.75-0.90 mm; index width/length 0.68-0.75). Fontanelle indistinct. Antennae 13 segmented; segment 3 shortest. Labrum subpentagonal, anteriorly projecting out medially (length 0.17-0.22, width 0.15-0.27 mm). Mandibles long and strongly incurved apically (length 0.70-0.95 mm); about three fourth of head-length (index left mandible-length/head-length 0.70-0.79); finely serrated. Postmentum club-shaped, weakly incurved at waist and slightly longer than half of head-length (length 0.60-0.65, maximum width 0.30-0.32, width at waist 0.24-0.26 mm). Pronotum saddle-shaped; distinctly notched anteriorly and weakly emarginated posteriorly (length 0.23-0.32, width

0.51-0.60 mm). *Worker* : Head-yellow; body pale whitish yellow. Total body-length 4.4-4.8 mm. Head subsquarish (length to base of mandibles 0.85-0.90, maximum width 0.85-0.87 mm). Fontanelle indistinct. Antennae 13 segmented; segment 2 equal to 3+4. Postclypeus swollen, hairy; as long as or slightly longer than half its width. Pronotum saddle-shaped (length 0.17-0.25, width 0.50-0.59 mm); anterior margin weakly notched, posterior margin weakly invaginated medially.

Distribution : India ; Gujarat (Bhavnath, Junagarh), Vadtal (Kachhh-Bhuj), Maharashtra, Rajasthan and Delhi.

Elsewhere : Pakistan : Punjab, Sind, NWFP and Baluchistan.

Subfamily (v) TERMITINAE

31. *Angulitermes dehraensis*. (Gardner)

1945. *Mirotermes dehraensis* : J. C. M. Gardner, *J. Ent.*, **6**, 108-110. Im. S. and W in FRI, BM, ZSI. Type-locality : Dehradun, Uttar Pradesh, India.

1949. *Termes dehraensis* (Gardner) Snyder, *Smith. Misc. Colls.*, **112** : 179.

1955. *Angulitermes dehraensis* : (Gardner), Ahmad, *Biologia*, Lahore, **1** : 259-260.

1997. *Angulitermes dehraensis* : O. B. Chhotani, *Fauna of India and adjacent countries*, Isoptera (Termites), Vol. **II** : 237-241, Zool. Surv. India.

Caste known : Imago, Soldier and worker.

Material examined : One vial with 2 soldiers and few workers (mix with *Microtermes mycophagus* species) from Ambaji forested area 58 km E of Palanpur, R. C. Sharam coll., 24.xi.1986, Ex. Dry twig.

Diagnostic characters : *Soldier* : Head yellowish; antennae pale brown, mandibles reddish brown. Total body-length 3.90-4.60 mm. Head-capsule subrectangular, broader anteriorly (length with mandibles 2.54-2.75, length to base of mandibles 1.11-1.40, maximum width 0.89-1.06 mm); Frontal projection broad anteriorly, medially notched (length of frontal projection 0.10-0.13 mm). Antennae with 14 segments; segment 3 longer than 2, 4 shortest. Labrum deeply

notched at anterior margin (length 0.33, width 0.30 mm). Mandibles long rod-like, longer than head (length 1.32-1.45 mm, index 1.16-1.25). Postmentum club-shaped (length 0.30, maximum width 0.43-0.45, minimum width 0.25 mm). Pronotum strongly saddle-shaped (length 0.23, width 0.50 mm). *Worker* : Head-capsule pale yellow. Total body-length 4.50 mm Head-capsule subcircular (head length to tip of labrum 1.0-1.08 mm, head length to base of mandibles 0.65-0.73, maximum width of head 0.83 mm). Fontanelle plate circular, indistinct. Antennae with 14 segments; segment 4 shortest. Postclypeus strongly swollen, fairly hairy; length about 0.20 mm width 0.45 mm. Pronotum strongly saddle-shaped (length 0.20 mm, maximum width 0.45-0.50 mm).

Distribution : India; Uttar Pradesh, Gujarat.

Elsewhere : Pakistan, Afghanistan.

Remarks : First record of genus from Gujarat (Palanpur district)

32. *Dicuspiditermes incola* (Wasmann)

(Synonyms : *Capritermes longicornis* Wasmann and *Dicuspiditermes pername* Thakur and Chatterjee.

1983. *Eutermes incola* : Wasmann, *Wien Ent. Zeit.*, **12**(7) : 242. Holotype; Im. in NHM, Maastricht. Type-locality : Colombo, Sri Lanka.

1997. *Dicuspiditermes incola* : O. B. Chhotani, *Fauna of India and adjacent countries*, Isoptera (Termites), Vol. **II** : 298-303, Zool. Surv. India.

Caste known : Imago. Soldier and worker.

Material examined : One vial with 5 soldiers and several workers from Saputara hills, Ahwa district, (Dangs division), Gujarat, Coll. Ram Sewak, 9.viii.1989, Ex. Under stone.

Diagnostic characters : *Soldier* : Head-capsule yellowish to yellowish brown; left mandible blackish, right reddish brown. Total body-length 5.10-8.5 mm. Head-length with mandibles 3.9-4.4 and to base of mandibles 2.00-2.45 mm. Maximum head-width 1.33-1.50 mm, head index width/length 0.58-0.65 mm; median suture extending

upto half of head-length from posterior margin. Fontanelle transverse, situated anteriorly at about four-fifth of head-length from posterior margin on the frontal inclination. Antennae with 14 segments, segments 2,3 and 4 subequal, 3 sometimes longer than 2 or 4. Labrum asymmetrical, length 0.40-0.60, width 0.30- 0.40 mm. Mandibles asymmetrical, only a little shorter than head (length of left mandibles 1.80-2.20 mm, right mandible 1.75-2.15 mm, index left mandible-length/ head-length to base of mandibles 0.84-0.93 mm. Left mandible twisted at middle and with a prominent beak at tip. Right mandible blade-like, weakly incurved on inner and outer margins; apical part strongly incurved and with a long pointed apex. Postmentum club-like; waist long and narrow, lying below middle length 0.99-1.2 mm, maximum width 0.33-0.54, minimum width at waist 0.18-0.22 mm. Pronotum saddle-shaped and weakly notched at anterior margin, length 0.25-0.39, width 0.75-0.88 mm. *Worker* : Head, antennae and postclypeus creamish to yellowish. Total body-length 3.60-5.50 mm. Head-capsule subcircular (length to tip of labrum 1.33-1.40 to base of mandibles 0.85-0.93 and width 1.05 -1.13 mm); slightly depressed in region of fontanelle. Fontanelle plate oval to round. 0.10-0.17 mm in diameter. Antennae with 14 segments; segment 3 slightly shorter than 2 and 4 slightly shorter than 3. postclypeus swollen, hairy, length about half or a little more than half of width (length 0.26-0.28, width 0.50-0.55 mm). Pronotum strongly saddle shaped (length 0.25-0.30, width 0.50-0.60 mm).

Distribution : India : Maharashtra : Khandala near Bombay, Karnataka : Bababudin Hills and Mercara. Tamil Nadu : Kethi (Nilgiri Hills), Kodai Kanal, Perumalai, Madurai. Kerala : Nilambur. Madhya Pradesh; Achanaknar Forest (Kota range), Bilaspur, Jaisingnagar range, Sahdol; and West Bengal.

Elsewhere : Sri Lanka : Anuradhpura, Bandarawella and Colombo (type-locality).

Remarks : This is a new record of genus and species from Saputara Hills (Ahwa district, Dangs Division), Gujarat.

Sub family (VII) MACROTERMITINAE
Kemner

33. *Odontotermes anamallensis*
Holmgren and Holmgren

1917. *Odontotermes anamallensis* : Holmgren and Holmgren. *Mem. Dept. Agric. India (Ent.)*, 5(3) : 157-158. Soldier and worker. Syntypes : In Riksmus and AMNH (IS,IW).

1997. *Odontotermes anamallensis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 447-449. Zool. Surv. India.

Caste known : Soldiers and worker.

Material examined : One vial with 20 exs. of soldiers and workers from Karjan 32 kms S. of Vadodara, coll. R. Sewak, 21.iii.1988, Ex. Under stone.

Diagnostic characters : *Soldier* : Head-capsule, labrum pale yellow to brown; mandible dark brown to blackish, paler basally; body creamish to yellow. Total body-length 4.9-7.4 mm. Head-capsule subrectangular, sides weakly convex and somewhat converging in front (head length with mandibles 2.80-3.55 mm and length to base of mandibles 1.75-2.30 mm, maximum width 1.35-1.85); width at base of mandibles 0.95-1.18 mm; base nearly 2/3 to 3/4 of maximum width (index, maximum width/length 0.68-0.80 and index, width at mandible-base/ maximum width 0.63-0.74 mm). Antennae with 16-17 (generally 17) segments; in 16- segmented antennae segment 2 longer than 3, 4 shortest; in 17-segmented ones segment 2 twice as long as 3, the latter shortest. Mandibles sabre-shaped, strong and stout; length (1.10- 1.30 mm), a little more than half of head-length (index, left mandible-length/ head-length 0.54- 0.63). Left mandible with a prominent tooth at about middle (distance of tooth from tip of mandible 0.50-0.65 mm, index, tooth-distance from tip/mandible-length 0.41-0.50). Right mandibles with a minute corresponding tooth at middle. Postmentum subrectangular, widest in anterior third (length 1.15-1.60, maximum width 0.45-0.70 mm). Pronotum saddle-shaped (length 0.60-0.83, width 0.95-1.40 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellow to brownish yellow.

Total body-length 4.0-5.5 mm. Head-capsule subcircular broader than long (length to base of mandibles 1.2-1.65, maximum width 1.35-1.78 mm). Fontanelle plate a small, whitish, translucent, round spot at middle of head. Antennae with 17-19 segments; in 17 segmented antennae, segment 4 shortest and in 19 segmented one 3 either shortest or subequal to 4 or 5. Postclypeus, length less than half of width. Pronotum saddle-shaped (length 0.40-0.58 mm, width 0.75-1.03 mm). *Worker minor* : Resembles worker major but is smaller and has 15 to 16 segmented antennae. Total body-length 3.0-4.0; length of head to base of mandibles 0.80-0.88, maximum width of head 0.93-1.00, length of pronotum 0.30-0.35 and width 0.60-0.68 mm.

Distribution : India ; Karnataka, Tamil nadu, Kerala, Gujarat (Karjan c 32 km S of Vadodara).

Remarks : This is the first record from Gujarat state.

34. *Odontotermes assumuthi* Holmgren

1913. *Odontotermes assumuthi* : N. Holmgren, *J. Bombay nat. Hist. Soc.*, 22(1) : 112-113. Soldier and worker. Lectotype (selected A. E. Emerson) : S, in Riksmus., Stockholm. Type-locality : Borivilli Jungles, Bombay, India

1997. *Odontotermes assumuthi* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 449-453. Zool. Surv. India.

Caste known : Imago, Soldier and worker.

Material examined : One vial with soldier and workers from Thordai near Khavda about 102 km from Bhuj, N.S. Rathore coll., 16.1.1981, Ex., Cow-dung covered with soil. One vial with soldiers and workers from Saputara hills, Ahwa (Dangs Division), R. K. Singh coll., 14.i.1989, Ex. Under Log.

Diagnostic characters : *Soldier* : Head-capsule, antennae and labrum pale yellow to pale brown; antennae uniformly coloured; mandibles brown to blackish brown. Total body-length 4.5-6.5 mm. Head-capsule subrectangular, sides slightly convex (head length with mandibles 2.43-2.70 mm and length to base of mandibles 1.44-1.75, maximum width 1.07-1.35 mm; width at base of mandibles

0.78-0.98 mm). Antennae with 16 segments (rarely 17); segment 4 shortest. Labrum tongue-shaped (length 0.35, width 0.30 mm); anteriorly narrowly rounded at tip. Mandibles stout and short; apically weakly incurved (length 0.77-0.95 mm); very slightly longer than half of head-length (index mandibles-length/head-length 0.51-0.57 mm). Left mandible with prominent, anteriorly directed tooth a little behind apical third; tooth distance 0.28-0.35 mm, index, tooth-distance/mandible-length 0.33-0.37. Right mandible with a weak denticle a little below level of tooth in left mandible. Postmentum subrectangular (length 0.94-1.25, maximum width 0.45-0.60 mm). Pronotum saddle-shaped (length 0.48-0.58, width 0.75-0.95 mm). *Worker* : Dimorphic. *Worker Major* : Head-capsule pale yellow to pale brownish yellow; antennae paler; total body-length 3.5-4.0 mm. Head subsquarishly rounded (length to base of mandibles 1.05-1.20, maximum width 1.25-1.33 mm). Antennae 17 segmented; segment 3 shortest; 4 longer than 5. Postclypeus swollen hairy; length less than half of width. Pronotum saddle-shaped (length 0.25-0.35, width 0.52-0.58 mm). *Worker minor* : Resembles worker major except for its smaller size. Antennae 16-segmented (with 4th segment shortest). Total body-length 2.8-3.3, length of head to base of mandibles 0.80-0.90, maximum width of head 0.85-0.95, pronotum-length 0.25-0.35 and pronotum-width 0.52-0.58 mm.

Distribution : India : very widely distributed species, occurring in Assam, Bihar, Gujarat, Jammu and Kashmir, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Tamil nadu, Orissa, West Bengal and Uttar Pradesh.

Elsewhere : Pakistan, Hongu (Kohat district), Bangladesh, Drier area of Dinajpur and Rajshahi.

Remarks : From Gujarat this species was known from Saurashtra (Şasan Gir) and Kutch Bhuj (Thordoi near Khavda). Now it is also known from extreme south Gujarat (Ahwa, Dangs division).

35. *Odontotermes bellahunisensis* Holmgren and Holmgren

1917. *Odontotermes bellahunisensis*: K. Holmgren and N.

Holmgren, *Mem. Dept. Agric. Sci.*, 5(3) : 150-151.
Soldier and worker. Lectotype: S, in ZSI. Type-locality
: Bellahunisi (Bellary district), Karnataka, India.

1997. *Odontotermes bellahunisensis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 453-457, Zool. Surv. India.

Caste known : Imago, Soldier and worker.

Material examined : One vial with 5 soldiers and 20 workers from Harij, Mahesana district, 17.iii.1986, coll. Ram Sewak, Ex. from grass., one vial with many soldiers and workers from Vijapur, Mahesana district, 15.iii.1986, coll. Ram Sewak, Ex. under dung. Four vials with many soldiers and workers from Jhear and Limbhoi village, Dantiwada, Navalpur, Himatnagar, coll. R. C. Sharma, 23-28.xi.1986. One vial with many soldiers and workers from Waghai, Ahwa, Dangs district, coll. Ram Sewak, 14.iii.1988, Ex. under stone.

Diagnostic characters : *Soldier* : Head-capsule yellowish brown to dark castaneous brown; antennae yellowish brown, darker distally. Total body-length 3.60-5.60 mm. Head broadly oval, broadest posteriorly and narrowed in front (head length with mandibles 1.70-1.88 mm and length to base of mandibles 1.05-1.35, maximum width 0.95-1.15, width at base of mandibles 0.63-0.70 mm, index, maximum width/length 0.81-0.93, index width at base of mandibles / maximum width 0.61-0.70). Antennae with 16-17 segments; segment 4 shortest in 16 segmented and 3 in 17 segmented antennae. Labrum tongue-shaped, apically converging into somewhat pointed tip (length 0.30-0.35, width 0.28 mm). Mandibles short, stout, sickle-shaped and strongly incurved distally (length 0.60-0.73 mm); shorter in comparison to head (index, mandible length-head-length 0.54-0.58). Left mandible with a large pointed tooth at distal third from tip 0.18-0.25 mm, (index tooth distance/mandible-length 0.27-0.33). Right mandible with a minute tooth a little above middle. Postmentum subrectangular, with weakly convex sides; length a little more than width (length 0.60-0.75, maximum width 0.45-0.55 mm). Pronotum saddle-shaped (length 0.40-0.55, width 0.70-0.90

mm). *Worker* : Dimorphic: *Worker major* : Head-capsule pale yellow to yellowish brown. Total body-length 3.5-4.50 mm. Head-capsule subsquarish, (length to base of mandibles 1.0-1.10, maximum width 1.05-1.15 mm). Antennae 17 segmented; segment 3 shortest. Postclypeus swollen, hairy; length almost half of width. Pronotum saddle-shaped (length 0.40, width 0.63 mm). *Worker minor* : Resembles worker major except for smaller size and 16 to 17 segmented antennae. Total body-length 3.0-3.60, length of head to base of mandibles 0.70-0.80, maximum width of head 0.78-0.90, length of pronotum 0.30-0.40 and width of pronotum 0.50-0.60 mm.

Distribution : India : Assam, Andhra Pradesh, Maharashtra, Bihar, Karnataka, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, Gujarat (districts Palanpur, Himmatnagar, Mahesana, Gandhinagar, Jamnagar, Kachchh, Kheda, Rajkot, Bharuch, Vadodara, Valsad and Dangs).

Remarks : This species is very widely distributed in Gujarat state.

36. *Odontotermes bhagwatii* Chatterjee and Thakur

1967. *Odontotermes bhagwatii* : P. N. Chatterjee and M. L. Thakur, *Indian For. Rec. (N.S.), Ent.*, 11(1) : 6, 33-35. Pls. 3 and 4. Soldier and worker. Holotype : S, in FRI. Type-locality : Pathankot, Punjab, India

1997. *Odontotermes bhagwatii* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 457-460. Zool. Surv. India.

Caste known : Imago, Soldier and Worker.

Material examined : One vial with 6 Soldiers and many workers from Navalpur 21 km E of Himatnagar, coll. R. C. Sharma, 30.xi.1986, Ex. under log.

One vial with 4 soldiers and 11 workers from Kim 34 km N of Surat, coll. Ram Sewak, 4.iii.1988, ex. under stone.

Diagnostic characters : *Soldier* : Head-capsule pale yellow to yellowish brown; antennae uniformly coloured. Total body-length 4.25-7.70 mm Head-capsule subrectangular, wider posteriorly (head length with mandibles 2.00-2.75

mm and length to base of mandibles 1.25-1.88, maximum width 1.10-1.38 mm). Antennae 15-17 segmented; segment 2 equal to 3+4 combined, 4 shortest. Labrum tongue-shaped, anteriorly narrowed to a pointed tip. Mandibles sabre-shaped, a little longer than half of head-length (length 0.80-1.02 mm, index, left mandible-length/head-length 0.55-0.66); left mandible with a small tooth, situated a little above basal one third, distance of tooth from tip of mandible 0.43-0.59 mm (tooth index, tooth-distance from tip/mandible-length 0.51-0.62 mm); right mandible without any tooth. Postmentum subrectangular (length 0.80-1.30 width 0.50-0.62 mm); sides behind widest point (distal 1/4) substraight. Pronotum saddle-shaped (length 0.45-0.62, width 0.83-1.20 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule yellow to yellowish brown. Total body-length 3.9-5.0 mm. Head-capsule subcircular (length to base of mandibles 1.15-1.35, maximum width 1.20-1.48 mm). Antennae with 17 segments; segment 2 equal to 3 and 4 combined together; 3 slightly shorter than 4. postclypeus swollen, hairy; length less than 1/2 of its width. Pronotum strongly saddle-shaped. *Worker minor* : Resembles worker major except for its smaller size and 15 to 16 segmented antennae. Total body-length 2.9-3.6, length of head to base of mandibles 0.70-0.85, maximum width of head 0.80-0.95, length of pronotum 0.30-0.35, width of pronotum 0.50-0.55 mm.

Distribution : India : Jammu & Kashmir, Punjab, Uttar Pradesh, Madhya Pradesh, Karnataka, Delhi and Gujarat (Himatnagar and Surat districts).

Remarks : This is the first record of this species from Gujarat.

37. *Odontotermes brunneus* (Hagen)

1958. *Termes brunneus* : H. A. Hagen, *Linn. Ent.*, 12 : 133-135. Imago. S(?). Holotype : Im, in Museum Berlin. Type-locality : Bengal, India.

1997. *Odontotermes brunneus* : O.B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 462-465. *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : One vial with few soldiers

and workers, Tankara 44 km N of Rajkot, Ram Sewak coll., 8.ix.1990, Ex. under stone.

One vial with 2 soldiers and 2 workers, Kaizam, Vadodara, Ram Sewak coll., 24.iii.1988, Ex. under stone.

Diagnostic characters : *Soldier* : Head-capsule pale brown to reddish brown. Total body-length 5.0-7.0 mm. Head-capsule subrectangular, oval, (head length with mandibles 2.43-2.90 mm and length to base of mandibles 1.5-2.0 mm, maximum width 1.28-1.50 mm, index width/length 0.75-0.87). Antennae 17 segmented; 3 shortest, 4 shorter than 2, 5 shorter than 4. Labrum tongue-shaped with rounded anterior margin. Mandibles thick, stout and short; strongly incurved anteriorly (length 0.90-1.10 mm) shorter than head (index, mandible-length/head-length 0.56-0.62 mm). Left mandibles with a large prominent tooth below distal third (tooth-distance 0.33-0.45, index tooth-distance/mandible-length 0.34-0.42 mm). Right mandible with a small tooth situated almost at middle. Postmentum subrectangular (length 0.95-1.20, maximum width 0.50-0.60 mm). Pronotum saddle-shaped; max width 0.90-1.10 mm and length of pronotum 0.55-0.70 mm. *Worker* : Dimorphic. *Worker major* : Head-capsule pale brownish yellow. Total body-length 4.8-5.6 mm. Head-capsule subsquarish (length to base of mandibles 1.25-1.45, maximum width 1.45-1.60 mm). Antennae with 17-19 segments; 3 or 4 shortest. Postclypeus swollen, length a little less than half of width. Pronotum as in soldier (length 0.45-0.53, width 0.80-0.88 mm). *Worker minor* : Similar to worker major but smaller in size with 16 to 17 segmented antennae. Total body-length 3.6-4.5, length of head to base of mandibles 0.75-0.88, maximum width of head 0.93-1.00, length of pronotum 0.40-0.45, width of pronotum 0.65-0.70 mm.

Distribution : India : Widely distributed in southern states; also Gujarat, Maharashtra, Orissa and Uttar Pradesh.

38. *Odontotermes distans* Holmgren and Holmgren

1917. *Odontotermes (Cyclotermes) distans* : K. Holmgren and N. Holmgren, *Mem. Dept. Agric. Sci.*, 5(3) : 153

Imago only. Lectotype : Im, In IARI. Type-locality : Kedar Rocks, Shevaroy Hills, Tamil Nadu, India.

1975. *Odontotermes distans* : M.L. Roonwal. *Zool. Jb. Syst.*, **103** : 490, 491, *Is parvidens*.

1997. *Odontotermes distans* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites), Vol. **II** : 468-470. *Zool. Surv. India*.

Caste known : Imago, soldier and worker.

Material examined : One vial with few soldier and workers, from Danta forest 3 km from Danta, Palanpur, N.S. Rathore coll., 22.i.1978, Ex. Under stone.

Two vials with soldiers and workers (i) from Kaprada village, Valsad, N.S. Rathore coll., 28.xii.1980, Ex. Bark of mango tree (ii) from forest area of Bordevi, Bhavnath near Girnar hills, Jamnagar, N.S. Rathore coll., 7.i.1981, Ex. Trunk of dead tree.

Diagnostic characters : Soldier : Head-capsule subrectangular, pale yellow to deep reddish brown. Total body length 5.50-8.25 mm. Head-length with mandibles 3.0-3.95 mm. Maximum head-width 1.50-2.10 mm. Antennae 17 segmented, 1 segment longest, 3 smallest, last oval. Labrum tongue shaped. Mandibles strongly built, sabre-shaped, left and right mandible length 1.20-1.40, left mandible with a small tooth, lying on the upper edge of basal third, distance of tooth from tip of mandible 0.70-0.90 mm, and mandible tooth-index 0.58-0.65 mm. Postmentum subrectangular, median length of postmentum 1.35-1.70 and maximum width of postmentum 0.65-0.90. Pronotum saddle-shaped, much narrower than head-width, length 0.65-0.90 and maximum width 1.15-1.60 mm. Abdomen elongated. Cerci 1.10-1.13 mm long and styli 0.08-0.10 mm long. *Worker* : Worker monomorphic : Head-capsule subsquarish yellowish brown. Total body-length 4.75-5.80 mm Head-length to tip of labrum 2.10-2.30 mm; head-width 1.60-1.80 mm Antennae 17-19 segmented. Labrum subsquarish. Pronotum saddle-shaped broader than long (length 0.50-0.60 and width 0.85-1.05 mm; anterior margin notched medially. Abdomen oblong, cerci 0.10 mm long.

Distribution : This species has been recorded

as very widely distributed throughout India upto an elevation of 2100 m in the Himalaya. From Gujarat it is recorded from districts Jamnagar, Bhavnagar, Banaskantha, Valsad, and Bharuch.

Elsewhere : Many parts of Pakistan, Bhutan (Phunsholing and Thimphu).

39. *Odontotermes feae* (Wasmann)

1896. *Termes feae* : Wasmann, *Ann. Mus. Stor. Nat. Genova*, (2) **16**(36) : 625-626. Soldier and worker. Holotype : S, in Natural History Museum. Maastricht. Type-locality : Carin Cheba, Burma.

1912. *Odontotermes feae* : Holmgren, *J. Bombay nat. Hist. Soc.* **21** (3) : 786-787.

1997. *Odontotermes feae* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites), Vol. **II** : 471-475. *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : One vial with 4 soldiers and 6 workers from Surat road 6 km N of Valsad, Ram Sewak coll., 8.iii.1988, Ex. under stone.

One vial with few soldiers and many workers from Jagbol 40 km E of Valsad, Ram Sewak coll., 15.viii.1989, Ex. under wooden log.

Diagnostic characters : Soldier : Head-capsule yellow to reddish brown. Total body-length 6.5-9.0 mm. Head-capsule subrectangular, longer than wide (head length with mandibles 3.65-4.75 mm and length to base of mandibles 2.25-3.10, maximum width 1.80-2.50 mm); widest in posterior region, width more than 3/4 of length. Antennae with 17 segments; segment 3 shortest. Labrum tongue-shaped, narrowed in front with a pointed tip. Mandibles stout, strong, sabre-shaped; a little longer than head-length (length 1.20-1.65 mm, mandible/head index 0.51-0.59). Left mandible with a medium sized tooth near middle. tooth distance from tip of mandible 0.67-0.90 mm (tooth-index 0.50-0.55, angle of tooth variable from either right angle to little less). Right mandible with a minute tooth at basal third. Postmentum subrectangular, somewhat swollen near basal third (length 1.30-2.0, maximum width 0.73-0.98 mm). Pronotum saddle-shaped (length

0.75-1.00, width 1.40-1.83 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellow to rusty yellow. Total body-length 5.0-6.5 mm. Head-capsule subsquarish; a little wider than long; sides subparallel, widest at base of antennae (length to tip of labrum 2.05-2.50, length to base of mandibles 1.50-1.85, maximum width 1.68-2.10 mm). Fontanelle plate small rounded. Antennae with 19 segments, 3 and 4 subequal, 5 shortest. Labrum dome-shaped. Pronotum as in soldier (length 0.48-0.65, width 0.85-1.20 mm). *Worker minor* : as in worker major but smaller in size (total body length 3.5-4.70, head-length to tip of labrum 1.70-2.0, head-length to base of mandibles 1.10-1.48, maximum width of head 1.15-1.50, pronotum-length 0.35-0.53, pronotum width 0.58-0.90 mm).

Distribution : India : recorded from almost all over the country.

Elsewhere : Nepal, Bhutan, Bangladesh, Sri Lanka, Burma, Thailand and Vietnam.

Remarks : This is the first record from Gujarat state

40. *Odontotermes giriensis* Roonwal and Chhotani

1962. *Odontotermes giriensis* : M. L. Roonwal and O. B. Chhotani, *Proc. natnl. inst. Sci. India.*, (B) 28(4) : 289, 296, 341-345. Pls. 28,29. Soldier and Worker. Holotype : S, in ZSI. Type-locality; Rongrengiri Garo Hills, Meghalaya, India.

1997. *Odontotermes giriensis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 478-482. *Zool. Surv. India*.

Caste known : Soldier and worker.

Material examined : One vial with 30 soldiers and 54 workers from Gomadi village 10 km E of Himatnagar, R. C. Sharma coll., 29.xi.1986, Ex. from ground.

Diagnostic characters : *Soldier* : Head-capsule yellow to dark brownish. Total body-length 3.75-5.5 mm. Head-capsule oval, longer than broad; sides convex, narrowed anteriorly (head length with mandibles 1.75-2.00 mm and head-length to base of mandibles 1.13-1.30,

maximum width of head 1.00-1.20, width of head at base of mandible 0.85-1.03 mm, index width at mandible base/maximum width 0.56-0.61). Antennae with 15-16 segments; segment 3 equal to 2; 4 large, subdivided in 15-segmented one and shortest in 16-segmented antennae. Labrum tongue-shaped, narrowed in front into a pointed tip. Mandibles long, sabre-shaped, weakly incurved at tip; shorter than head-capsule (length 0.63-0.76 mm, index mandible-length/ head-length 0.50-0.63). Left mandible with a sharp tooth at about distal fourth (tooth distance from tip 0.15-0.20 mm, index, tooth-distance/ mandible-length 0.21- 0.27 mm) Right mandibles with a minute tooth at about same level as the tooth in left mandible. Postmentum subrectangular (length 0.70-0.85, width 0.50-0.60 mm); sides abruptly converging in distal fourth (width at anterior margin 0.30-0.35 mm). Pronotum saddle-shaped (length 0.45-0.60, width 0.73-0.93 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellow to yellow. Total body length 4.0-5.0 mm. Head-capsule subcircular (length to base of mandibles 1.18-1.35, width 1.30-1.50 mm). Antennae with 17-18 segments; segment 3 shorter than 2; in 17 segmented antennae 4 subequal to 3 and 5 shortest, in 18-segmented ones 4 shortest. Pronotum saddle-shaped; length 0.35-0.50, width 0.65-0.75 mm. *Worker minor* : Similar to worker major smaller and has 16 segmented antennae with segment 4 shortest. Total body-length 3.10-3.40, length of head to base of mandibles 0.70-0.80, maximum width of head 0.83-0.95, pronotum-length 0.35-0.45 and minimum width of pronotum 0.58-0.65 mm.

Distribution : India : Assam, Meghalaya, Arunachal Pradesh, Tripura, Manipur, Orissa, Delhi, Rajasthan, Gujarat (Ahwa, Dist. Dangs; Kaprada, Dist. Valsad; Gomadi, Dist. Himatnagar), Uttar Pradesh.

Elsewhere : Bangladesh.

41. *Odontotermes girnarensis* Thakur

1989. *Odontotermes girnarensis* : R. K. Thakur, *Indian For. Rec. (N.S.), Ent.*, 15(1) : 46-49. Soldier and worker. Type-locality : India : Gujarat, Bordevi, Gimar hills, Junagarh.

Caste known : Soldier and worker.

Material examined : 18 vials 1964-81 from Amreli, Gandhinagar, Jamnagar, Kachchh, Mahesana, Panchmahal, Vadodara and Valsad district. Except Mahesana district collection collected by V.C. Agrawal, all other material was collected by N.S. Rathore during the year 1980-81.

Diagnostic characters : *Soldier* : Head-capsule pale yellow to dark brown, subrectangular. Mandibles light brown, paler basally. Total body-length with mandibles 5.45-5.58 mm, head-length with mandible 2.55-2.75 mm (without mandibles 1.50-1.66 mm), maximum width of head 1.28-1.40 mm. Antennae 16 segmented, 1st longest, 4th shortest, and apical ovate. Labrum tongue-shaped, longer than broad (length 0.34-0.38 mm, width 0.31-0.34 mm). Mandibles long, stout, sickle-shaped, length of right and left mandibles 1.0-1.13 mm. Left mandible with a prominent anteriorly directed tooth lying near the distal end of middle one third portion (distance of tooth from tip of mandible 0.34-0.39 mm). Postmentum flat, length 0.91-1.10 mm and maximum width 0.50-0.63 mm. Pronotum saddle-shaped, maximum width 0.95-1.20 mm, and maximum length 0.63-0.67 mm. Cerci 0.11 mm. Styli single jointed 0.07 mm long. *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellow to yellowish brown. Total body-length 4.25-4.45 mm; head subsquarish, broader than long, width 1.44-1.47 mm, length 1.26-1.33 mm. Antennae with 16-17 segments, segment 1st longest, 4th shortest. Left mandible with one apical and three marginal teeth. Pronotum saddle-shaped, width 0.84-0.88 mm, and length 0.46-0.49 mm; anterior margin with deep median notch. Apical tibial spur formula 3 : 2 : 2; tarsi 4 segmented. Cerci, 2-jointed 0.11 mm long and styli 0.70 mm. *Worker minor* : Similar to worker major only that it is smaller in size.

Distribution : India : Gujarat : Amreli, Gandhinagar, Jamnagar, Kachchh, Mahesana, Panchmahal, Vadodara, Valsad and Junagarh

districts.

42. *Odontotermes gurdaspurensis* Holmgren and Holmgren

1917. *Odontotermes gurdaspurensis* : K. Holmgren and N. Holmgren, *Mem. Dept. Agric. Sci.*, 5(3) : 149-150. Lectotype : S in IARI, Type-Locality : Gurudaspur, Punjab, India.

1997. *Odontotermes gurdaspurensis* : O.B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 492-493, *Zool. Surv. India*.

Caste known : Alates, Soldier and Worker.

Material examined : 6 vials examined containing soldiers and workers from Junagarh, Rampur-Rajkot road, R. Sewak coll., 4.iii.1986, Ex. under stone. Jainabad, 98 km from Surendranagar, R. Sewak coll., 12.iii.1986, Ex. under stone. Chotilla and Saylla, Surendranagar, R. Sewak coll., 13.iii.1986, Ex. under stone. Limboi 6 km from Idar, Himatnagar, R. C. Sharma coll., 28.xi.1986, Ex. under stone. Tilakwada 60 km SW of Vadodara, R. Sewak coll., 20.iii.1988, Ex. under stone. Desalpur village 25 km SW of Bhuj, N.S. Rathore coll., 25.ii.1989, Ex. ground.

Diagnostic characters : *Soldier* : Head-capsule golden yellow to dark brown. Total body-length 5.0-6.5 mm. Head-capsule subrectangularly oval; (head length with mandibles 2.40-2.65 mm and length to base of mandibles 1.42-1.65, maximum width 1.20-1.40 mm and width at base of mandibles 0.73-0.95 mm, index maximum width/length 0.80-0.89 and index width at base of mandibles/maximum width 0.58-0.68 mm). Antennae 16 segmented; segment 4 shortest. Mandibles long, slender, weakly incurved (length 0.95-1.08 mm); longer than half of head-length (index mandibles-length/head-length 0.63-0.72). Left mandible with a prominent, sharp tooth a little behind distal third (tooth distance 0.33-0.45, index tooth distance/mandible-length 0.33-0.40). Right mandible with a small, minute tooth in middle third of mandible. Postmentum subrectangular, sides weakly convex (length 0.80-1.0, maximum width 0.40-0.55 mm). Pronotum saddle-shaped (length 0.50-0.70, width 0.85-1.10 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellow to golden yellow. Total

body-length 4.5-5.2 mm. Head-capsule subsquarish (length to base of mandibles, 1.25-1.40, maximum width 1.45-1.65 mm). Antennae 17 segmented; segment 3 and 5 shortest and subequal. Postclypeus swollen, hairy; length less than half of width. Pronotum saddle-shaped (length 0.40-0.58, width 0.74-0.90 mm). *Worker minor* : as worker major except for its smaller size and head subrectangularly oval. Total body-length 3.5-4.0., length of head to base of mandibles 0.65-0.80, maximum width of head 0.95-1.10, length of pronotum 0.35-0.48 and width of pronotum 0.55-0.70 mm.

Distribution : India; Widely distributed in India and is reported from Jammu and Kashmir, Punjab, Himachal Pradesh, Haryana, Uttar Pradesh, Madhya Pradesh, West Bengal, Rajasthan, Maharashtra and Gujarat.

Elsewhere : Pakistan. Also widely distributed.

43. *Odontotermes horai* Roonwal and Chhotani

1962. *Odontotermes horai* : M. L. Roonwal and O. B. Chhotani, *Proc. natnl. Inst. Sci. India.*, (B) 28(4) : 289, 296, 346-349. Pls. 30, 31. Soldier and Worker. Holotype : S, in ZSI. Type-locality : Bank of Nongpriang Stream, Khasi Hills, Meghalaya, India.

1997. *Odontotermes horai* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 495-498. *Zool. Surv. India*.

Caste known : Imago, soldier and worker.

Material examined : One vial with soldier and workers. Navalpur 21 km E of Himatnagar, R. C. Sharma coll., 30.xi.1986, ex. under wooden log.

Diagnostic characters : *Soldier* : Head-capsule and labrum brownish yellow; antennae uniformly yellow. Total body length 4.85-6.80 mm. Head-capsule subrectangular; sides slightly narrowed in front; longer than wide (length to base mandibles 1.65-2.00, maximum width 1.28-1.65 mm, index width /length 0.74-0.89). Antennae with 15-16 segments, 4 shortest. Labrum subtraingular, with a sharp tip; length subequal to width, 0.26-0.33 mm. Mandibles sabre-shaped, slightly incurved near tips; about 2/3 of head-length (mandible-length 1.05-1.23 mm index mandible-length/head-length to base of mandibles

0.55-0.65). Left mandible with a small tooth in proximal part of middle third, index tooth-distance/mandible-length 0.60-0.66 mm). Right mandible without any tooth or basal projection. Pronotum subrectangular (length 1.13-1.38, maximum width 0.53- 0.70 mm); Pronotum saddle-shaped; much broader than long (length 0.55-0.75, maximum width 0.90-1.25 mm). *Worker* : Monomorphic. Head-capsule and antennae pale yellow. Total body-length 3.90- 5.50 mm. Head-capsule subcircular (length to tip of labrum 1.60-2.20, length to base of mandibles 1.10-1.45, maximum width 1.25- 2.50 mm). Antennae with 17 segmented; segment 3 shorter than 2, subequal or shorter than 4; 5 subequal to 3. Postclypeus swollen, pilose; length a little less than half of width. Pronotum-length 0.40-0.53, maximum width 0.63-0.85 mm.

Distribution : India : Meghalaya, Nagaland, West Bengal, Uttar Pradesh, Madhya Pradesh and Gujarat.

Elsewhere : Nepal (Jirikhala Tal, Sikri and kabre) and Pakistan (Thall).

Remarks : This is first time recorded from Gujarat.

44. *Odontotermes indicus* Thakur

1981. *Odontotermes indicus* : M. L. Thakur, *Indian For. Rec. (N.S.) Ent.*, 14(2) : 70-75. Imago, Soldier and worker. Type-locality : India : Bombay.

Caste known : Imago, soldier and worker.

Material examined : One vial with soldier and worker, Saputara 45 km S of Ahwa, 15.iii.1988, R. Sewak coll., Ex. under stone.

Diagnostic characters : *Soldier* : Head-capsule deep yellow to reddish brown. Total body-length 6.50-9.00 mm maximum head-width 1.80-2.35 mm, length of head with mandibles 3.45-4.35 mm. Antennae with 17 segments; segment 2 about twice as long as 3; 3 shortest; last ovate. Mandibles sabre-shaped, stout length 1.20-1.55 mm. Left mandible with a medium sized distinctly acute tooth near the middle in the basal half, tooth distance from tip of mandibles 0.62-0.80 mm (tooth index 0.50-0.55 mm). Pronotum weakly saddle-shaped; length 0.80-1.00 mm and maximum

width 1.40-1.70 mm. Cerci 2 segmented length 0.10 mm, styli one jointed length 0.08 mm Worker : Dimorphic. Head-capsule and postclypeus pale yellow to rushty yellow. Total body-length 5.00-6.50 mm. Head-capsule subsquarish; wider near the base of antennae. Fontanelle about 0.10 mm. Antennae with 19 segments; segment 2 cylindrical, 5 shortest; last ovate. Pronotum saddle-shaped; narrower than head-width; anterior and posterior margin notched in the middle. Cerci 2 segmented; length 0.15 mm. Styli one jointed 0.08 mm. *Worker minor* : resemble worker major but smaller in size and paler in colour. Antennae 17-18 segmented.

Distribution : India : Orissa, Gujarat (widely distributed in Dangs, Jamnagar, Kheda and Panchmahal districts). This species is widely distributed throughout India, Except the eastern part, Thakur (1976, 1981).

45. *Odontotermes kushwahi* Roonwal and Bose

1964. *Odontotermes kushwahi* : M. L. Roonwal and G. Bose, *Zoologica*, Stuttgart, 40(3) : 33-35.

Caste known : Soldier and worker.

Material examined : 3 vials with soldiers and workers as follows : Bodeli 68 km W of Vadodara, R. Sewak coll., 18.iii.1988, Ex. under dung. Kathor 18 km NE of Surat, R. Sewak coll., 7.viii.1989, Ex. under dung. Adara village 14 km from Rajkot on Morvi road, R. N. Bhargava coll., 23.viii.1988, Ex. from ground.

Diagnostic characters : *Soldier* : Head-capsule, labrum and postclypeus brown; anteclypeus whitish. Total body length with mandibles 5.40-6.50 mm. Head-capsule subrectangularly oval; head-length with mandibles 2.93-3.25 mm. Head-length to base of mandibles 1.82-1.94, maximum width of head 1.55-1.57 mm. Eye and ocelli absent. Antennae with 17 segments; segment 1 long and cylindrical, 3 shortest and apical ovate. Labrum tongue-shaped, slightly broader than long (length 0.36-0.40, width 0.42-0.45 mm). Mandibles long, sickle-shaped, distal half strongly incurved, length 1.25-1.30 mm. Left mandible with a sharp pointed tooth in anterior part of middle-third (index tooth distance/mandible-length

0.38-0.47 mm); right mandible with a very small tooth in the corresponding position. Postmentum subrectangular, much longer than broad (length 1.05-1.25 mm, width 0.55-0.62 mm). Pronotum saddle-shaped, sparsely pilose much broader than long (length 0.70-0.75 mm, width 1.25-1.30 mm). Abdomen elongate, oval. Cerci 2 jointed 0.13 long; styli 1 jointed 0.08 mm long. *Worker* : Monomorphic : Head-capsule pale yellow, frons whitish, distal segments of antennae deep yellowish brown, Total body-length 4.58-6.50 mm. Head-capsule subsquarish, narrower posteriorly; slightly broader than long (length 1.35-1.40 mm width 1.50-1.58 mm. Eye, ocelli absent. Antennae with 18-19 segments, 1 longest and 3 shortest. Pronotum strongly saddle-shaped much broader than long (length 0.45-0.55, width 0.85-0.90 mm). Apical tibial spurs formula 3 : 2 : 2. Abdomen long, oval, pilose; cerci 2 jointed 0.10 mm long; styli 1 jointed 0.08 mm long.

Distribution : India : Rajasthan : Bhupalsagar and Amet, Udaipur district. Gujarat : Tuwa (Kheda dist.), Rajkot, Surat and Vadodara district.

46. *Odontotermes latiguloides* Roonwal & Verma

1973. *Odontotermes latiguloides* : M. L. Roonwal and S. C. Verma, *J. Indian Acad. Wood. Sci.*, 4(2) : 83-86. Soldier and worker. Holotype : S. In ZSI. Type-locality : Mandalgarh, Bhilwara district, Rajasthan, India.

1997. *Odontotermes latiguloides* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 510-512. *Zool. Surv. India*.

Caste known : Soldier and worker.

Material examined : One vial with soldier and workers from Saputara hills, Ahwa (Dangs Division), R. K. Singh coll., 14.i.1989, Ex. under log (mix with *O. Assmuthi* Holmgren).

Diagnostic characters : *Soldier* : Head-capsule yellowish brown; antennae brownish, basal segments paler. Total body length 3.8-5.2 mm. Head-capsule broadly oval; narrowed anteriorly; width almost equal to length (head length with mandibles 1.79-2.10 mm and length to base of mandibles 1.0-1.26, maximum width 1.0-1.21 mm, index width/length 0.96-1.0 mm). Antennae with 16-17 segments; segment 3 shortest. Labrum

tongue-shaped, with several long hairs; longer than broad; tip broadly round and narrowed (length 0.26-0.37, width 0.26-0.32 mm). Mandibles sabre-shaped, strongly incurved apically; about 3/4 of head-length (length 0.79-0.89 mm, index, mandible-length/ head-length 0.75-0.79 mm). Left mandible with an acute, forwardly pointed, well marked tooth at about distal 1/3 (tooth-distance from tip 0.26-0.34 mm, index, tooth-distance/mandible-length 0.33-0.38 mm). Right mandible with minute tooth a little lower than tooth on left mandible. Postmentum strongly arched and swollen; width slightly shorter than length (length 0.53, maximum width 0.47 mm, index width/length 0.92 mm). Pronotum saddle-shaped; strongly notched both at anterior and posterior margins (length 0.47-0.58, width 0.77-0.95 mm). Legs with 3:2:2 apical tibial spurs (not 2:2:2 as mentioned by Roonwal and Verma 1973). *Worker* : Head-capsule yellowish brown body straw coloured. Head sparsely and body fairly pilose. Total body length 3.70-5.0 mm. Head-capsule subsquarishly rounded (length to base of mandibles 1.16-1.53, width 1.32-1.42 mm). Antennae with 17 segmentes; segment 2 subequal to 3+4. Postclypeus swollen, with a few hairs; length less than half of width. Pronotum saddle-shaped (length 0.30-0.38, width 0.68-0.75 mm). Legs with 3 : 2 : 2 apical tibial spurs (not 2 : 2 : 2).

Distribution : Rajasthan : Banswara, Bhilwara, Dungarpur, Jaipur, Jhunjhunu, Jodhpur, Sikar and Sirohi district. Gujarat : Amreli, Bharuch, Dangs, Gandhinagar, Junagarh, Kheda, Kachchh, Mahesana, Panchmahal, Rajkot, Sabarkantha, Vadodara and Valsad.

47. *Odontotermes lokanandi*

Chatterjee and Thakur

1967. *Odontotermes lokanandi* : P. N. Chatterjee and M. L. Thakur, *Indian For. Rec. (N.S.), Ent.*, 10(1) : 38-41. Soldier and worker. Type-locality : India : Jammu & Kashmir : Resident Plot No. 6, near River Tavi, Jammu.

Caste known : Imago, Soldier and worker.

Material examined : 7 vials with soldiers and workers from Bhuj, Dangs, Junagarh, Vadodara and Valsad districts, N.S. Rathore coll., 10.ii.1978 and Dec-Jan. 1980-81.

Diagnostic characters : *Soldier* : Head-capsule yellowish brown to dark brown. Total body-length 3.70-4.50 mm. Head-capsule oval shaped, head-length with mandibles 1.50-1.80, maximum head-width 0.95-1.10; Fontanelle indistinct. Antennae with 15-16 segmentes; 2 longer than 3, in 15 segmented condition 2 equal to 3+4 combined in 16 segmented antennae; last ovate. Labrum tongue-shaped; slightly longer than broad. Mandibles short, stout and sickle-shaped with strongly incurved apices; maximum length 0.55-0.68. Left mandible with a medium size sharply pointed acute tooth lying near the apical third, 0.15-0.20 mm distance from tip (mandibular tooth index 0.26-0.31). Right mandible with a small rudimentary tooth placed in front of middle. Postmentum short, only slightly longer than wide (postmentum index 0.84-0.96). Pronotum weakly saddle-shaped; narrower than head-width; length 0.43-0.55 and maximum width 0.70-0.90. Abdomen oblong, hairy. Cerci 0.08-0.10 mm long. Styli 0.06-0.08 mm long. *Worker* : Head-capsule brownish; rest of the body straw yellow. Head-capsule sparsely hairy. Total body-length 3.50-4.25 mm. Head-capsule subsquarish, slightly broader than long, head-length to tip of mandible 1.95-2.25 mm. Antennae with 17-18 segments; 2 longer than 3 in 17 segmented condition; subequal to combined length of 3 and 4 in 18 segmented antennae. Labrum subsquarish anterior margin rounded. Pronotum saddle-shaped; maximum length 0.35-0.48 and maximum width 0.65-0.80 mm; anterior margin deeply notched medially; posterior margin concave. Abdomen oblong. Cerci 0.06-0.08 mm long. Styli 0.08 mm long.

Distribution : India : Himachal Pradesh, Jammu & Kashmir, Uttar Pradesh, Gujarat (Banaskantha, Dangs, Junagarh, Kachchh, Mahesana, Vadodara and Valsad).

Elsewhere : Pakistan (very widely distributed throughout Pakistan), Bangladesh.

48. *Odontotermes malabaricus*

Holmgren and Holmgren

1917. *Odontotermes (Odontotermes) malabaricus* : K. Holmgren and N. Holmgren, *Mem. Dept. Agric. India (Ent.)*, 5(3) : 157-158. Soldier and worker. Syntypes : In Riksmus and AMNH (IS, IW).
1959. *Odontotermes kulkarnii* : M.L. Roonwal and O. B. Chhotani, *Sci & Cult.*, Calcutta, 25(5) : 325.
1960. *Odontotermes kulkarnii* : M. L. Roonwal and O. B. Chhotani, *Indian J. Agric. Sci.*, New Delhi, 29(4) : 57-62.
1981. *Odontotermes malabaricus* : M. L. Thakur, *Indian For. Rec. (N. S.) Ent.*, 14(2) : 87-90.

Caste known : Soldier and worker

Material examined : One vial with soldier and workers from Gogha 20 km from Bhavnagar, 24.ii.1986, R. Sewak coll., Ex. from roots of *Accacia* tree.

Diagnostic characters : *Soldier* : Head-capsule yellowish to brownish-yellow. Total body-length 5.40-7.0 mm. Head-capsule subrectangular. Length of head with mandibles 3.0-3.6 mm and maximum width of head 1.23-1.70 mm, Fontanelle indistinct. Antennae with 16-17 segment; in 16 segmented antennae, segment 2 slightly longer than 3; 4 shortest; in 17 segmented condition, 2 almost twice as long as 3; 3 shortest; last ovate. Labrum tongue-shaped; sides subparallel. Mandibles sabre-shaped; strongly built with broadly pointed and incurved apices; length more than half the head-length. Left mandible with a prominent and acute marginal tooth near the lower edge of apical third (mandible-tooth index 0.34-0.43 mm). Right mandible with a minute rudimentary tooth near the middle in the distal half. Postmentum subrectangular. Pronotum saddle shaped; distinctly narrower than head-width; anterior margin with a distinct notch in the middle. Maximum head-width 1.23-1.70. posterior margin weakly emarginate to deeply notched. Abdomen elongate. Cerci and styli 08-0.10 mm long. *Worker* : Dimorphic. *Worker major* : Head-capsule yellowish brown; antennae yellowish white, becoming darker distally. Total body-length 3.80-5.30 mm. Head-capsule subrectangular; maximum head-width 1.33-1.63 mm. Fontanelle indistinct. Antennae with 17

segments; rarely 18 segmented (4 incompletely divided); segment 2 distinctly longer than 3; 3 shortest; last ovate. Pronotum saddle-shaped, broader than long; maximum length 0.35-0.40 and maximum width 0.70-0.80 mm; posterior margin with broad emargination. Abdomen subglobular. Cerci 0.10-0.13 mm styli 0.10 mm. *Worker minor* : similar to worker major except smaller in size and Head-capsule somewhat oval in shape and antennae 16-segmented.

Distribution : India : Poovanur, Malabar district (in old Madras presidency), Now in Kerala, Bababiddin hill and Shevroy hills, Yercaud. Species is very widely distributed in the Peninsular India. Gujarat : Bhavnagar district.

Remarks : This species is first time recorded from Gujarat.

49. *Odontotermes microdentatus*

Roonwal and Sen-Sarma

1960. *Odontotermes microdentatus* : M. L. Roonwal and P. K. Sen-Sarma, *Contr. Syst. Orient. Termites (ICAR) Ent., Monog. 1* : 33-39, 2 pls. Imago. Soldier and Worker. Holotype : S, in FRI. Type-locality : Dehra Dun, Uttar Pradesh, India.
1997. *Odontotermes microdentatus* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites) Vol. II* : 514-517. *Zool. Surv. India*.

Caste known : Imago, Soldier and Worker.

Material examined : One vial with soldiers and Workers from Bokhra near Saputara 21 km from Ahwa (Dangs), N.S. Rathore coll., 30.xii.1980.

Diagnostic characters : *Soldier* : Head pale brown to dark-brown; antennae brownish, darker distally. Total body-length 3.9-5.3 mm. Head-capsule oval, slightly longer than broad (head length with mandibles 1.90-2.10 mm and length to base of mandible 1.0-1.54, maximum width 0.90-1.15, width at base of mandibles 0.55-0.68 mm; index width/length 0.73-0.95 and index width at mandible base/maximum width 0.55-0.64 mm). Antennae 16 to 17 segmented; segment 4 shortest in 16 and 3 and 5 shortest and subequal in 17 segmented antennae. Labrum

tongue-shaped, converging anteriorly into a narrow rounded tip (length 0.35, width 0.30 mm). Mandibles long, slender and almost straight, very slightly bent inwards at distal tip; length 2/3 to 3/4 of head-length (length 0.78-0.90 mm; index mandible length/head-length 0.62-0.78 mm). Left mandible with a minute tooth above distal 1/3 (tooth distance from tip 0.20-0.28 mm, index tooth-distance/mandible-length 0.28-0.33 mm) Right mandible with a rudimentary tooth at distal 1/3. Postmentum subrectangular with convex sides (length 0.65-0.80, maximum width 0.40-0.50 mm). Pronotum saddle-shaped (length 0.45-0.55, width 0.70-0.85 mm). *Worker* : Monomorphic. Head-capsule deep straw-coloured. Total body-length 3.5-4.8 mm. Head-capsule subsquarish (length to base of mandibles 1.2-1.55, maximum width 1.40- 1.74 mm). Antennae 17 segmented; segment 3 and 4 subequal. Postclypeus swollen, hairy, length about 1/2 of width. Pronotum saddle-shaped (length 0.33-0.50, width 0.63-0.90 mm).

Distribution : India : Recorded from Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Orissa, Gujarat, Bihar and Karnataka.

50. *Odontotermes obesus* (Rambur)

1842. *Odontotermes obesus* : J. P. Rambur, *Histoire nat. Insectes, Ne'vrop'te'res* : 304. Imago only. Syntypes : one Im, in Hope Mus. Oxford (U.K.). Type-locality : India : Bombay.

1997. *Odontotermes obesus* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 519-524. *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : Lot (A) 5 vials with soldier and workers, Palanpur district, R. C. Sharma coll., Nov., 1986. Lot (B) 5 vials with soldier and workers, Himatnagar district, R. C. Sharma coll., Nov. 1986. Lot (C) 2 vials with soldier and workers Kim 34 km N of Surat, R. Sewak coll., 4.iii.1988. Mahwa 45 km SW of Surat, R. Sewak coll., 5.iii.1988. Lot (D) - One vial with soldier and workers, Saputara, Dangs, Ahwa, R. Sewak coll., 15.11.1988.

Diagnostic characters : *Soldier* : Head-capsule pale yellow to castaneous brown. Total body-length 4.0-6.0 mm. Head-capsule oval, weakly converging anteriorly (head length with mandibles 2.00-2.53 mm and length to base of mandibles 1.03-1.67, maximum width 0.95-1.37 mm, index, width/length 0.82-0.95 and converging index, width at mandible base/maximum width 0.62-0.70). Antennae with 16-17 segments; segment 2 subequal to 3 + 4 in 16 segmented antennae and 3 shortest in 17-segmented ones. Mandibles long, slender, sabre-shaped (length 0.75-1.03 mm, mandible-length/head-length 0.59-0.68 mm). Left mandible with a sharp prominent tooth at distal 1/3 (tooth-distance from tip 0.25-0.38, index, tooth-distance/mandible-length 0.30-0.40 mm). Right mandible with a minute tooth a little below level of tooth on left mandible. Postmentum subrectangular (length 0.70-0.93, width 0.50- 0.58 mm). Pronotum saddle-shaped, distinctly notched (length 0.50-0.65, width 0.80-1.07 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule and antennae pale yellow to yellowish brown; distal segments darker, body creamish to straw yellow. Total body-length 3.80-4.50 mm. Head-capsule subsquarish, widest near antennae (length to base of mandible 1.15-1.40; max width 1.37-1.58 mm). Antennae with 17-18 segments; in 17 segmented one, segment 3 shortest and in 18 segmented one, 4 shortest. Postclypeus weakly swollen, length less than half its width. Pronotum strongly saddle-shaped (length 0.43-0.58, width 0.70-0.85 mm). *Worker minor* : Smaller than worker major and with 16-17 segmented antennae. Total body-length 2.70-4.70, length of head to base of mandibles 0.65-1.00, maximum width of head 0.75-1.15, pronotum-length 0.30-0.40, pronotum width 0.50-0.63 mm.

Distribution : Widely distributed in the Indian subcontinent. It is known from Gujarat state from district Ahmedabad, Banaskantha, Bharuch, Dangs, Kachchh, Kheda, Jamnagar, Mahesana, Panchmahal, Sabarkantha, Surat, Vadodara and Valsad.

51. *Odontotermes paralatiguloides* Thakur

1989. *Odontotermes paralatiguloides* : R.K. Thakur, *Indian For. Rec. (N.S.) Ent.*, 15(1) : 57-60. Soldier and Worker.

Holotype : S, in ZSI, Calcutta. Type-locality : Vijarkhi village, 15 km S of Jamnagar, Gujarat, India.

Caste known : Soldier and worker.

Material examined : One vial with soldier and workers from Vijarkhi village 15 km S of Jamnagar, R. C. Sharma coll., 12.ix.1975, Ex. Decayed wooden log. One vial with soldier workers from Thordoi near Khavda coast of the Great Rann of Kachchh 102 km from Bhuj, N.S. Rathore coll., 16.i.1981, Ex. cow dung.

Diagnostic characters : *Soldier* : Head-capsule yellowish brown, oval shaped; (head length with mandibles 1.81-1.94 mm and head-length to base of mandibles 1.06-1.19 mm, maximum width of head 1.03-1.13 mm), posterior margin broadly rounded. Fontanelle indistinct. Total body-length 3.94-4.65 mm. Antennae with 16 segment, segment 1 longest, 4 shortest, apical ovate. Labrum tongue-shaped, (length 0.28- 0.33 and width 0.23-0.28 mm). Mandible short, stout and deeply incurved. Left mandible length 0.74-0.78 mm with a medium sized, sharply pointed forwardly directed acute tooth lying near the apical third (distance of tooth from tip of mandible 0.22-0.28 mm and mandibular-tooth index 0.27-0.32 mm). Right mandible length is equal to left one but with a small rudimentary tooth placed in front of middle. Postmentum short, length 0.47-0.50 mm and maximum width 0.44-0.47 mm (postmentum index width/ length 0.88-0.94. Pronotum saddle-shaped, maximum length 0.50-0.56 and maximum width 0.81-0.88. Cerci 2 segmented, short 0.11 mm and styli single joined short 0.07 mm. *Worker* : Monomorphic. Head-capsule yellowish brown; rest of the body straw yellow. Total body-length 4.31-4.90 mm. Head-capsule subsquarish, head-length with mandibles 1.75-2.14 mm and maximum width of head 1.26-1.33 mm. Antennae 15-16 segmented; segment 1 longest, 3 shortest, last ovate. Pronotum saddle-shaped, length 0.35-0.49 and maximum width 0.63-0.77 mm. Abdomen oblong, hairy. Cerci 2 segmented, short 0.07 mm; styli unsegmented short 0.08 mm long.

Distribution : India : Gujarat (Dangs, Jamnagar, Junagarh and Kachchh).

52. *Odontotermes redemanni* (Wasmann)

1893. *Termes redemanni* : W. Wasmann, *Wein. Ent. Zeig.*, 12(7) : 239. Imago, Soldier and Worker. Lectotype : S, in NHM, Maastricht. Type-locality : Sri Lanka.

1997. *Odontotermes redemanni* : O.B. Chhotani, *Fauna of India and adjacent countries, Isoptera* (Termites), Vol. II : 519-524. *Zool. Surv. India*.

Caste known : Soldier and worker.

Material examined : (A) One vial with few soldier and many workers, Ganeshpur 35 kms from Mahesana R. Sewak coll., 16.iii.1986, Ex. under Bark of Neem tree (B) One vial with soldiers and workers from Mahi river area 21 kms. N.E. of Vadodara, R. Sewak coll., 19.iii.1988, Ex. from grass.

Diagnostic characters : *Soldier* : Head-capsule pale yellowish to dark yellowish brown. Total body-length 3.5-5.10 mm. Head-capsule oval (head length with mandibles 1.85-2.25 mm and length to base of mandibles 1.15-1.35, maximum width 1.0-1.20 mm). Resembles *O. obesus* very much. Antennae 16-17 segmented; segment 4 shortest in 16 segmented antennae and 3 in 17 segmented ones. Labrum tongue-shaped; anterior margin broadly rounded. Mandibles long, slender, sabre-shaped, incurved distally; length 0.75-0.95 mm; longer than 1/2 of head-length (index, mandible-length/head-length 0.60-0.63 mm). Postmentum moderately swollen, subrectangular (length 0.65-0.85 mm, width 0.45-0.58 mm). Pronotum saddle-shaped, (length 0.45-0.60, maximum width 0.70-1.0 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale-yellowish brown. Total body-length 3.0-5.20 mm. Head-capsule subsquarish (length to base of mandibles 1.20-1.35, maximum width 1.30-1.40 mm). Antennae with 17-18 segmented; segment 5 in 17 segmented antennae and 4 in 18 segmented ones, shortest. Postclypeus weakly swollen; length nearly 1/2 of width. Pronotum saddle-shaped, prominently notched at anterior and posterior margins (length 0.35-0.38, width 0.70-0.80 mm). *Worker minor* : Resembles worker major but for its smaller size and 16 to 17 segmented antennae. Total body-length 3.0-3.8 mm, length of head to base of mandibles 0.70-0.78, maximum width of

head 0.85-0.90, length of pronotum 0.30-0.35 and width of pronotum 0.57-0.60 mm.

Distribution : India : Quite widely distributed in southern and eastern India and reported from Tamil Nadu, Kerala, Andhra Pradesh, Karnataka, Maharashtra, Madhya Pradesh, Eastern Bihar and West Bengal, Jammu and Kashmir, Orissa, Rajasthan, Gujarat, Tripura.

Elsewhere : Sri Lanka : very widely distributed.

53. *Odontotermes sasangirensis* Thakur

1989. *Odontotermes sasangirensis* : R. K. Thakur, *Indian For. Rec. (N.S.) Ent.*, **15**(1) : 61-64. Soldier and Worker. Holotype : S, in ZSI, Calcutta. Type-locality : Sasan Gir Forest, Junagarh, Gujarat, India.

Caste known : Soldier and worker.

Material examined : A paratype soldier and a paramorphotype worker, collected from soil tunnel on the ground, Sasan Gir Forest (Junagarh district), N.S. Rathore coll., 8.i.1981.

Diagnostic characters : *Soldier* : Head-capsule yellowish brown to dark brown, suboval; longer than broad (head-length with mandibles 1.19-1.28 mm; width 1.09-1.19 mm. Mandibles pale brown to reddish brown, long, stout, weakly incurved, length 0.75-0.81 mm. Left mandible with a prominent tooth lying just above the 1/4 or a little in front, tooth index 0.27-0.29 mm. Total body length with mandibles 5.32-5.60 mm. Fontanelle absent. Antennae 16 segmented 4 shortest, apical ovate. Labrum longer than broad, length 0.31-0.34 mm and width 0.23-0.28 mm. Postmentum subrectangular with sides convex in the middle, length 0.55-0.58, width 0.44-0.50 mm. Pronotum saddle-shaped, narrower than head-capsule, width 0.90-0.97 mm; length 0.50-0.56 mm. Legs slender, apical tibial spur formula 3:2:2. Cerci 2-jointed, 0.11 mm long. Styli single-jointed 0.09 mm long. *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellowish white, mandible dark brown, subcircular, broader than its length to base of mandible (width 1.26-1.37 mm). Total body-length 3.92-4.20 mm. Fontanelle indistinct. Antennae with 17-18 segments, segment 1 longest, 5 shortest in 17 segmented antennae and 4 shortest in 18

segmented antennae; last ovate, club shaped. Left mandible with an apical and 3 marginal teeth and right mandible with an apical and two marginal teeth. Pronotum saddle-shaped, width 0.75-0.78 mm, length 0.41-0.44 mm. Cerci 2 jointed, 0.14 mm long and styli 1 jointed and 0.10 mm long. *Worker minor* : Resembles worker major except smaller in size and the antennae with 16 segments.

Distribution : India : Gujarat : Banaskantha, Bharuch, Kachchh, Jamnagar, Junagarh, Mahesana, Panchmahal, Sabarkantha and Vadodara districts.

54. *Odontotermes wallonensis* (Wasmann)

1902. *Termes obesus sub. sp. wallonensis* : W. Wasmann, *Zool. Jb. Syst.*, **17**(1) : 106. Imago. Soldier and Worker. Holotype : Im, in NHM, Maastricht. Type-locality : Wallon, Sangamner (Dist. Ahmadnagar), Maharashtra.

1904. *Termes obesus sub. sp. wallonensis* : J. Desneux, *genera Insects.*, **25** : 38.

1914. *Termes wallonensis* : E. Bugnion, *Bull. Mus. Hist. nat. Paris*, **20**(4) : 189.

1949. *Odontotermes (Odontotermes) wallonensis* : T. E. Snyder, *Smiths misc. Coll.*, **112** : 243. Synonymy.

1997. *Odontotermes wallonensis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. **II** : 547-552. *Zool. Surv. India*.

Caste known : Imago, Soldier and Worker.

Material examined : One vial with soldier and worker from Limbhoi village 6 km from Iddar and 33 kms N of Himatnagar, R. C. Sharma coll., 28.xi.1986, Ex. from ground.

Diagnostic characters : *Soldier* : Head-capsule pale yellow to brownish yellow. Total body-length 4.6-6.70 mm. Head-capsule subrectangularly oval, sides faintly convex (head length with mandibles 2.50-2.90 mm and length to base of mandible 1.50-1.90, maximum width 1.30-1.50, width at base of mandibles 0.88-1.03 mm index maximum width/length 0.70-0.87 and index width at base of mandibles/maximum width 0.65-0.73). Antennae with 16-17 segments; in 16-segmented antennae, segment 2 subequal to 3 and 4 shortest; in 17 segmented ones, 2 longer than 3. Labrum broadly tongue-shaped; anteriorly broadly rounded (length

0.35-0.48; width 0.40-0.43 mm). Mandibles long and fairly strongly incurved anteriorly; length about 2/3 of head-length (length 1.03-1.20, index left mandible-length/head-length 0.62- 0.71); left mandible with a prominent tooth a little above middle point (tooth-distance from tip 0.43-0.53, index, tooth-distance/mandible-length 0.41-0.46 mm); right mandible with a small tooth at middle (tooth-distance 0.50-0.58 mm). Postmentum subrectangular, flat; widest at anterior 1/4; behind sides slightly incurved ((length 0.95-1.18, maximum width 0.53-0.65 mm). Pronotum saddle-shaped (length 0.53- 0.75, width 0.95-1.20 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale brownish, yellow. Total body length 4.0-5.5 mm Head-capsule subcircular, wider than long (length base of mandible 1.20-1.38, maximum width 1.40-1.63 mm). Antennae with 17-18 segments, segment 4 shortest. Postclypeus swollen, pilose; length less than half of width (length 0.33, width 0.80 mm). Pronotum saddle-shaped (length 0.45- 0.55, width 0.80-0.90 mm). *Worker minor* : As worker major except that it is smaller in size and has comparatively more swollen postclypeus and 17 segmented antennae. Total body-length 3.2-3.8 mm, length of head to base of mandibles 0.73-0.88, maximum width of head 0.90-1.05, length of postclypeus 0.25, width 0.50 mm, length of pronotum 0.33-0.45, width 0.55-0.68. mm.

Distribution : India : It is a very wide spread species in peninsular India and is reported from Maharashtra, Gujarat, Karnataka, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, Bihar, Orissa, and Delhi state.

55. *Microtermes incertoides* Holmgren

1913. *Microtermes incertoides* : N. Holmgren, *J. Bombay nat. Hist. Soc.*, 22(1) : 113-114. Soldier and worker. Holotype : Probably in Riksmus., Stockholm. Type-locality : Wallon, Ahmadnagar Dist. Maharashtra, India.

1997. *Microtermes incertoides* : O. B. Chhotani. *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 579-580. *Zool. Surv. India*.

Caste known : Soldier and worker.

Material examined : One vial with soldiers and workers from Forest Rest house compound,

Ahwa, Dangs district, N.S. Rathore coll., 29.xii.1980, Ex. rotten wood.

Diagnostic characters : *Soldier* : Head-capsule straw yellow; labrum yellowish; antennae and body whitish; mandibles reddish brown, paler basally. Head and body fairly densely hairy. Total body-length 3.10-4.0 mm. Head-capsule oval; a little longer than wide (head length with mandibles 1.26-1.40 mm and length to base of mandible 0.80-0.88, maximum width 0.73-0.78 mm); sides converging in front. Antennae with 14 segments; segment 2 subequal to 3+4. Labrum lancet-shaped, extending upto 2/3 of mandibles; tip narrow and pointed (length 0.30-0.33, width 0.20-0.23 mm). Mandibles thin, delicate, weakly incurved anteriorly (length 0.47-0.53 mm), index mandibles-length/head length 0.60-0.63 mm). Postmentum a little longer than wide; sides weakly convex (length 0.45, width 0.35-0.38 mm). Pronotum saddle-shaped (length 0.33-0.40, width 0.48-0.58 mm). *Worker* : Dimorphic. *Worker major* : Head-capsule pale yellowish brown. Total body-length 3.5-4.30 mm. Head-capsule subsquarish, (length to base of mandibles 0.80, width 0.87 mm). Antennae with 14 segments; postclypeus swollen, length 1/2 of width. Pronotum saddle-shaped (maximum width 0.46 mm). *Worker minor* : Resembles worker major except, head-capsule subcircular. Total body-length 3.0, head-width 0.68, pronotum-width 0.42 mm.

Distribution : India : Maharashtra, Karnataka, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Gujarat, Tamil Nadu and Daman.

56. *Microtermes mycophagus* (Desneux)

1905. *Termes mycophagus*: J. Desneux, *Ann. Soc. Ent. Belg.*, 49(12) : 348-352. Imago, Soldier and Worker. Holotype : Repository not known. Type-locality : Karachi, Sind, Pakistan.

1997. *Microtermes mycophagus* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)* Vol II : 581-583, *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : Three vials with soldier and workers first from Navalpur, Himatnagar, R. C. Sharma coll., 30.xi.1986 second vial from

Verahi 18 km W of Radhanpur, district Palanpur, N.S. Rathore coll., 21.ii.1989, Ex. dry *Accacia* branch and third vial from Jetda-village 14 km from Tharad, Palanpur district, N.S. Rathore coll., 7.iii.1989, Ex. wooden log. Also 40 vials collected during 1986 to 1992 from Ahmedabad, Bhuj, Gandhinagar, Himatnagar, Mahesana and Palanpur district.

Diagnostic characters : *Soldier* : Head-capsule yellowish to pale reddish brown. Total body-length 3.20-5.0 mm. Head-capsule oval, slightly longer than wide (head length with mandibles 1.40-1.58 mm and length to base of mandibles 0.85-1.03, maximum width 0.78-0.95 mm); sides weakly convex, widest at middle. Antennae with 15-segments; segment 2-5 variable in size. Labrum tongue-shaped, extending upto distal third of mandible; tip broadly pointed, not lanceolate; longer than wide (length 0.28-0.35, width 0.25-0.30 mm). Mandibles thin and feeble built, slightly incurved apically (length 0.56-0.65 mm); a little longer than 1/2 head-length (index, mandible-length/head-length 0.62-0.67 mm). Left mandible with a minute, rudimentary tooth on apical third. Right mandible without any tooth. Postmentum swollen, arched; sides convex (length 0.43-0.53, width 0.33-0.45 mm). Pronotum saddle-shaped (length 0.35-0.48, width 0.55-0.70 mm). *Worker* : Dimorphic. *Worker major* : Head Pale brownish yellow; body whitish. Head and body fairly densely hairy. Total body-length 4.0-5.0 mm. Head-capsule subsquarish (length to base of mandible 0.98-1.20, maximum width 1.08-1.15 mm). Antennae 15-16 segmented. Postclypeus swollen; length less than 1/2 width. Pronotum saddle-shaped (length 0.20-0.28, width 0.45-0.55 mm); anteriorly distinctly notched, posteriorly substraight.

Distribution : India : Rajasthan, Delhi, Haryana, Punjab, Gujarat (Districts Ahmedabad, Bhuj, Dangs, Gandhinagar, Himatnagar, Kachchh, Mahesana, Palanpur and Vadodara).

Elsewhere : Pakistan; Punjab, Sindh.

57. *Microtermes obesi* Holmgren

1911. *Microtermes obesi* : N. Holmgren, *J. Bombay nat.*

Hist. Soc., 21(1) : 787-788. Imago only. Holotype : Probably in Riksmus., Stockholm. Syntypes (vide P. N. Chatterjee and R. S. Thakur 1964) present in FRI and IARI. Type-locality : Khandala, Maharashtra, India.

1997. *Microtermes obesi* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 583-587. *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : Five vials with soldiers and workers from Himatnagar, Palanpur and Vadodara district, 1982 to 1992 were examined.

Lot (a) One vial from Ani Dam submergence area, Chhota Udaipur, Vadodara, 21.x.1992, N.S. Rathore coll., Ex. dry stick.

Lot (B) One vial from Ambaji forest area, 24.xi.1986, N.S. Rathore coll., Ex. Dry Bamboo (ii) from forested area 14 kms of Dunta, 19.ii.1992, N.S. Rathore Coll., Ex. under dung. (iii) from Rama Rampura village 13 kms W of Deea, 10.iii.1992, N.S. Rathore coll., Ex. dry twig.

Lot (C) One vial from Navalpur 21 km E of Himatnagar, 30.xi.1986, R. C. Sharma coll., Ex. Dry wooden log.

Diagnostic characters : *Soldier* : Head-capsule yellowish to brownish yellow. Total body-length 3.2-5.0 mm. Head-capsule oval, a little longer than wide (head length with mandibles 1.33-1.47 mm and length to base of mandibles 0.80-1.0, maximum width 0.74-0.90 mm); widest at middle of head. Antennae with 14 segments; segment 2 subequal to 3+4; 4 shortest. Labrum long, lanceolate, reaching upto about 2/3 of mandibles; tip comparatively wider than in other species. Mandibles thin, delicate and weakly incurved apically (length 0.48-0.55 mm); a little longer than half of head-length (index mandible-length/head-length 0.55-0.62 mm). Postmentum a little longer than wide and slightly arched; sides weakly convex (length 0.40-0.59 width 0.35-0.52 mm). Pronotum strongly saddle-shaped (length 0.30-0.50, width 0.48-0.76 mm); anterior margin deeply notched; posterior margin weakly emarginate. *Worker* : Dimorphic. *Worker major* : Head-capsule yellow to brownish yellow. Total body-length 3.0-5.0 mm. Head-capsule subsquarish (length to base of mandibles

0.80-0.90, maximum width 0.90-1.03 mm. Antennae with 13-14 segments; segment 2 equal to 3 + 4. Postclypeus swollen; length almost half of width. Pronotum saddle-shaped (length 0.25-0.33, width 0.45-0.50 mm). *Worker minor* : As worker major except for smaller size. Total body-length 3.0-3.5, length to base of mandibles 0.60-0.65, maximum width of head 0.65-0.73, width of pronotum 0.35-0.43 mm.

Distribution : India : very widely distributed.

Elsewhere : Pakistan, Sri Lanka, Bangladesh, Bhutan, Thailand, Vietnam, Kampuchea, Myanmar, Cambodia.

58. *Microtermes unicolor* Snyder

1933. *Microtermes unicolor* : T. E. Snyder, *Proc. Biol. Soc. Washington*, **46** : 92-93. Imago only. Syntypes : In BM and USNM

1997. *Microtermes unicolor* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 589-592. *Zool. Surv. India*.

Caste known : Imago, soldier and worker.

Material examined : Seven vials with soldiers and workers from 1982-1992 were examined as follows :

Lot (A) One vial from Ani dam submergence area, Chhota Udaipr, Vadodara, N.S. Rathore coll., 21.10.1982, Ex. under stone.

Lot (B) from Navalpur area 21 kms E of Himatnagar, N.S. Rathore coll., 30.xi.1986, Ex. from ground.

Lot (C) from Lakhtar dam area, Surendranagar, N.S. Rathore coll., 13.ii.1991, Ex. dry stick.

Lot (D) Three vials from Palanpur (i) Forest area 14 km NE of Danta, N.S. Rathore coll., 19.ii.1992, Ex. Plant bark. (ii) from Kapra village on Tharad road, N.S. Rathore coll., 22.viii.1992, Ex. under stone (iii) Ambaji forest area, N.S. Rathore coll., 24.xi.1986, Ex. dry bamboo.

Lot (E) - One vial from Aithar village 13 km from Unjjha, Mahesana, N.S. Rathore coll., 25.ii.1992, Ex. dry twig.

Diagnostic characters : *Soldier* : Head-capsule yellowish white to brownish yellow. Total body length 3.8-4.9 mm. Head-capsule oval, widest posteriorly and converging anteriorly (head length with mandibles 1.33-1.55 mm and length to base of mandibles 0.82-0.96, maximum width 0.75-0.86 mm). Antennae with 14 segments segment 2 slightly smaller than 3+4, latter two subequal. Labrum long, lanceolate, reaching upto three fourth of mandibles (length 0.30-0.37, maximum width 0.23-0.25 mm), sides convex; tip comparatively broad. Mandibles thin, delicate, weakly incurved apically and without any tooth (length 0.49-0.56 mm); a little longer than half of head-length (index mandible length/head-length 0.58-0.61 mm). Postmentum well arched; a little longer than wide (length 0.38-0.45, maximum width 0.35-0.43 mm). Pronotum saddle-shaped (length 0.27-0.37, width 0.48-0.58 mm); anterior margin notched, posterior margin weakly incurved. *Worker* : Head-capsule pale yellow to straw yellow; body whitish. Head and body moderately hairy. Total length 3.6-4.5 mm Head-capsule subsquarish (length to base of mandibles 0.78-0.85, maximum width 0.85-0.95 mm). Antennae with 14-15 segments; segment 2 equal to 3+4 Postclypeus swollen. Length almost half of width. Pronotum saddle-shaped (length 0.20-0.25, width 0.45-0.50 mm); anterior margin distinctly notched. Posterior margin substraight.

Distribution : Uttar Pradesh, Himachal Pradesh, Punjab, Jammu & Kashmir, Rajasthan and Gujarat (Dangs, Junagarh, Himatnagar, Palanpur, Surendranagar and Vadodara districts).

Subfamily (Viii) NASUTITERMITINAE

59. *Trinervitermes biformis* (Wasmann)

1902. *Eutermes biformis* : E. Wasmann, *Zool. Jb. Syst.*, **17**(1) : 133-135, pl. 4. Lectotype : S. maj (designated here). in NHM, Maastricht. Type-locality : Bandarawella, Sri Lanka.

1949. *Trinervitermes biformis* : T. E. Snyder, *Smiths misc Coll.*, **112** : 323-324.

1997. *Trinervitermes biformis* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 726-732, *Zool. Surv. India*.

Caste known : Imago, Soldier and worker.

Material examined : 12 vials with soldiers (major and minor) and workers from 1986-1992, were examined.

Lot (a) from Dantiwara Forest area, Palanpur, N.S. Rathore coll., 23.xi.1986, Ex. under stone.

Lot (B) from Limbhoi village 31 km from Himatnagar N.S. Rathore coll., 28.xi.1986, Ex. ground (ii) from forest plantation, Navalpur 21 km E of Himatnagar, N.S. Rathore coll., 29.xi.1986, Ex. under stone. (iii) from Dharoi dam plantation area 30 km SW of Khedbramha, Himatnagar, N.S. Rathore coll., 5.iii.1992, Ex. wooden stump. (iv) from Kheroj village 26 km NW of Khedbramna, Himatnagar, N.S. Rathore coll., 6.iii.1992, Ex. under stone. (v) from Medari and Vanoj village of Vijaynagar forest, Himatnagar, N.S. Rathore coll., 7.iii.1992, Ex. under stone.

Lot (C) from Lunavada village, Godhara, R. Sewak coll., 21.viii.1989, Ex. under stone.

Lot (D) from Bhanvad village 64 km S of Jamnagar, R. Sewak coll., 28.viii.1990, Ex. under stone.

Lot (E) from Talata village 75 km S of Junagarh, R. Sewak coll. 31.viii.1990. Ex. under dung.

Lot (F) from Gondal from 88 kms S of Rajkot, R. Sewak coll. 6.ix.1990, Ex under stone.

Lot (G) from Dolia and around 52 kms SW of Surendranagar, R. Sewak coll., 30.viii.1991, Ex. under dung.

Lot (H) from taranga hills 60 kms NE of Unjha, Mahesana, N.S. Rathore coll., 23.ii.1992, Ex. under stone.

Diagnostic characters : *Soldier* : Dimorphic : Soldier major : Head dark golden yellow to brown, Fontanelle gland area paler; rostrum reddish to dark brown, apically reddish brown; antennae brown, apical segments slightly paler; abdomen pale brown to dark smoky brown above; sternites and legs paler, straw coloured. Head with minute hairs all over, longer hair generally absent, nasute

with minute hairs all over and 1 or 2 slightly longer hair at tip; pronotum with minute hairs along margins; abdomen tergites with short and long hairs. Total body-length 4.00-5.30 mm Head-capsule without rostrum broadly pyriform to almost round. Anteriorly sharply convergent (length with rostrum 2.15-2.52, length without rostrum 1.33-1.62, maximum width 1.23-1.63 mm); in profile fairly incurved behind rostrum and strongly arched at occiput. Rostrum short, conical, width at base variable, and little raised anteriorly (length 0.77-0.95 mm); about 1/2 to 2/3 of head-length without rostrum (index rostrum-length/head-length 0.50-0.67 mm). Antennae with 12-14 segments; segment 3 two and half times as long as 2 and subequal to 4 in 12 segmented one, almost two and half times as long as 2 and twice as long as 4 in 13 segmented one and a little longer than 2 in 14 segmented one, segment 3 about two and half times as long as 2 and 4 about half of 3. Mandibles vestigial without spines. Pronotum strongly saddle-shaped, length 0.22-0.30, width 0.56-0.68 mm, anterior margin weakly emarginated at middle. Soldier minor : Body colour and pilosity as in soldier major, rostrum somewhat paler or darker. Total body-length 2.95-4.0 mm. Head-capsule elongately pyriform to subrectangular (length with rostrum 1.40-1.73, length without rostrum 0.81-1.10, width 0.55-0.70 mm); in profile weakly to appreciably incurved, sometimes with a faint indication of hump. Rostrum thin, long, cylindrical; comparatively longer in relation to head-length than in soldier major (length 0.58-0.73 mm index rostrum-length/head-length 0.62-0.76); in profile weakly to appreciably raised anteriorly. Antennae with 12-14 segments; segment 3 more than twice to nearly three times that of segment 2 in length; segment 4 a little shorter than 3. Mandibles and pronotum (length 0.18-0.22, width 0.41-0.48 mm) as in major soldier; and anterior margin of pronotum sometimes without any emargination. *Worker* : Head-capsule brown to smoky brown, anteriorly yellowish brown, somewhat paler laterally and translucent along Y-suture; antennae, postclypeus legs and abdominal tergites yellowish to pale yellowish brown. Head and body with numerous minute and few long hairs; sternites

more hairy. Total body-length 3.90-4.80 mm. Head-capsule subcircular (length to base of mandibles 1.25-1.50, width 1.35-1.63 mm); Y-suture prominent. Fontanelle plate oval, whitish. Antennae with 15 segments; segment 2, 3 and 4 subequal. Postclypeus swollen, hairy; length about 1/2 width (length 0.33, width 0.65-0.68 mm). Pronotum strongly saddle-shaped (length 0.25-0.38, width 0.55-0.73 mm); anterior lobe greatly upturned and weakly to strongly emarginated at middle; posterior, margin convex, without notch.

Distribution : India : widely distributed and is reported from Maharashtra, Madhya Pradesh, Rajasthan, West Bengal, Tamil Nadu, Andhra Pradesh, Kerala, Karnataka, Orissa, Delhi and Gujarat (Gandhinagar, Jamnagar, Godhra, Kachchh, Sabarkantha, Banaskantha, Surendranagar, Valsad, Rajkot and Mahesana).

Elsewhere : Sri Lanka and Pakistan.

60. *Trinervitermes fletcheri* Chatterjee & Thakur

1965. *Trinervitermes fletcheri* : P. N. Chatterjee and M. L. Thakur, *Bull. Syst. Zool.*, 1(1) : 11-18. Soldier minor and worker. Holotype : S, in FRI. Type-locality : Coimbatore, Tamil Nadu, India.

1997. *Trinervitermes fletcheri* : O. B. Chhotani, *Fauna of India and adjacent countries, Isoptera (Termites)*, Vol. II : 732-734, *Zool. Surv. India*.

Caste known : Soldier and worker.

Material examined : Three vial with soldier and workers from Dangs, Gandhinagar and Valsad district, N.S. Rathore coll. (i) from Kaprada forest, near Govatka village, 28.xii. 1980 (ii) from Bokhra 2 km from Forest Rest house, Ahwa, 29.xii.1980 (iii) from road side 15 kms from Gandhinagar, 3.i.1981.

Diagnostic characters : *Soldier* : Dimorphic. Soldier major : Head-capsule yellowish brown to brown; rostrum dark brown; antennae rusty yellow; abdominal tergites pale brown; sternites and legs pale yellow. Head and abdominal tergites without any long hairs; rostrum tip with a few short hairs; abdominal sternites with short and long hairs. Total body-length 4.50-5.00 mm.

Head-capsule with rostrum 2.43-2.50 mm and without rostrum 1.55-1.65, width 1.35-1.50 mm); in profile weakly incurved behind base of rostrum, arched at occiput; rostral hump absent. Rostrum weakly conical; anteriorly uplifted a little; length about half of head-length without rostrum (length 0.80-0.90 mm, index rostrum-length/head length 0.49-0.55 mm). Antennae with 14 segments; segment 3 about one and half time of 2; 4 almost as long as 3. Mandibles vestigial, without spines. Pronotum saddle-shaped (length 0.25-0.30, width 0.60-0.75 mm); anterior lobe strongly raised and with a strong invagination at anterior margin; posterior margin subconvex. *Soldier minor* : Head-capsule yellow; legs and abdominal sternites pale yellow; abdominal tergites pale brownish. Pilosity as in soldier major. Total body-length 3.0-3.5 mm. Head-capsule subrectangular; sides slightly incurved behind antennae (length with rostrum 1.65-1.80, length without rostrum 0.98-1.08, width 0.63-0.70 mm); in profile incurved appreciably behind rostrum. Rostrum long, cylindrical, raised a little anteriorly (length 0.65-0.80 mm); nearly 2/3 to 3/4 of head-length (index rostrum-length/head-length 0.67-0.78 mm). Antennae long; with 12-14 (generally 13), segments; segment 3 in 12 and 13 segmented one nearly twice as long as 2 and slightly longer than 2 in 14 segmented one. Mandibles as in soldier major. Pronotum small, saddle-shaped (length 0.15-0.20, width 0.45-0.50 mm). *Worker* : Head-capsule brown to reddish brown; antennae, anteclypeus, labrum, pronotum and legs straw coloured; abdominal tergites brownish. Head and body with a few microscopic hairs; sternites with long and short hairs. Total body-length 5.0-5.9 mm. Head-capsule subsquarish, wider than long (length to base of mandibles 1.55-1.70, width 1.68-1.80 mm); epicranial suture prominent. Fontanelle pale subtriangular, white, translucent. Antennae with 15 segments; segment 3 about one and half times of 2; 4 a little shorter than 3. Postclypeus swollen; length less than 1/2 of width. Pronotum strongly saddle-shaped (length 0.45-0.50, width 0.80-0.93 mm); anterior margin with deep emargination; posterior margin convex.

Distribution : India : Tamil Nadu (Coimbatore), Gujarat (Dangs, Gandhinagar and Valsad districts).

SUMMARY

In all 60 species of Isoptera (termites) belonging to 16 genera under 4 families and 8 subfamilies are recorded from Gujarat. One new species to genus *Cryptotermes* and 13 new records of genus *Heterotermes* (1), *Speculitermes* (1), *Amitermes* (1), *Eremotermes* (1), *Microcerotermes* (2), *Angulitermes* (1), *Dicuspitermes* (1), *Odontotermes* (5) are being reported for the first time from the state. Family Kalotermitidae representing 3 species, family Hodotermitidae with 1 species, family Rhinotermitidae with 6 species and family Termitidae representing 50 species and have largest representation. A comprehensive classified list of taxa of Isoptera known from Gujarat is also provided.

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REFERENCES

- Ahmad, M. 1955. Termites of West Pakistan; *Biologia*, 1(2) : 202-264.
- Ahmad, M. 1965. Termites (Isoptera) of Thailand; *Bull. Amer. Mus. Nat. Hist.*, 131(1) : 1-114.
- Assmuth, J. 1913. Wood-destroying White Ants of the Bombay Presidency; *J. Bombay nat. Hist. Soc.*, 23(2) : 372-384.
- Bose, G. 1984. Termite Fauna of Southern India; *Rec. zool. Surv. India*, (Misc. Pub.), *Occ. Paper No. 49* : IX + 1-270.
- Bose, G. and Das, B. C. 1987. Insecta : Isoptera (A Check List), *Fauna of Orissa : State Fauna Series No. 1* : 103, *Zool. Surv. India*.
- Chatterjee, P. N. and Thakur, M. L. 1964. Revision of Termite Genus *Microtermes* Wasmann (Isoptera : Termitidae : Microtermitinae) from the Indian Region; *Indian For. Rec.*, 10(11) : 219-260.
- Chatterjee, P. N. and Thakur, M. L. 1968. On a Collection of Termites from Daman; *Indian Forester*, 94(7) : 560-570.
- Chaudhary, M. I., Ahmad, M., Malik, N. K., Akhtar, M. S. and Arshad, M. 1972. Termites of Pakistan (Identification, Distribution and Ecological Relationship); *Final Tech. Report, PL-480 Project No. A. 17-FS-12 (1967-1972)* : 1-70.
- Chhotani, O. B. 1963. The Termites *Cryptotermes havilandi* (Sjostedt) from the Interior of India; *J. Bombay nat. Hist. Soc.*, 66(1) : 287-288.
- Chhotani, O. B. 1970. Taxonomy, Zoogeography and Phylogeny of the Genus *Cryptotermes* (Isoptera : Kalotermitidae) from the Oriental region; *Mem. Zool. Surv.*, 15(1) : 1-81.
- Chhotani, O. B. 1977. Termites of Kanha National Park (M.P.), India; *Rec. zool. Surv. India*, 22 : 367-388.
- Chhotani, O. B. 1980. Termite pest of Agriculture in Indian Region and their Control; *Zool. Surv. India, Tech. Monogr.*, No. 4 : 1-84.

- Chhotani, O. B. 1997. *Fauna of India : Isoptera, (Termites)* Vol. II. XXVIII + 800 (Publ. Zool. Surv. India), Calcutta.
- Holmgren, K. and Holmgren, N. 1917. Report on a Collection of Termites from India; *Mem. Dept. Agric. India (Ent.)*, **5**(3) : 137-171.
- Holmgren, N. 1913a. Termites from British India (near Bombay, Gujarat and Bangalore) Collected by Dr. J. Assmuth; *J. Bombay nat. Hist. Soc.*, **22**(1) : 101-117.
- Holmgren, N. 1913b. Termiten Studdien IV. Versucheiner systematischen monographie der Termiten der Orientalischen Region; *K. Svenska Vetensk. Acad. Handl.*, **50**(2) : 1-276.
- Maiti, P. K., Lahiri, A. R., Saha, N. and Roy, P. H. 1995. Insecta : Isoptera (Termite). *State Fauna Series : Fauna of Meghalaya*, **4**(3) : 431-455., *Zool. Surv. India*.
- Maiti, P. K. and Saha, N. 1993. Insecta : Isoptera. *State Fauna Series : Fauna of West Bengal*, **3**(4) : 511-523, *Zool. Surv. India*.
- Maiti, P. K. and Saha, N. 1997. Isoptera. *State Fauna Series : Fauna of Delhi*, **6** : 207-213, *Zool. Surv. India*.
- Maiti, P. K., Saha, N. and Roy, P. H. 2000. Insecta : Isoptera. *State Fauna Series : Fauna of Tripura*, **7**(2) : 295-308, *Zool. Surv. India*.
- Mathur, R. N. and Thapa, R. S. 1965. Some Termites from Assam (India) with Description of Three New Species; *Bull. Ent.*, **6** : 1-14.
- Prashad, B. and Sen-Sarma, P. K. 1966. Review of the Genus *Trinervitermes* Holmgren from the Indian Region (Isoptera : Termitidae : Nasutitermitinae); *Indian For. Bull. (N. S.) Ent.*, **247** : 1-42.
- Prashad, B., Thapa, R. S. and Sen-Sarma, P. K. 1970. Revision of the Indian Species of the Genus *Microcerotermes* Silvestri (Isoptera : Termitidae : Amitermitinae); *Indian For. Bull. (N. S.) Ent.*, **246** : 1-56.
- Rathore, N.S. 1987. First Indian Record of Imago of the Termite *Eremotermes neoparadoxalis* (Termitidae : Amitermitinae); *Annals of Arid Zones*, **26**(3) : 177-180.
- Rathore, N.S. 1994. A new species of *Cryptotermes* (Isoptera : kalotermitidae) from Gujarat, India; *Hexapoda*, **6**(1) : 19-32.
- Rathore, N.S. 1996. Termites (Isoptera) of the Thar Desert; *Faunal Diversity in Thar Desert Gaps in Researches* (Ed. By A. K. Ghosh, Q. H. Baqri and I. Prakash), 171-183. (Scientific Publisher, Jodhpur).
- Rathore, N.S. 1999. New Record of a Termite *Dicuspiditermes incola* (Wasmann) from Gujarat, India (Isoptera : Termitidae). *Bionotes*, **1**(2) : 39-40.
- Rattan lal and Menon, R. D. 1953. Catalogue of Indian Insects, Part 27-Isoptera : 2 + 1-94. (Govt. India Pub.).
- Roonwal, M. L. 1994. Nomenclature Status of a Palestine Termite, *Microcerotermes palestinensis* (Termitidae : Amitermitinae); *J. zool. Soc. India*; **24**(2) : 193-194.
- Roonwal, M. L. and Bose, G. 1962. A redescription of the Indian Termite, *Odontotermes bellahumisensis* Holmgren and Holmgren, with Description of a new subspecies of it from Rajasthan; *J. Bombay nat. Hist. Soc.*, **58**(3) : 580-594.

- Roonwal, M. L. and Bose, G. 1964. Termite Fauna of Rajasthan, India; *Zoologica, Stuttgart*, **40(3)** : (Heft 113) : VI+58.
- Roonwal, M. L. and Chhotani, O. B. 1960. Soldier caste found in the Termite Genus *Speculitermes*; *Sci. and Cult.*, **26(3)** : 143-144.
- Roonwal, M. L. and Chhotani, O. B. 1962a. Termite Fauna of Assam region, Eastern India; *Proc. natnl. Inst. Sci. India*, (B) **28(4)** : 281-406.
- Roonwal, M. L. and Chhotani, O. B. 1962b. Indian Species of Termite Genus *Coptotermes*; *Indian Counc. Agric. Res.; (Ent. Monogr. No. 2)* : IX + 1-115.
- Roonwal, M. L. and Chhotani, O. B. 1989. The Fauna of India and the Adjacent Countries. Isoptera (Termites), Vol. I (Introduction and families : Termipsidae, Hodotermitidae, Kalotermitidae, Rhinotermitidae, Stylotermitidae and Indotermitidae), 8 + viii + 672 pp., 5 pls. (Publ. *Zool. Surv. India*), Calcutta.
- Roonwal, M. L. and Sen-Sarma, P. K. 1960. Contribution to the Systematics of Oriental Termites; *Indian Counc. Agric. Res. (Ent. Monogr. No. 1)* : XV + 1-407.
- Roonwal, M. L. and Verma, S. C. 1977. Re-survey of the Termite Fauna of Rajasthan, India and its Zoogeography; *Rec. zool. Surv. India*, **72** : 425-480.
- Sands, W. A. 1972. The Soldierless Termites of Africa (Isoptera : Termitidae); *Bull. Br. Mus. Nat. Hist. (Ent.)*, **18** : 1-244.
- Sen-Sarma, P. K. and Thakur, M. L. 1979. Termites of Tripura (Insecta : Isoptera); *Indian For. Rec.*, **13(1)** : 1-67.
- Snyder, T. E. 1933. New Termites from India. *Proc. U. S. natnl. Mus.*, **82(16)** : 1-15.
- Snyder, T. E. 1934. New Termites from India. *Indian For. Rec.*, **20(11)** : 1-28.
- Snyder, T.E. 1949. Catalogue of the Termites (Isoptera) of the World; *Smiths Misc. Coll.*, **112** : 1-490.
- Thakur, M.L. 1976. Zoogeography of Termite Genus *Odontotermes* in the (Isoptera : Termitidae : Macrotermitinae); *Indian Forester*, **102(8)** : 498-505.
- Thakur, M.L. 1980. Bioecology and Zoogeography of Termite Genus *Cryptotermes* in the Indian Region (Isoptera : Kalotermitidae); *J. Bombay nat. Hist. Soc.*, **76(1)** : 106-114.
- Thakur, M. L. 1981. Revision of Termite Genus *Odontotermes* Holmgren from India (Isoptera : Termitidae : Macrotermitinae); *Indian For. Rec.*, **14(2)** : 1-183.
- Thakur, M. L. 1984. A review of family Macrotermitidae (Insecta : Isoptera) from the Oriental Region; *Oriental Insects*, **17** : 35-77.
- Thakur, M. L. and Sen-Sarma, P. K. 1979. Revision of termite genus *Heterotermes* Froggatt (Isoptera : Rhinotermitidae : Heterotemitinae) from the Indian Region. *Indian For. Rec. Ent. (N.S.)*, **13(2)** : 1-27.
- Thakur, R. K. 1985. Pest status of termites in Gujarat, India (Insecta : isoptera); *Indian Journal of Forestry*, **8(1)** : 37-40.
- Thakur, R. K. 1989. Termite fauna of Gujarat (Insecta : Isoptera); *Indian For. Rec. (N.S.), Ent.*, **15(1)** : 1-76.

- Thakur, R. K. 1991. Field ecology, ecobiogeography and economic importance of Gujarat termites: *Indian For. Rec. (N.S.), Ent.*, **16**(1) : 1-41.
- Thakur, R. K. and Rathore, N.S. 1982. On the occurrence of *Cryptotermes bengalensis* Snyder (Isoptera : Kalotermitidae) in Gujarat, India. *J. Bombay nat. Hist. Soc.*, **79**(3) : 699-700.
- Unesco, 1962. Humid Tropics Research; *Proc. Intern. Symp. On Termites in the Humid Tropics*, (Oct., 4-12, 1960), Unesco Publication, **1962** : 1-254.
- Verma, S. C. and Thakur, R. K. 1982. Termites from Madhya Pradesh, India, with new distribution records (Insecta : Isoptera); *Rec. zool. Surv. India*, **79** : 311-318.
- Verma, S. C., Purohit, G. L. and Rathore, N.S. 1993. The Termites (Isoptera) of Haryana, India. *Zoology*, **3**(3) : 211-225.

INSECTA : HEMIPTERA : COCCOIDEA

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INTRODUCTION

Almost nothing is known about the coccid fauna of Gujarat. There are some sporadic records, which have been compiled here from the published literature. Only 11 species are reported here, based on the check-list (Varshney, 1992, 1995).

The author undertook a survey tour of the Saurashtra region, particularly Distts. Jamnagar and Junagadh, in March-April, 1997. However, no appreciable infestations were come across. This may be due to the peculiar alkaline soil in this region, paucity of fresh water and the preponderance of petrochemicals, marble tiles and other industries. The dry deciduous forest is visible in the Gir National Park and Wildlife Sanctuary (Junagadh) only. Kasargode (1914) has dealt with some coccids of western India, but it does not deal with Gujarat. Varshney (1996) has consolidated information on the Thar coccids.

SYSTEMATIC ACCOUNT

Family MONOPHLEBIDAE

Genus *Hemaspido*proctus Morrison

Type species : *Walkeriana cinerea* Green.

1. *Hemaspido*proctus cinereus (Green)

1908. *Walkeriana cinerea* Green, Mem. Dept. Agr. India (Ent.), 2 (2) : 18.

1922. *Aspido*proctus cinerea; Green, Coccidae of Ceylon, Pt. 5 : 450.

1928. *Hemaspido*proctus cinerea; Morrison, Tech. Bull. U.S. Dept. Agr., 52 : 148.

1970. *Hemaspido*proctus cinerea; Ali, Indian Mus. Bull., 5 (1) : 86.

1992. *Hemaspido*proctus cinereus; Varshney, Rec. zool. Surv. India, Occ. Paper, 139 : 20.

Host plants : *Acacia arabica* in Gujarat. Also recorded on *Grevillea*, *Terminalia*, *Thespesia*, *Achras*, *Psidium*, *Punica* etc.

Distribution : India : Gujarat : Surat. Also recorded from Bihar, Delhi, Rajasthan, Tamil Nadu and Kerala in India and from Bangladesh, Pakistan, Sri Lanka and Indonesia.

Remark : Originally this species was collected from Gujarat and Green named it in 1908, but described it in 1922 publication shown above.

Family TACHARDIIDAE

Genus *Kerria* Targ.

Type species : *Coccus lacca* Kerr

2. *Kerria* sp.; Indian lac insect.

1977. *Kerria* : Varshney, Oriental Ins. Suppl., No. 5 (1976) : 19.

2000. *Kerria* sp. : Varshney, Bionotes, 2 (2) : 27.

Host Plant : *Ziziphus mauritiana*. Polyphagous.

Distribution : India : Gujarat : Dahegam, in the east of Gandhinagar.

Remark : The author collected a moderate natural encrusted colony of lac insect in April 1997, on a *Ziziphus* tree, planted in the Dahegam Govt. Rest House campus.

This is the first authentic collection of the lac insect in Gujarat. Varshney (1977) has shown only a doubtful occurrence in the State and Varshney (2000) made the record.

Family PSEUDOCOCCIDAE

Genus *Coccidohystrix* Lindinger

Type species : *Echinococcus echinatus*
Balachowsky.

3. *Coccidohystrix insolita* (Green)

1908. *Phenacoccus insolitus* Green, *Mem. Dept. Agr. India (Ent.)*, **2** (2) : 26.
1930. *Phenacoccus insolitus*; Ayyar, *Bull. Dept. Agr. Res. Inst. Pusa*, **197** : 61.
1954. *Centrococcus insolitus*; Ferris, *Microent.*, **19** (2) : 54.
1970. *Coccidohystrix insolita*; De Lotto, *Ent. Mem. Dept. Agr. Union S. Africa*, **20** : 2.
1992. *Coccidohystrix insolita*; Varshney, *Rec. zool. Surv. India, Occ. Paper*, **139** : 40.

Host plants : A pest on brinjal (*Solanum melongena*). Also recorded on *Abutilon*, *Hibiscus*, *Euphorbia*, *Momordica*, *Ficus*, *Croton*, *Dalbergia*, *Morus* etc.

Distribution : India : South Gujarat. Also recorded from Bihar, U.P., West Bengal, Andhra Pradesh, Goa, Tamil Nadu, Kerala etc. in India and from Pakistan, Bangladesh, Sri Lanka, China and various countries of Africa.

Genus *Rastrococcus* Ferris

Type species : *Phenacoccus iceryoides* Green.

4. *Rastrococcus iceryoides* (Green)

1908. *Phenacoccus iceryoides* Green, *Mem. Dept. Agr. India (Ent.)*, **2** (2) : 26.
1922. *Phenacoccus iceryoides*; Green, *Coccidae of Ceylon*, Pt. **5** : 393.
1954. *Rastrococcus iceryoides*; Ferris, *Microent.*, **19** (2) : 55.
1970. *Rastrococcus iceryoides*; Ali, *Indian Mus. Bull.*, **5** (2) : 97.
1992. *Rastrococcus iceryoides*; Varshney, *Rec. zool. Surv. India, Occ. Paper*, **139** : 46.

Host plants : On *Capparis* in Gujarat. Also recorded on mango, citrus, *Ficus*, *Achras*, *Lannea*, *Hibiscus*, *Vitex*, *Cajanus*, cotton and other cultivated plants etc.

Distribution : India : Gujarat : Surat. Also

recorded from U.P., Bihar, W. Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra and Andaman Is. in India and from Bangladesh, Sri Lanka, Thailand, Malaysia, Indonesia, Hong Kong and Japan etc.

5. *Rastrococcus invadens* Williams

1986. *Rastrococcus invadens* Williams, *Bull. ent. Res.*, **76** (4) : 696.
1992. *Rastrococcus invadens*; Varshney, *Rec. zool. Surv. India, Occ. Paper*, **139** : 46.

Host plants : *Mangifera*, *Citrus*, *Echites*, *Premna*, *Ailanthus*, *Psidium*, *Calophyllum* and *Ficus*.

Distribution : India : Gujarat : Junagadh : Mangrol. Also recorded from U.P., Orissa, Bihar, W. Bengal, Andhra Pradesh, Sikkim, Maharashtra and Karnataka in India and from Pakistan, Bangladesh, and Sri Lanka.

Remarks : A species described by Williams (1986) and reported to have been introduced in west Africa from the Oriental region.

Narasimham (1990) has provided its field diagnostic characters.

Genus *Planococcoides* Ezzat & McConnell

Type Species : *Pseudococcus njalensis* Laing.

6. *Planococcoides robustus* Ezzat & McConnell

1956. *Planococcoides robustus* Ezzat & McConnell, *Bull. Maryland Agr. Exp. Stn*, A **84** : 59.
1992. *Planococcoides robustus*; Varshney, *Rec. zool. Surv. India, Occ. Paper*, **139** : 56.

Host plants : On roots and fruits of mango, citrus, *Lannea*, *Phoenix*, *Albizia*, *Ficus*, *Erythrina*, *Acacia*, *Artocarpus*, *Vitis*, etc.

Distribution : India : Gujarat : Baroda and Surat. Also recorded from U.P., Bihar, Orissa, Andhra Pradesh, Karnataka, Kerala and Maharashtra in India and from Bangladesh, Pakistan, etc.

Remark : This species has not been included in the catalogue of Oriental Coccoidea by Ali (1970a : 89).

Family COCCIDAE

Genus *Ceroplastes* Gray

Type Species : *Coccus (Ceroplastes) janeirensis* Gray.

7. *Ceroplastes actiniformis* Green

1896. *Ceroplastes actiniformis* Green, *Indian Mus. Notes*, 4 : 8.

1914. *Ceroplastes actiniformis*; Kasargode, *J. Bombay nat. Hist. Soc.*, 23 : 136.

1974. *Ceroplastes actiniformis*; Ali, *Indian Mus. Bull.*, 6 (2) (1971) : 15.

1992. *Ceroplastes actiniformis*; Varshney, *Rec. zool. Surv. India, Occ. Paper*, 139 : 78.

Host Plants : Polyphagous. On palms, mango, guava, grape vine, *Canna*, *Areca*, *Santalum*, *Ficus*, *Ipomoea*, *Populus*, *Cordia*, *Erythrina*, etc.

Distribution : India : South Gujarat. Also recorded from U.P., Bihar, W. Bengal, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Goa and Maharashtra in India and in Pakistan, Sri Lanka and Indonesia.

Genus *Coccus* Linn.

Type species : *Coccus hesperidum* Linn.

8. *Coccus hesperidum* Linnaeus

1758. *Coccus hesperidum* Linnaeus, *Systema Nat.*, ed. 10th, 1 : 455.

1930. *Lecanium hesperidum*; Ayyar, *Bull. Dept. Agr. Res. Inst. Pusa*, 197 : 46.

1974. *Coccus hesperidum*; Ali, *Indian Mus. Bull.*, 6 (2) (1971) : 24.

1985. *Coccus hesperidum*; Varshney, *Oriental Ins.*, 19 : 26, Fig. 9.

1992. *Coccus hesperidum*; Varshney, *Rec. zool. Surv. India, Occ. Paper*, 139 : 84.

Host plants : On *Citrus* in Gujarat. Also recorded on many plants including palms, coconut, redgram, tea, areca nut, *Amaranthus*, *Croton*, *Diospyros*, *Eugenia*, *Ficus*, *Lonicera*, *Mangifera*, *Psidium*, *Hibiscus*, *Vinca*, *Ziziphus*, etc.

Distribution : India : Gujarat : Surat (Misra, 1923). Also recorded from Jammu & Kashmir, Bihar, Assam, Tripura, W. Bengal, Orissa, Andhra Pradesh, Kerala, Karnataka and Goa in India and from Bangladesh, Myanmar, Pakistan, Sri Lanka, Thailand, Indonesia, Malaysia and several other parts of the world.

Remark : This is type species of genus *Coccus*, which is type genus of the family and superfamily.

Genus *Ceroplastodes* Cockerell

Type species : *Lecanopsis dugesii* Signoret

9. *Ceroplastodes cajani* (Maskell)

1891. *Eriochiton cajani* Maskell, *Indian Mus. Notes*, 2 : 61.

1900. *Ceroplastodes cajani*; Cockerell, *Nature*, 61 : 368.

1930. *Ceroplastodes cajani*; Ayyar, *Bull. Dept. Agr. Res. Inst. Pusa*, 197 : 42.

1974. *Ceroplastodes cajani*; Ali, *Indian Mus. Bull.*, 6 (2) (1971) : 53.

1992. *Ceroplastodes cajani*; Varshney, *Rec. zool. Surv. India, Occ. Paper*, 139 : 106.

Host plants : On *Coleus* sp. in Gujarat. Also recorded on *Cajanus*, *Ziziphus*, *Ocimum*, *Tephrosia*, *Ficus*, *Hibiscus*, *Ipomoea*, etc.

Distribution : India : Gujarat : Surat. Also recorded from Himachal Pradesh, U.P., W. Bengal, Tamil Nadu, Andaman Is. and North-eastern states in India and from Pakistan, Sri Lanka, Malaysia and Philippine Is.

Remark : Reported by Fletcher (1919) from Gujarat.

Family DIASPIDIDAE

Genus *Chrysomphalus* Ashmead

Type species : *Coccus aonidum* Linnaeus.

10. *Chrysomphalus aonidum* (Linn.)

1758. *Coccus aonidum* Linnaeus, *Systema Nat.*, ed. 10th, 1 : 455.

1880. *Chrysomphalus ficus*; Ashmead, *Amer. Ent.*, 3 : 267.

1930. *Aspidiotus ficus*; Ayyar, *Bull. Dept. Agr. Res. Inst. Pusa*, **197** : 25.

1970. *Chrysomphalus ficus*; Ali, *Indian Mus. Bull.*, **5** (1) : 40.

1985. *Chrysomphalus aonidum*; Varshney, *Oriental Ins.*, **19** : 33.

Host plants : Polyphagous. On *Ficus*, *Eugenia*, *Phoenix*, *Areca*, *Mangifera*, *Citrus*, *Cocos*, etc.

Distribution : India : Gujarat : Mahuva. Also recorded from Bihar, M.P., W. Bengal, Assam, Tripura, Andhra Pradesh, Tamil Nadu, Kerala Karnataka and Maharashtra in India and from Pakistan, Sri Lanka, Philippines, Taiwan, etc.

Genus *Melanaspis* Cockerell

Type species : *Aspidiotus obscurus* Cockerell.

11. *Melanaspis glomerata* (Green)

1903. *Aspidiotus (Targionia) glomeratus* Green, *Indian Mus. Notes*, **5** : 93.

1943. *Melanaspis glomerata* : Lindinger, *Arb. Morph. Taxon. Ent.*, **10** : 147.

1970. *Melanaspis glomerata*; Ali, *Indian Mus. Bull.*, **5** (1) : 49.

1985. *Melanaspis glomerata*; Varshney, *Oriental Ins.*, **19** : 33.

Host plants : A pest on sugarcane. Also occurs

on other species of *Saccharum*.

Distribution : India : Gujarat : Bardoli. Also recorded from Delhi, U.P., Bihar, Orissa, Andhra Pradesh and Tamil Nadu in India and from Pakistan.

Remark : Dealtwith in detail by Rao & Sankaran (1969).

SUMMARY

Eleven species of coccids occurring in Gujarat are reported. They belong to 5 families and 10 genera. Occurrence of the lac insect (*Kerria* sp.) in Gujarat has been confirmed.

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REFERENCES

- Ali, S.M. 1969. A catalogue of the Oriental Coccoidea. Part I. *Indian Mus. Bull.*, **4** (1) : 67-83.
- Ali, S.M. 1969a. A catalogue of the Oriental Coccoidea. Part II. *Indian Mus. Bull.*, **4** (2) : 38-73.
- Ali, S.M. 1970. A catalogue of the Oriental Coccoidea. Part III. *Indian Mus. Bull.*, **5** (1) : 9-94.
- Ali, S.M. 1970a. A catalogue of the Oriental Coccoidea. Part IV. *Indian Mus. Bull.*, **5** (2) : 71-150.
- Ali, S.M., 1974. A catalogue of the Oriental Coccoidea. Part V. *Indian Mus. Bull.*, **6** (2) (1971) : 7-82.
- Ayyar, T.V.R., 1930. A contribution to our knowledge of South Indian Coccidae (Scales and Mealy-bugs). *Bull. agric. Res. Inst. Pusa*, **197** (1929) : 73 pp.
- Fletcher, T.B. 1919. Annotated list of Indian crop pests. *Rep. Proc. 3rd Ent. Mtg. Pusa*, **3** (1) : 33-314.
- Kasargode, R.S., 1914. A preliminary account of the Coccidae of Western India. *J. Bombay nat. Hist. Soc.*, **23** : 133-137.

- Misra, C.S., 1923. A list of Coccidae in the Pusa collection. *Rep. Proc. 5th Ent. Mtg. Pusa*, **5** : 345-351.
- Narasimham, A.U. 1990. Field diagnostic characters of some *Rastrococcus* species occurring in India. *Oriental Ins.*, **24** : 259-265.
- Rao, V.P. & Sankaran, T., 1969. The scale insects of sugarcane. *In* : Pests of Sugarcane. Elsevier Publ. Co., Amsterdam : 325-342.
- Varshney, R.K. 1977. Taxonomic studies on Lac insects of India (Homoptera : Tachardiidae). *Oriental Ins. Suppl.*, No. **5** (1976) : 97 pp.
- Varshney, R.K. 1985. A review of Indian Coccids (Homoptera : Coccoidea). *Oriental Ins.*, **19** : 1-101.
- Varshney, R.K. 1992. A check list of the scale insects and mealybugs of South Asia. Part I. *Rec. zool. Surv. India, Occ. Paper*, No. **139** : 152 pp; [2002. *Ibid.*, Part 2. *Rec. zool. Surv. India, Occ. Paper*, No. **191** : 147 pp.].
- Varshney, R.K. 1995. Genera of the diaspidoid scale insects (Coccoidea : Diaspidoidea) of South Asia. *Israel J. Entomol.*, **29** : 153-155.
- Varshney, R.K., 1996. Scale Insects and mealybugs in the Indian Thar desert. *In* : Faunal Diversity in the Thar Desert - Gaps in Research. Scientific Publishers, Jodhpur : 185-189.
- Varshney, R.K. 2000. First authentic record of the Lac insect from Gujarat. *Bionotes*, **2** (2) : 27.
- Williams, D.J., 1986. *Rastrococcus invadens* sp. n. (Hemiptera : Pseudococcidae) introduced from the Oriental region to west Africa and causing damage to mango, citrus and other trees. *Bull. ent. Res.*, **76** (4) : 695-699.

INSECTA : COLEOPTERA

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INTRODUCTION

The present paper deals with the material collected by the different parties of Zoological Survey of India from Head Quarters, Calcutta. Of the parties, the renowned coleopterist, Late Dr. T.G. Vazirani led one of the parties in which another coleopterist Dr. G.N. Saha was one of the members. Dr. Vazirani mainly concentrated on the aquatic coleoptera of the family Dytiscidae and Dr. G.N. Saha on the family Meloidae. Materials of Dytiscidae and Meloidae collected from that area were studied by the respective authors and subsequently the results were published. Materials of other parties belonging to the different families have been worked out here and the results have been incorporated in the present paper. Besides this, extensive search was made to locate the material present in the National Zoological Collections which were also collected by different parties of Zoological Survey of India. Attempts were also made to search the published literature on Indian coleoptera and comparatively better results were achieved in the latter case. These efforts of exploring different sources were made to make the present account as comprehensive as possible. However, it appears that still very little is known coleoptera fauna of Gujarat State.

Altogether 77 species under 51 genera belonging to 11 families have been included in this paper. References, material studied, and distribution have been given under each species where the species are recorded for the first time from the state. Other species which were already reported in literature and no additional distributional could be added by actual study have only been included in the classified list and species

recorded as new from the state have been marked with asterisk. No key to the species and genera has been given. However, a key to the families recorded from the state has been given.

CLASSIFIED LIST OF SPECIES FROM THE STATE OF GUJARAT, INDIA

Family 1. CICINDELIDAE

Genus 1. *Cicindela* Linnaeus 1735

1. *Cicindela imperfecta* Chaudoir

Family 2. CARABIDAE

Genus 2. *Abacetus* Dejean 1828

2. *Abacetus guttata* Chaudoir

Genus 3. *Clivina* Laterille 1802

3. *Clivina lobata* Bon

Genus 4. *Amblystomus* Erichson 1837

4. *Amblystomus* sp.

Genus 5. *Tachys* Stephens 1828

5. *Tachys* sp.

Family 3. GYRINIDAE

Genus 6. *Dineutus* Macleay 1825

6. *Dineutus indicus* Aube

Family 4. DYTISCIDAE

Genus 7. *Hydrocoptus* Motschulsky 1859

7. *Hydrocoptus subvittulus* Motschulsky

Genus 8. *Canthydrus* Sharp 1882

8. *Canthydrus laetabilis* (Walker)

Genus 9. *Laccophilus* Leach 1817

9. *L. chinensis* Boheman

10. *L. flexuosus* Aube

11. *L. sharpi* Regimbart
 12. *L. parvulus* Aube
 13. *Laccophilus* sp.
 Genus 10. *Neptosternus* Sharp 1882
 14. *Neptosternus circumductus* Reg.
 Genus 11. *Hyphydrus* Iliger 1807
 15. *Hyphydrus flavicans* Reg.
 16. *H. intermixtus* Walker
 Genus 12. *Hydrovatus* Motschulsky 1855
 17. *Hydrovatus fuscus* Sharp
 Genus 13. *Clypeodytes* Regimbart 1894
 18. *Clypeodytes orissaensis* Vazirani
 Genus 14. *Guignotus* Houlbert 1934
 19. *Guignotus flammulatus* (Sharp)
 20. *G. gujaratensis* Vazirani
 21. *G. pendjabensis* Guignot
 Genus 15. *Yola* Gozis 1886
 22. *Yola consasanguina* (Reg.)
 Genus 16. *Uvarus* Guignot 1939
 23. *Uvarus genitilis* (Sharp)
 Genus 17. *Herophydrus* Sharp 1882
 24. *Herophydrus musicus* (Klug)
 Genus 18. *Pescheticus* Guignot 1935
 25. *Pescheticus quadricostatus* (Aube)
 26. *P. toxophorus* Guignot
 Genus 19. *Copelatus* Erichson 1832
 27. *Copelatus mysorensis* Vazirani
 Genus 20. *Eretes* Castelnau 1833
 28. *Eretes sticticus* (L.)
 Genus 21. *Hydaticus* Leach 1817
 29. *Hydaticus luczonicus* Aube
 30. *H. vittatus* (F.)
 31. *H. fabricii* Macleay
 Genus 22. *Sandracottus* Sharp 1882
 32. *Sandracottus dejeani* (Aube)
 Genus 23. *Cybister* Curtis 1827
 33. *Cybister tripunctatus asiaticus* Sharp
 34. *C. limbatus*. (Fabricius)

Family 5. HYDROPHILIDAE

- Genus 24. *Sternolophus* Solier, 1834
 35. *Sternolophus rufipes* (Fabricius)
 Genus 25. *Regimbartia* Zaitsev, 1908
 36. *Regimbertia attenuata* (Fab.)
 Genus 26. *Enochrus* Thomson 1859
 37. *Enochrus* sp.
 Genus 27. *Laccobius* Erichson, 1837
 38. *Laccobius* sp.
 Genus 28. *Helochares* Muls., 1844
 39. *Helochares* sp.

Family 6. HISTERIDAE

- Genus 29. *Peranus* Lewis 1906.
 40. *Peranus bimaculatus* (L.)
 Family 7. STAPHYLINIDAE
 Genus 30. *Paederus* Fabricius 1775
 *41. *Paederus fuscipes* Curt.
 Genus 31. *Leptacinus* Erichson, 1837-39.
 42. *Leptacinus parumpunctatus* (Gyll.)

- Genus 32. *Indoscitalinus* Heller, 1900
 *43. *Indoscitalinus feae* (Fauvel)
 Genus 33. *Philonthus* Curtis, 1825
 *44. *Philonthus pubipennis* Cameron
 *45. *P. poephagus* Cameron
 *46. *P. fimetarius* (Gr.)
 *47. *P. castaneus* Gemm. et Har.
 *48. *P. circumductus* Fauvel

Family 8. SCARABAEIDAE

- Genus 34. *Anthracophora* Burmeister 1842
 49. *Anthracophora crucifera* (Olivier)
 Genus 35. *Protaetia* Burmeister 1842
 50. *Protaetia ferrosa* (Gory & Percheron)
 51. *P. albogutta* (Vigors)
 Genus 36. *Pachyrrhinadoretus* Ohaus 1912
 52. *P. rugipennis* Ohaus
 Genus 37. *Adoretus* Castelnau 1840
 53. *A. lobiceps* Arrow
 54. *A. stoliczkae* Ohaus
 55. *A. bicolor* Brenske

56. *A. decanus* Ohaus

Genus 38 *Gymnopleurus* Illiger 1803

57. *G. sumptuosus* Castelnau

Genus 39. *Sisyphus* Latreille 1807

58. *S. neglectus* Gory

Genus 40. *Onthophagus* Latreille 1802

59. *O. sternalis* Arrow

60. *O. catta* (Fabricius)

Genus 41. *Onitis* Fabricius 1798

61. *O. philemon* Fabricius

Family 9. COCCINELLIDAE

Genus 42. *Scymnus* Kugelann 1794

62. *Scymnus* sp.

Genus 43. *Brumus* Mulsant 1850

63. *Brumus suturalis* (Fabricius)

Genus 44. *Menochilus* Timberlake 1943

64. *Menochilus sexmaculatus* (Fabricius)

Genus 45. *Coccinella* Linnaeus 1758

65. *Coccinella septempunctata* Linnaeus

Family 10. MELOIDAE

Genus 46. *Eletica* Lacordaire 1859

66. *Eletica* (*Meteletica*) *Kaszabi* Saha

Genus 47. *Psalydolytta* Peringuey 1909

67. *Psalydolytta antennata* Saha

68. *P. rouxi* (Laporte)

69. *P. villipes* (Haaq-Rutenberg)

Genus 48. *Mylabris* Fabricius 1775

70. *Mylabris ajantaensis* Saha

71. *M. phalerata* (Pallas)

Genus 49. *Cylindrothorax* Escherich 1896

72. *Cylindrothorax audouini* (Haag Rutenberg)

73. *C. pictus* (Laporte)

74. *C. ruficollis* (Fabricius)

75. *C. semitestaceus* (Fairmaire)

Genus 50. *Cyaneolytta* Peringuey 1909

76. *Cyaneolytta acteon* (Laporte)

Family 11. CURCULIONIDAE

Genus 51. *Crinorrhinus* Marshal 1941

77. *Crinorrhinus approximans* Marshal

SYSTEMATIC ACCOUNT

Key to the families of COLEOPTERA
recorded from Gujarat

- 1(8) Hind coxae immovably fused to the metasternum, completely dividing 1st visible abdominal sternite. Prothorax usually with notopleural suture distinct.
- 2(5) Terrestrial insects. Hind coxae not extending to the elytra; metapleure and the first visible abdominal segment are in contact. First 2-4 antennal segments glabrous.
- 3(4) Clypeus extending laterally in front of antennal insertions. Lacinia of maxilla usually with a hook articulated at apex. Elytra not regularly striate CICINDELIDAE
- 4(3) Clypeus not extending laterally in front of antennal insertions. Lacinia of maxilla very rarely with such a hook (Hexagonini)..... CARABIDAE
- 5(2) Aquatic insects with the hind coxae extending to the elytra and dividing the metapleure from the first visible abdominal segment. All antennal segment with similar surface ornamentation:
- 6(7) Eyes not completely divided. Antennae filiform. Mid and hind legs not very short and broadDYTISCIDAE
- 7(6) Eyes completely divided into dorsal and ventral parts. Antennae short and thick, 2nd segment with a process. Mid and hind legs forming short, broad paddles GYRINIDAE
- 8(1) Hind coxae rarely fused to metasternum, if so not dividing 1st visible abdominal sternite, prothorax rarely with notopleural suture.
- 9(16) Pleural sclerites of the true 2nd abdominal sternite distinct from those of 3rd, sternite itself represented by small lateral plates, rarely fully developed when the elytra are much shorter than the abdomen.

- 10(11) Antennae usually 10 segmented, with 3-7 apical segments produced on one side to form a lamellate club. Species usually stout SCARABAEIDAE
- 11(10) Antennae never with club of this type, species usually less stout.
- 12(13) Maxillary palpi nearly always longer than the antennae of which the first 3-5 segments are glabrous, the next segment cup like, and the last ones form a strong pubescent club. Habits normally aquatic HYDROPHILIDAE
- 13(12) Antennae not so constructed and not shorter than the maxillary palpi. Habits rarely aquatic.
- 14(15) Antennae with last 3 segments rarely forming club, if they do 1st segment not elongate. Exoskeleton rarely very hard and shining, elytra truncate and usually leaving more than 2 abdominal segments exposed STAPHYLINIDAE
- 15(14) Antennae geniculate with last 3 segments forming a compact club, Exoskeleton hard, black, shining, elytra truncate and leaving 1 or 2 abdominal segments exposed HISTERIDAE
- 16(9) Pleural sclerite of the true 2nd abdominal sternite almost always fused to that of third, sternite itself usually entirely membranous, more rarely fully sclerotised, Antennal club, if developed, not usually made up of the last 5 segments.
- 17(18) Head more or less produced into rostrum, gular suture nearly always confluent. Antennae usually geniculate and clubed CURCULIONIDAE
- 18(17) Head not produced into a rostrum, gular suture not confluent. Antennae not geniculate
- 19(20) Front coxae not projecting. Tarsal formula usually 3-3-3, never heteromerous Maxillary palpi securiform COCCINELLIDAE

20(19) Front coxae projecting. Tarsi heteromerous MELOIDAE.

Family I. CARABIDAE

Genus *Abacetus* Dejean, 1828

1. *Abacetus guttata* Choudoir

1852. *Abacetus guttata* Choudoir, Mon. P. 374.

Material examined : 1 ex. India : Gujarat Sasan 28.viii.69, V. Majumder.

Distribution : India : Gujarat (Sasan), North India, Madhyapradesh.

Elsewhere : Mynamar.

Genus *Clivina* Latreille

2. *Clivina lobata* Bon, 1802

1802. *Clivina lobata* Bon

1813. *Clivina lobata* Bon *Mem. Acad. Sci. Turin*, 20 : 481.

Material examined : 1 ex., India : Gujarat, Sasan, 28.viii.69. V. Majumder.

Distribution : India : Gujarat (Sasan).

Genus *Amblystomus* Erichson 1837

3. *Amblystomus* sp.

Material examined : 1 ex. India : Gujarat; Sasan, 28.viii.69, V. Majumder.

Genus *Tachys* Stephens, 1828

4. *Tachys* sp.

Material examined : 1 ex. India : Gujarat, Sasan, 28. viii. 69. V. Majumder. 1 ex. Gir Forest near Viabadar, Junagadh dist. 10.12. 1973. S.K. Gupta and party.

FAMILY II. DYTISCIDAE

Genus *Canthydrus* Sharp 1882

5. *Canthydrus laetabilis* (Walker)

1858. *Hydroporus laetabilis* Walker, *Ann. Mag. Nat. Hist.*, (3) 2 : 205.

1882. *Canthydrus laetabilis*, Sharp, *Sci. Trans. R. Dublin Soc.*, 2 : 277.

1977. *Canthydrus laetabilis*, Vazirani, *Cat. Orient. Dytiscidae*, P. 6.

Material examined : 3exs., India : Gujarat, Bhabnagar dist., Sihor, 26.xii. 1973, S.K. Gupta coll.

Distribution : India : Gujarat, Andhra Pradesh, Bihar, Assam, Kerala, Maharashtra, Orissa, Punjab, Rajasthan, U.P., W. Bengal.

Elsewhere : Sri Lanka; Nepal; Myanmar; Congo.

Genus *Laccophilus* Leach 1817

6. *Laccophilus parvulus* Aube

1838. *Laccophilus parvulus* Aube, *In : Dejean's, species Coleopteres*, 6 : 429.

1977. *Laccophilus parvulus*, Vazirani, *Cat. Orient. Dytiscidae*, P. 13.

Material examined : 1ex. India : Gujarat, Junagadh dist., Girforest, 10. xii. 1973. S.K. Gupta coll.; 5exs., INDIA : Gujarat, Bhabnagar dist., Sihar, 26.xii. 1973, S.K. Gupta coll.

Distribution : India : Gujarat, Assam, Manipur, Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, Goa, Orissa, Rajasthan, Tamil Nadu, W. Bengal.

Elsewhere : Sri Lanka; Pakistan; Thailand; Malaysia; Indonesia; Vietnam, Myanmar.

7. *Laccophilus* sp.

Material examined : 7exs., India : Gujarat, Bhabnagar dist., Sihor, 26.xii.1973, S.K. Gupta coll.

Remarks : The specimen does not agree with any of the Indian species so far described. Nearest Indian species is *Laccophilus sharpi* Reg., but the specimen differs in microsculpture and colour pattern. The specimen comes close to *L. religatus* Sharp, known only from Australia. The specimen may turn out to be a new species. However, no attempt has been made to describe it as a new species at present.

Genus *Hydaticus* Leach 1817

8. *Hydaticus luczonicus* Aube

1838. *Hydaticus luczonicus* Aube, *In : Dejean's species Coleopteres*, 6 : 179.

1977. *Hydaticus luczonicus*, Vazirani, *Cat. Orient. Dytiscidae*, P. 79.

Material examined : 5exs., India : Gujarat, Mehsana dist., Baba, 14.xii. 1973, P.T. Cherian coll.

Distribution : India : Gujarat, Bihar, Madhya Pradesh, Maharashtra, Orissa, Rajasthan, U.P., W. Bengal.

Elsewhere : Thailand.

9. *Hydaticus vittatus* (Fabricius)

1775. *Dytiscus vittatus* Fabricius, *Syst. ent. App.* 825.

1838. *Hydaticus vittatus* Aube, *In : Dejean's species Coleopteres*, 6 : 208.

1977. *Hydaticus vittatus*, Vazirani, *Cat. Orient. Dytiscidae*, P. 81.

Material examined : 1ex., India : Gujarat, Mehsana dist., Baba, 14.xii. 1973. P.T. Cherian coll.

Distribution : India : Gujarat, Tripura, W. Bengal, U.P., Tamil Nadu.

Elsewhere : Sri Lanka; Pakistan; Nepal; Myanmar; Bangladesh; China; Formosa; Japan; Indonesia.

10. *Hydaticus fabricii* Macleay

1833. *Hydaticus fabricii* Macleay, *Annulosa Javanica*, P. 134.

1977. *Hydaticus fabricii*, Vazirani, *Cat. Orient. Dytiscidae*, P. 76.

Material examined : 2 ex India : Gujarat, Mehsana dist., Baba, 14.xii. 1973, P.T. Cherian coll.

Distribution : India : Gujarat, Andaman Island.

Elsewhere : Sri Lanka.

Family IV. HYDROPHILIDAE

Genus *Sternolophus* Soiler, 1834

11. *Sternolophus rufipes* (Fabricius)

Material examined : 4 exs., Baba, Mehsana

dist. 14.xii.1973. P.T. Cherian coll.

Distribution : India : Gujarat, West Bengal. Also known from Asia, East Asia, Sunda Island.

Genus *Regimbartia* Zaitev 1908

12. *Regimbartia attenuata* (Fabricius)

1801. *Regimbartia attenuata* Fabricius, *Syst. Eleuth.* 1 : 235.

Material examined : 2exs. Gir forest near Vicabadar. Junagadh dist. 10.12.73. S.K. Gupta and Party.

Distribution : India: Gujarat, West Bengal. Also known from Sri Lanka, Eas Asia, Japan Australia.

Genus *Enochrus* Thomson, 1859

13. *Enochrus* sp.

Material examined : 5exs., Gir forest near Vicabadar Junagarh dist. 10.12.1973. S.K. Gupta coll.

Family V. HISTERIDE

Subfamily HISTERINAE

Genus *Peranus* Lewis 1906.

14. *Peranus bimaculatus* (L.)

1758. *Hister Z-maculatus* Linnaeus, *Syst. Nat.* ed. X, I, P. 358.

1910. *Peranus bimaculatus*, Bickhardt, *Coleopt. Catalog.*, *W. Junk, Pars 24* : P. 53.

Material examined : 21 exs., Songadh, Bhabnagar, dist., Gujarat. 30.xii.1973, S.K. Gupta coll.

Distribution : This species is already known from Kathiawar, Gujarat. It is also known from Europe, Asia, North America and Argentina.

Family VI. STAPHYLINIDAE

Genus *Paederus* Fabricius 1775

1775. *Paederus* Fabricius, *Syst. Ent.*, 268.

15. *Paederus fuscipes* Curt.

1823-40. *Paederus fuscipes* Curt., *Ent. Brit.*, 3 : 106.

1931. *Paederus fuscipes* : Cameron, *Fauna British India*, 2 : 40-41.

Diagnostic characters : Shining; head and last two abdominal segments black; thorax and first four (visible) abdominal segents red; elytra blue. Antennae dark, the first three or four segments testaceous. Legs testaceous, the apex of the femora, base of the tibiae and tarsi mor or less infuscate. Length 6.5 to 7 mm.

Material examined : 13exs., India : Gujarat, Dwarka, 14.ii. 1973, 10exs., S.K. Gupta coll., Junagadh district, Choralard Road, 6.xii. 1973, 3exs., S.K. Gupta coll.

Distribution : India : Gujarat, Bihar, West Bengal, Karnataka, Madhya Pradesh.

Elsewhere : Sri Lanka.

Remarks : In the present study this species is recorded for the first time from Gujarat.

Subfamily STAPHYLININAE

Genus *Leptacinus* Erichson

1837-39. *Leptacinus* Erichson, *Kaf. Mark Brand.*, : 429.

16. *Leptacinus parumpunctatus* (Gyll.)

1827. *Staphylinus parumpunctatus* Gyll., *Ins. Suec.*, 4 : 481.

1932. *Leptacinus parumpunctatus* : Cameron, *Fauna British India*, 3 : 8-9.

Material examined : 6exs., India: Gujarat, Songadh, Bhavanagar district, 6exs., 30.xii. 1973, S.K. Gupta coll.

Distribution : India : Gujarat. Also Known from other Indian States.

Remarks : In the present study this species is recorded for the first time from Gujarat.

Genus *Indoscitalinus* Heller 1900

1900. *Indoscitalinus* Heller, *Abh. Mus. Dresd.*, 9 (5) : 5

17. *Indoscitalinus feae* (Fauvel)

1895. *Xantholinus feae* Fauvel, *Rev. d'Ent.* 14 : 242.

1932. *Indoscitalinus feae* : Cameron, *Fauna British India*, 3 : 38 39.

Material examined : 1ex., India : Gujarat, Songadh, Bhavnagar district, 1ex., 30.xii. 1973, S.K. Gupta col.

Distribution : India : Gujarat.

Elsewhere : Myanmar.

Remarks : In the present study this species is recorded for the first time from Gujarat.

Genus *Philonthus* Curtis 1825

1825. *Philonthus* Curtis, *Brit. Ent.*, 13 : 610.

18. *Philonthus pubipennis* Cameron

1919. *Philonthus pubipennis* Cameron, *E.M.M.*, 4 : 253.

1932. *Philonthus pubipennis* Cameron, *Fauna British India* 3 : 75.

Material examined : 1ex., India : Gujarat, Songadh, Bhavnagar district., 1ex., 30.xii. 1973, S.K. Gupta coll.

Distribution : India : Gujarat.

Elsewhere : Sri Lanka.

Remarks : In the present study this species is recorded for the first time from Gujarat.

19. *Philonthus poephagus* Cameron

1928. *Philonthus poephagus* Cameron, *Ann. Mag. Nat. Hist.* 2 (10) : 562.

1932. *Philonthus poephagus* Cameron, *Fauna British India*, 3 : 79-80.

Material examined : 8exs., India : Gujarat, Songadh, Bhavnagar district, 8exs., 30.xii.1973, S.K. Gupta coll.

Distribution : India : Gujarat.

Elsewhere : Tibet.

Remarks : In the present study this species is recorded for the first time from India (Gujarat).

20. *Philonthus fimetarius* (Gr.)

1802. *Staphylinus fimetarius* Gr., *Col. Micr. Brunsv.* : 210.

1932. *Philonthus fimetarius* : Cameron, *Fauna British India*, 3 : 92-93.

Material examined : 2exs., India : Gujarat, Songadh, Bhavnagar district, 2exs., 30.xii. 1973, S.K. Gupta coll.

Distribution : India : Gujarat; Uttar Pradesh.

Elsewhere : Widely distributed in Europe.

Remark : In the present study this species is recorded for the first time from Gujarat.

21. *Philonthus castaneus* Gemm. et Har.

1868. *Philonthus castaneus* Gemm. et. Har., *Cat. Col.* 2 : 586.

1858. *Philonthus badius* Motschulsky, *Bull. Mosc.*, 31 (1) : 661.

1932. *Philonthus castaneus* : Cameron, *Fauna British India*, 3 : 99-100.

Material examined : 1ex., India : Gujarat, Songadh, Bhavnagar district, 1ex., 30.xii. 1973, S.K. Gupta coll.

Distribution : India : Gujarat, Delhi.

Remark : In the present study this species 'is recorded for the first time from Gujarat.

22. *Philonthus circumductus* Fauvel.

1895. *Philonthus circumductus* Fauvel, *Rev. d'Ent.* 14 : 263.

1932. *Philonthus circumductus* : Cameron, *Fauna British India* 3 : 118-119.

Material examined : 1ex., India : Gujarat, Songadh, Bhavnagar district, 1ex., 30.xii. 1973. S.K. Gupta coll.

Distribution : India : Gujarat, Uttar Pradesh.

Elsewhere : Myanmar, Philipines and Malay peninsula.

Remarks : In the present study this species is recorded for the first time from India (Gujarat).

Family VIII. COCCINELLIDAE

Genus *Scymnus* Kugelan 1794.

23. *Scymnus* sp.

Material examined : 7exs., Chorward Road,

Junagadh dist., 6.xii. 1973, and 10exs., Veraval, Junagadh dist., 11.xii. 1973, S.K. Gupta coll.

Remarks : Due to lack of literature and standard identified material this species could not be identified upto the species level. Even it appears to be a new species from this area.

Genus *Brumus* Mulsant 1850

24. *Brumus suturalis* (Fabricius)

1798. *Coccinella suturalis* Fabricius, *Suppl. Ent. Syst.*, P. 78.

1850. *Brumus suturalis* (Fab.) : Mulsant, *Ann. Soc. Agric. Lyon*, (2) 2 : 494.

Material examined : 5exs., Chorward Road, 6.xii. 1973 and 1ex., Veraval, 11.xii. 1973, Junagadh Dist., S.K. Gupta coll.

Distribution : This species is widely distributed throughout the Oriental Region. It has been recorded from West Bengal, Tripura and Meghalaya in the Eastern India and Goa on the extreme West.

Genus *Menochilus* Timberlake 1943.

25. *Menochilus sexmaculatus* (Fabricius)

1781. *Coccinella sexmaculata* Fabricius, *Spec. Ins.* : 96.

1943. *Menochilus sexmaculatus* (Fab.) : Timberlake, *Bul. Hawaiian Sug. Plrs. Ass. Exp. Stn.* (Ent. Ser.), No. 22, 47 : 40.

Material examined : 2exs., Veraval, Junagadh dist., 11.xii. 1973 and 2exs., Jetpir, Rajkot Dist., 30.i. 1973, S.K. Gupta coll.

Distribution : It is a widely distribution species. It ranges from Nepal to Goa and Andaman Islands.

Genus *Coccinella* Linnaeus 1758.

26. *Coccinella septempunctata* Linnaeus

1758. *Coccinella 7-punctata* Linnaeus *Syst. Nat.* (ed. X.) P. 365.

Material examined : 4exs., Somnath, 4.xii. 1973, S.K. Gupta coll.

Distribution : This species is originally described from Europe. In India it is generally found in the foot hills of Himalaya and the plains.

SUMMARY

The present paper deals with 76 species under 51 genera belonging to 11 families. Species which marked with asterix are all to new records from the state.

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REFERENCES

- ANDREWS, H.E. 1929. Coleoptera Carabidae Vol+1 Carabinae Fauna of Brit. India including Ceylon and Burma. 1-xiii + 1-430 Taylor and Francis London.
- ANDREWS, H.E. 1930 Catalogue of Indian Insects Part 18 Carabidae : 1-xxii + 1-388. Government of India Publication, Calcutta.
- ANDREWS, H.E. 1935. Coleoptera Carabidae Vol Burm Harpalinae-1 : Fauna Brit. India including Ceylon and Burma. 1-XVI + 1-323. Taylor and Francis. London.
- ARROW, G.J. 1910. Coleoptera, Lamellicornia, Cetoniinae and Dynastinae. Fauna. Brit. India. including Ceylon and Burma. 1- XIV + 1- 322. Taylor and Francis, London.

- ARROW, G.J. 1917. Coleoptera, Lamellicornia, Part 11, Rutelinae, Desmonychinae and Euchirinae Fauna Brit. India including Ceylon and Burma. 1-VII + 1-387. Plts. V. Taylor and Francis, London.
- ARROW, G.J. 1931. Coleoptera, Lamellicornia Part III, Coprinae. Fauna Brit. India including Ceylon and Burma. 1-xii 1-428, Plts. XI, Taylor and Francis, London.
- CAMERON, M. 1931. The *Fauna of British India*, including Ceylon and Burma. Coleoptera : Staphylinidae, Vol. II London, iii + 257 pp., 2pl.
- CAMERON, M. 1932. The *Fauna of British India*, including Ceylon and Burma. Coleoptera : Staphylinidae, Vol. III, London, V + 443 pp., 4pl.
- FAUVEL, A. 1895. Staphylinides nouveaux de l'Inde et de la Malaisie. *Revue d'Entomologie*, Caen **14** : 180-286.
- FOWLER, W.W. 1912. Coleoptera. General introduction and Cicindelidae and Paussidae. Fauna Brit. India including Ceylon and Burma. 1-XVI + 1-529.
- KRAATZ, G. 1859. Staphylinen Fauna von Ostindien, insbesondere der Insel Ceylon. *Archiv für Naturgeschichte*, **25** : 1-193, 3pl. Sep. Berlin, 196 pp., 3pl.
- MOTSCHULSKY, V. 1858a. Enumeration des nouvelles espèces de Coleopteres rapportes de Ses voyages. (Continuation). *Bulletin de la société Imperiale des naturalistes de Moscou*, **31** (2) : 634-670.
- SAHA, G.N. 1979. Revision of Indian Blister beetles (Coleoptera : Meloidae : Meloinae) *Rec. zool. Surv. India* : 1-146.
- VAZIRANI, T.G. 1973. Contribution to the study of Aquatic beetles (Coleoptera) 12 on a collection of Dytiscidae from Gujarat with description of new species. *Rec. zool. Surv. India*, **67** : 287-302.
- VAZIRANI, T.G. 1977. Contribution to the study of aquatic beetles (Coleoptera) 14. On the collection of Dytiscidae from Gujarat, Part 2, *Rec. zool. Surv. India*, **73** : 53-62.
- VAZIRANI, T.G. 1977. Catalogue of Oriental Dytiscidae. *Rec. zool. Surv. India, Occ. Paper No. 6* : 1-111.

INSECTA : COLEOPTERA : SCARABAEIDAE : COPRINAE (DUNG BEETLES)

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INTRODUCTION

Coleoptera also popularly known as “beetles” is the largest and dominating group of insects. They exhibit a great degree of diversity and adaptability and found in different kind of habitats. The beetles found in the dung of herbivorous mammals are generally called “dung beetles” They are found in every part of the world. These dung beetles are very useful to man kind because they do not only act as intermediate hosts for different parasites of domestic animals but also play important role in pasture ecosystem, where they annually break down tonnes of animal dung which degrades into the soil and destroy the habitats of the larvae of horn fly.

The author carried out the extensive surveys of Gujarat state from 1988 to 1993 and collected large number of specimens from dung pad, dung heaps, digging of dung burrows and by utilising of light traps in urban and rural localities. Total forty nine species belonging to twelve genera of subfamily coprinae under the family Scarabaeidae have been identified. Most of the species have been recorded first time from Gujarat except eight species which have been reported by Sewak (1985). These studied dung beetles have been listed below according to their systemic position under three tribes *i.e.* Scarabaeini, Sisyphini and Coprini.

SYSTEMATIC ACCOUNT OF GUJARAT DUNG BEETLES

Class INSECTA
Order COLEOPTERA
Sub-order POLYPHAGA

Super family SCARABAEIODEA
Family SCARABAEIDAE
Sub-family COPRINAE

CLASSIFIED LIST OF DUNG BEETLES

Tribe 1. Scarabaeini

Genus 1. *Gymnopleurus* Illiger

1. *Gymnopleurus cyaneus* Fabricius
2. *Gymnopleurus miliaris* Fabricius
3. *Gymnopleurus parvus* Macleay
4. *Gymnopleurus gemmatus* Harold

Tribe II. Sisyphini

Genus 2. *Sisyphus* Latreille

5. *Sisyphus longipes* Olivier

Tribe III. Coprini

Genus 3. *Catharsius* Hope

6. *Catharsius molossus* Linnaeus

Genus 4. *Copris* Geoffroy

7. *Copris indicus* Gillet
8. *Copris repertus* Walker
9. *Copris corpulentus* Gillet
10. *Copris numa* Lansberge
11. *Copris imitans* Felsche
12. *Copris cribratus* Gillet
13. *Copris furciceps* Felsche

Genus 5. *Phalops* Erichson

14. *Phalops divisus* Wiedemann
15. *Phalops olivaceus* Lansberge
16. *Phalops cyanescens* Dorbigny

Genus 6. *Caccobius* Thoms.

17. *Caccobius meridionalis* Boucomont

18. *Caccobius indicus* Harold
 Genus 7. *Onthophagus* Latreille
 19. *Onthophagus oculatus* Arrow
 20. *Onthophagus variegatus* Fabricius
 21. *Onthophagus productus* Arrow
 22. *Onthophagus bonasus* Fabricius
 23. *Onthophagus catta* Fabricius
 24. *Onthophagus rectecornutus* Lansberge
 25. *Onthophagus seniculus* Fabricius
 26. *Onthophagus ramosus* Wiedemann
 27. *Onthophagus rana* Arrow
 28. *Onthophagus ephippioderus* Arrow
 29. *Onthophagus kuluensis* Bates
 30. *Onthophagus semicinctus* D'orbigny
 31. *Onthophagus tragus* Fabricius
 32. *Onthophagus politus* Fabricius
 33. *Onthophagus ensifer* Boucomont
 34. *Onthophagus cervus* Fabricius
 35. *Onthophagus falsus* Gillet
 Genus 8. *Liatongus* Reitter
 36. *Liatongus martialis* Harold
 37. *Liatongus rhadamistus* Fabricius
 Genus 9. *Oniticellus* Serville
 38. *Oniticellus pallipes* Fabricius
 39. *Oniticellus pallens* Oliver
 40. *Oniticellus spinipes* Roth
 41. *Oniticellus cinctus* Fabricius
 Genus 10. *Drepanocerus* Kirby
 42. *Drepanocerus exsul* Sharp
 Genus 11. *Onitis* Fabricius
 43. *Onitis siva* Gillet
 44. *Onitis lama* Lansberge
 45. *Onitis philemon* Fabricius
 46. *Onitis falcatus* Wulf
 47. *Onitis castaneus* Redtenbacher
 48. *Onitis brahma* Lansberge
 Genus 12. *Chironitis* Lansberge
 49. *Chironitis indicus* Lansberge

Key to the tribes of subfamily *Coprinae* from Gujarat

1. Middle coxae not widely separated; middle tibia with one terminal spur **Scarabaeini**
 —Middle coxae widely separated, middle tibia with two terminal spurs 2
2. Posterior legs extremely long, the tarsi filiform **Sisyphini**
 —Posterior legs not extremely long, tarsi more or less flat and tapering **Coprinae**

Tribe **Scarabaeini**

The tribe scarabaeini consist of two genera *Scarabaeus* and *Gymnopleurus*, but author found only the four species of the genus *Gymnopleurus*.

1. *Gymnopleurus* Illiger

1803. *Gymnopleurus* Illiger, *Mag. Ins.* 2 : 199.

1807. Latreille, *Gen. crust. et. Ins.* 2 : 78.

1856. Lacordaire, *Gen. Col.* 3 : 73.

Diagnostic characters : Small, broad and depressed. The clypeus completely fused with the occular lobes and produced into two or four short teeth at front margin. The prothorax large and convex, having several patches dorsally. The fore legs short and stout and front tibia armed with three external teeth. All six tarsi filiform. Scutellum visible. The two sexes are almost alike and ball rollers.

Key to the species of the genus *Gymnopleurus* from Gujarat

1. Clypeus with four teeth and upper surface without hairy clothing *cyaneus* Fabricius.
 – Upper surface with hairy clothing 2
2. Upper surface with fine hairy clothing and having a ring of spots on prothorax
 *miliaris* Fabricius
 – Clypeus not having four teeth 3

3. Clypeus with two teeth and prothorax with about six shining spots *parvus* Macleay
 — Clypeus with two teeth and prothorax with about fifteen shining spots
 *gemmatus* Harold.

1. *Gymnopleurus cyaneus* Fabricius

1798. *Copris cyaneus* Fabricius, *Ent. Syst. Suppl.* 34 p.

1840. *Gymnopleurus indicus* Castest, *Hist. Nat.* 2 : 73.

1931. *Gymnopleurus cyaneus* Arrow, *Fauna of British India*, Col. Lamell. Part-III Coprinae, 49-50 p.

Diagnostic characters : Broadly oval and not very convex. The clypeus with four blunt teeth at its anterior edge and the sides of the prothorax are strongly rounded. The front femur having a tooth placed at two thirds of its length from the base, the middle tibia scarcely and the hind tibia distinctly serrate. The all six tarsi present.

Distribution : India : Gujarat : Jamnagar (Khambhalia Road, 23.8.1990), Rajkot (Sardhar, 9.9.1990), 5 Exs., also recorded from Andhra Pradesh, Haryana, Karnataka, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Sri Lanka.

2. *Gymnopleurus miliaris* Fabricius

1775. *Scarabaeus miliaris* Fabricius, *Syst. Ent. App.* 817 p.

1931. *Gymnopleurus miliaris* Arrow, *Fauna of British India*, Coleop. Lamell. Part-III, Coprinae. 50-51 pp.

Diagnostic characters : Broadly oval and not very convex. The upper surface closely clothed with minute grey setae. The clypeus having four blunt lobes at its front edge. The prothorax having a ring of five spots along with an centrally located central spot, one on each letral side near the lateral pit, two spots adjoining the basal margin of each, one near the middle and one upon the apical callus. The front tibia armed with three external strong teeth, the middle and hind tibiae are coarsely serrate and the front femur has two sharp carina along its anterior margin.

Distribution : India : Gujarat : Bharuch (Rajapardi, 17.8.1989, Puktham village 19.8.1989),

Jamnagar (Khambhalia road, 23.8.1990). 9 Exs., also recorded from Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu and Uttar Pradesh.

Elsewhere : Sri Lanka.

3. *Gymnopleurus parvus* Macleay

1821. *Scarabaeus parvus* Macleay, *Horae Ent.* 517 p.

1931. *Gymnopleurus parvus* Arrow, *Fauna of British India* Coleop. Lamell. part III, Coprinae, 52-53.

Diagnostic characters : Oval and moderately convex, upper surface densely clothed with minute grayish setae, leaving a few shining denuded spots - three placed in a transverse row along the middle line of the pronotum, one between the last and the lateral spot, a common spot at the base of elytral suture, three along the basal margin, one on each side of the suture a little behind the middle and one upon each apical callus. The legs are slendered. The front tibia armed with three strong teeth, the middle and hind tibiae are coarsely toothed. The front femur is flat at its anterior edge and has not tooth. The clypeus produced into two lobes at its front margin.

Distribution : India : Gujarat : Junagarh (Girforest rest house 29.8.1990), 8 Exs., also recorded from Bihar, Haryana, Orissa, Tamil Nadu, Uttar Pradesh.

Elsewhere : Sri Lanka.

4. *Gymnopleurus gemmatus* Harold

1871. *Gymnopleurus gemmatus* Harold, *Col. Hefie.* VIII : 117 p.

1792. *Scarabaeus granulatus* Fabricius (Nex. Oliver), *Ent. Syst.* 1 : 65 p.

Diagnostic characters : Oval and not very convex. Upper surface closely clothed with minute grey setae. The clypeus is produced into two blunt lobes at front margin. The pronotum having several spots, a central spot, five adjoining the front margin, four adjoining the hind margin and three or four on each side and upon, the elytra suture, margins, a common transvers irregular patch

behind it just before the apices, three spots adjoining the basal margin on each side, one near the middle of the outer margin and one upon the apical callus. The front tibia armed with three strong external teeth, the middle and hind tibiae rather feebly toothed externally and the front femur has a flattened anterior edge and is not toothed.

Distribution : India : Gujarat : Junagarh (Una 30.8.1990), 12 Exs., also recorded from Andhra Pradesh, Bihar, Karnataka, Maharashtra, Orissa, Madhya Pradesh, Pondicherry, Tamil Nadu.

Elsewhere : Sri Lanka.

Tribe Sisyphini

The tribe sisyphini consist only one genus *Sisyphus* and author found only single species from Gujarat.

2. Genus *Sisyphus* Latereille

1807. *Sisyphus* Latereille, *Gen. (rust. et. ii : 79)*.

1856. Lacordaire, *Gen. Col. iii : 72*.

1927. Arrow *Ann. Mag. Nat. Hist. (9) ix : 456*.

Diagnostic characters : Spider like, subglobose, compressed laterally with long posterior legs and clothed with erect setae above and smooth beneath. Head broad and flat. The clypeus having two or four short teeth at front margin. The prothorax completely compressed and the front leg short with massive femur.

The author collected single species *Sisyphus longipes* from Gujarat.

5. *Sisyphus longipes* Olivier

1789. *Scarabaeus longipes* Oliver, *Entmon.*, 1 : 3, p. 164, pl. xix. 177.

1927. Arrow, *Ann. Mag. Nat. Hist.*, 19 : xix : 457

1972. *Scarabaeus minutus* Fabricius, *Ent. Syst.* i : 70

1978. *Copris helwigi* Fabricius, *Ent. Syst. Suppl.* 35 pp,

1931. *Sisyphus longipes* Arrow, *Fauna of British India* Lamell, Part III, Coprinae, 71-73.

Diagnostic characters : Broadly oval, highly convex with long and slendered posterior legs,

and the whole body convered with erect reddish setae above and beneath. The clypeus almost semi-circular, emarginate in front and produced into two sharp teeth. The pronotum having a fine posterior longitudinal groove. The middle and the hind femur are with very slender basal part and strongly swollen terminal part of the hind femur, confined to the outer half.

Distribution : India : Gujarat : Bharuch (Hansot 18.8.1989). 4 Exs., also recorded from Karnataka, Maharashtra, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Myanmar, Sri Lanka.

Tribe Coprini

The tribe coprini consist large number of genera and species, whose varies in size and forms. The author collected forty four species belonging to nine genera from Gujarat.

Key to genera of tribe coprinae from Gujarat

- 1 Antennal club entirely pubescent and prothoracic carina present.. *Catharsius* Hope
— Antennal club not entirely pubescent and prothoracic carina absent 2
2. Prothorax with a deep median groove
..... *Copris* Geoffroy
— Prothorax without a deep median groove .. 3
3. Four posterior tarsi broadly dialated
..... *Phalops* Erichson
— Four posterior tarsi not broadly dialated ... 4
4. Terminal margin of the front tibia at right angles to the inner margin and anterior angles of the prothorax hollowed beneath
..... *Caccobius* Thoms
— Terminal margin of the front tibia not at right angles to the inner margin and the anterior angles of the prothorax not hollowed beneath 5
5. The middle and hind tibiae dialated from base to extremity *Onthophagus* Latreille.
— The middle and hind tibiae dialated from base to extremity 6

6. Scutellum present and elytra not fringed before the hind margin *Liatongus* Reitter
 — Elytra fringed before the hind margin 7
7. Side of the abdomen exposed above
 *Onitcellus* Serville
 — Side of the abdomen not exposed 8
8. Clypeus bidentate and scutellum distinct
 *Drepanocerus* Kirby
 — Clypeus not bidentate and scutellum very minute 9
9. Prothorax with two basal impressions near the middle and front tarsi absent in both sexes
 *Onitis* Fabricius
 — Scutellum not very minute and front tarsi present in the female .. *Chironitis* Lansberge

Genus *Catharsius* Hope

1837. *Catharsius* Hope, *Col. Mon.* i : 21

1846. *Burmeister*, *Gem. Ins.* x, col. No. 27

1848. Erichson, *Ins. Deutschi* iii : 761.

Diagnostic characters : Broad, compact and very convex. Head broad and semicircular, prothorax completely margined at the base, middle coxae long, parallel and far apart. Four posterior tibiae strongly dialated from base to extremity. The middle tibia with two and hind tibia with one terminal spur. Scutellum wanting. The elytra with seven striae and completely covered the abdomen. The author has been found single species from Gujarat.

6. *Catharsius molossus* Linnaeus

1758. *Scarabaeus molossus* Linnaeus, *Syst. Nat. ed.* x : 347;

1789. Oliver, *Ent.* i (3) : 100, 19 pl. 25 Fig.

1801. Fabricius, *syst. Eleuth.* i : 43.

1931. *Catharsius molossus* Arrow, *Fauna of British India*, Lamell. part-III, *Coprinae*, 94-95 P.

Diagnostic characters : Broadly oval and very convex, partially clothed with reddish hairs beneath. The head is broad with front margin almost imperceptibly excised in the middle. The side of the pronotum are rounded, the front angles

are broadly truncate and the hind angles almost obsolete, and the lateral scars large and deep. The metasternal shield is acutely angular in front and longitudinally grooved in its hinder part. The front tibia is armed with three external teeth, the middle and hind tibiae are broad and crenate at the extremity. The male having conical, median cephalic horns, broad and a little flattened behind at the steep declivity in front, the upper edge of which forms a sharp ridge feebly convex in the middle and curved, pointed at its extremity. The head of the female has a short and pointed process and the pronotum with nearly straight ridge.

Distribution : India : Gujarat : Bharuch (Rajapardi, 17.8.1989), Gandhinagar (Chandrala, 15.9.1991), Banaskantha (Danta 17.8.1992), Sabarkantha (Kankrol, 30.8.1992, Vijaynagar Situse, 10.9.1992, Dharoi dam 14.9.1992, Visnagar 15.9.1992), 33 Exs. also recorded from Arunachal Pradesh, Andaman & Nicobar, Assam, Bihar, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Meghalaya, Orissa, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

Elsewhere : Sri Lanka.

Genus 4. *Copris* Geoffroy

1772. *Copris* Geoffroy, *Ins. Des. Env. Deparis* 87.

1785. Fourcroy, *Ent. Paris* i : 13.

1856. Lacordaire, *Gen. Col.*, iii : 96.

Diagnostic characters : Compact, convex or little depressed. Head broad, more or less semicircular and clypeus notched in the middle at front margin. Prothorax broad and transverse, and its front margin furnished with membranous fringe and hind margin with a deep median groove. Middle coxae long and nearly parallel. The tarsi short and basal joint about twice as long as the second. Scutellum wanting. Elytra not very short having eight striae and single lateral carina. Seven species of the genus have been from the Gujarat.

Key to the species of *Copris* from Gujarat

1. Elytra very shining and front angles of prothorax very blunt *indicus* Gillet
 —The front angles of prothorax are not blunt

- 2
2. Front angles of prothorax truncate and elytra feebly striate *repertus* Walker
- The front angles of prothorax are not truncate 3
3. Front angles of prothorax obtuse and elytra lightly striate *corpulentus* Gillet
- Elytra is not lightly striate 4
4. Elytra deeply striate and clypeus feebly notched in the middle at front margin
..... *numa* Lansberge
- Clypeus is not notched in the middle at front margin 5
5. Clypeal margin is reflexed and with one erect process *imitans* Felsche
- Clypeal margin without any process 6
6. Prothorax and elytra strongly punctured and metasternal shield evenly punctured
..... *cribratus* Gillet
- Prothorax, elytra and metasternal shield well punctured *Furciceps* Felsche

7. *Copris indicus* Gillet

1910. *Copris indicus* Gillet, *Notes Leyd. Mus.*, xxxii : 5.

1911. *Ann. Soc., Ent., Belg.* v : 314.

Diagnostic characters : Broadly oval and highly convex. The head is semicircular and the front margin feebly bilobed in the middle. The sides of the prothorax are nearly straight in front, strongly rounded behind, the front angles are broadly truncate and hind angles are very obtuse. The front tibia is broad and armed with four blunt external teeth, and the terminal spur has bented tip at right angles. The male with a short erect and flattened median cephalic horn, which is slightly dilated and feebly bicuspid at the extremity and the pronotum with dorsal straight prominence along with lateral tubercle on each side. The female bears a slight transverse cephalic elevation.

Distribution : India : Gujarat : Kachchh-Bhuj

(Kandla 6.12.1993, Loriya 7.12.1993, Anjar 8.12.1993). 9 Exs. also recorded from Arunachal Pradesh, Orissa, Karnataka, Kerala, Tamil Nadu.

8. *Copris repertus* Walker

1858. *Copris repertus* Walker, *Ann. Mag. Nat. Hist.* 3 (ii) : 208.

1886. Lansberge, *Tijds. Ent.*, xxix : 11.

1877. *Copris clavdius*-Harold, *Ann. Mus. Civ. Genova* x : 8.

Diagnostic characters : Broadly oval and highly convex and covered with reddish bristles beneath. The head is semicircular and the clypeus deeply notched in the middle. The pronotum is strongly grooved longitudinally along the middle, the front angles are truncate and the hind angles almost obsolete. The front tibia is broad and armed with four external teeth and its nearly straight. The male bears a slendered, slightly compressed, erect cephalic horn, and with a minute tooth near the base on each side and female with short transverse elevated cephalic carina.

Distribution : India : Gujarat : Vadodara (Padra 1.8.1989), Surat (Dumas 6.8.1989; Kator 7.8.1989), Bharuch (Rajapardi 17.8.1989), Ahmedabad (Dholka 7.9.1991), Kheda 13.9.1991, Banaskantha (Ambaji 25.8.1992, Ratanpur village 26.8.1992), Sabarkantha (Vijaynagar 31.8.1992), Mahesana (Vijapur 8.9.1992, Modera 13.9.1992); Kachchh-Bhuj (Loriya 7.12.1993), 34 Exs., also recorded from Arunachal Pradesh, Karnataka, Maharashtra, Madhya Pradesh, Pondicherry, Rajasthan, Tamil Nadu and Uttar Pradesh.

Elsewhere : Sri Lanka.

9. *Copris corpulentus* Gillet

1910. *Copris corpulentus* Gillet, *Notes Leyd. Mus.* xxxii : 13.

Diagnostic characters : Elongate-oval and moderately convex, covered with reddish bristles beneath. The clypeal margin is notched in the middle and feebly bilobed and there is a sharp pointed, backwardly curved cephalic horn in the middle. The pronotum with median groove, the front angles are obtuse and the male thoracic prominence are simple conical and the female thoracic prominence are flattened in front and

dilated laterally.

Distribution : India : Gujarat : Kachchh-Bhuj (Loriya 7.17.1993; Anjar 8.12.1993). 7 Exs. also recorded from Arunachal Pradesh, Manipur, Meghalaya, Rajasthan, Uttar Pradesh.

Elsewhere : Myanmar, Tonkins.

10. *Copris numa* Lansberge

1886. *Copris numa* Lansberge, *Tijd. Ent.* xxix : 19.

Diagnostic characters : Narrowly oval and moderately convex, covered with reddish bristles beneath. The clypeus is feebly excised in the middle at front margin and with a very short conical cephalic process just in front of the eyes. The median pronotal groove is extended from base to in front of the middle, and the front angles are truncate and hind angles obsolete. The middle and hind tibiae are trilobed at the extremity. The front tibial spurs of the male are blunt and slightly spatulate and the female front tibial spurs are pointed.

Distribution : India : Gujarat : Banaskantha (Ratanpur village 26.8.1992), Kachchh-Bhuj (Mandvi 5.12.1993). 6 Exs., also recorded from Arunachal Pradesh, Rajasthan, Uttar Pradesh.

Elsewhere : Borneo, Malaya Peninsula, Myanmar, Sumatra.

11. *Copris immitans* Felsche

1910. *Copris immitans* Felsche, *Deutsche Ent. Zeits.* 347 p.

Diagnostic characters : Broadly oval and convex, covered with reddish bristles beneath. The clypeal margin is reflexed, a little emarginate in front and produced upward in the middle. The front angles of the prothorax are very obtuse and the hind angles obsolete. The front femur of the male has two teeth, the inner one is blunt and the outer rather sharp. The anterior margin of the female prothorax is angulate.

Distribution : India : Gujarat : Surat (Dumas 6.8.1989, Sarbham 5.8.1989), 11 Exs. also recorded from Goa, Karnataka, Maharashtra.

12. *Copris cribratus* Gillet

1927. *Copris cribratus* Gillet, *Ann. Soc. Ent. Belg.* LXVII : 253.

Diagnostic characters: Chocolate brown and more reddish beneath and the bristle only present on the legs and the punctures having pale minute setae. The front clypeal margin strongly bidentate. The front angles of the prothorax are broadly rounded and prominent and the hind angles almost obsolete. The front tibiae are rather broad and armed with four sharp external teeth.

Distribution : India : Gujarat : Surat (Dumas 6.8.1989), 5 Exs., also recorded from Karnataka, Kerala and Tamil Nadu.

13. *Copris furciceps* Felsche

1910. *Copris furciceps* Felsche, *Deutsche Ent. Zeitschr.* 348 p.

Diagnostic characters : Oval and not very convex, covered with reddish or yellowish bristles beneath. The front clypeal margin distinctly excised and bidentate in the middle. The lateral margin of the prothorax are rounded, the front angles are blunt and the hind angles are obsolete. The front tibia is armed with four sharp external teeth. The male with long and backwardly curved cephalic horn and the female have slightly elevated transverse and bicuspid cephalic tubercle.

Distribution : India : Gujarat : Panchmahal (Kalol 20.8.1989), Kheda (Dakor 9.9.1991, Kapadvanj 12.9.1991). 5 Exs., also recorded from Arunachal Pradesh, Meghalaya, Rajasthan, Uttar Pradesh.

Elsewhere : Myanmar.

Genus 5. *Phalops* Erichson

1848. *Phalops* Erichson, *Nat. Ins. Deutschl.* III : 764.

1856. *Lacordaire Gen. Col.* III : 109.

1883. *Lansberge, Stett. Ent. Zeit.* XIIIV : 162.

1893. *Ephillopus* Reitter, *Verh. Ver. Brunn.* XXXI : 168.

Diagnostic characters : Rather short and broad.

not very convex. The clypeus narrowly produced in front. Legs moderately long and the middle and hind tarsi broad and flattened.

Three species of the genus *Phalops* have been found from Gujarat.

Key to species of *Phalops* from Gujarat

1. Prothorax entirely granulate and elytra very opaque *cyanescens* Dornbigny
— Elytra not very opaque 2
2. Elytra opaque, maculate .. *divisus* Wiedemann
— Prothorax rugose, with granules at the sides only *olivaceus* Lansberge

14. *Phalops divisus* Wiedemann

1823. *Copris divisus* Wiedemann, *Zool. Mag.* II : 12,

1883. *Phalops divisus* Lansberge, *Stett. Ent. Zeit.*, XLIV : 169.

Diagnostic characters : Short, broad and not very convex. Bright metallic green, dark blue or coppery and the elytra with yellow markings, and the dorsal surface clothed with fine erect yellow setae. The clypeus is separated from the fore head by a carina. The front angles of prothorax are broadly truncate and having minute external tooth, and the hind angles feebly indicated and its sides are slightly sinuate behind and the base is rounded.

The clypeus of male is produced into a reflexed tongue like lobe in middle and rounded in female. The legs are longer in male than female. The external teeth of front tibiae are shorter than the female.

Distribution : India : Gujarat : Amreli (Babra 28.7.1989), Rajkot (Tankara 8.9.1990). 8 Exs., also recorded from Tamil Nadu, Madhya Pradesh and Uttar Pradesh.

Elsewhere : Sri Lanka.

15. *Phalops olivaceus* Lansberge

1883. *Phalops olivaceus* Lansberge, *Stett. Ent. Zeit.* XLIV : 164, 169.

Diagnostic characters : Deep bluish or greenish black and upper surface uniformly clothed with fine yellowish hairs. The clypeus is separated from the fore head by a curved carina and strongly reflex in the middle. The front angles of the pronotum are blunt and lateral margins are sinuated behind. In the male, the prothorax is little hollowed behind the posterior cephalic process.

Distribution : India : Gujarat : Jamnagar (Jodiya 22.8.1990), Bhavnagar (Ballabhipur 13.9.1990). 5 Exs.

16. *Phalops cyanescens* D'ornbigny

1897. *Onthophagus cyanescens* Dornbigny, *Ann. Sec. Ent. France.* LXVI : 243.

1898. Id, *Labeille* XXIX : 221

1931. *Phalops cyanescens* Arrow *Fauna of British India*, Lamell. part III Coprinae, 137-138 p.

Diagnostic characters : Dark blue and elytra with a yellow outer marginal line and with numerous irregular spots. The upper surface clothed with minute yellow setae. The sides of the head is produced into a broadly rounded lobes and the clypeus of male is reflexed tongue like process in front and bi-lobed in female. The front tibiae of male are long and with blunt external teeth and broadly and strongly toothed in female.

Distribution : India : Gujarat : Junagarh (Satadar 1.9.1990). 11 Exs., also recorded from Rajasthan, Tamil Nadu.

Elsewhere : Pakistan.

Genus 6. *Caccobius* Thoms

1863. *Caccobius* Thoms *Skand. Col.*, V : 34.

1913. *Dornbigny*, *Ann. Sco. Ent. France*, 16 p.

1872. *Caccophilus* Jekel *Rev. Mag. Zool.*, 410 p.

1872. *Cacconemus* Jekel, *Op. Cit.* 418 p.

Diagnostic characters : Short, compact, and small size. The clypeus is bilobed. The front angles of the prothorax have a deep hollow beneath, sharply defined. The legs are short and the front tibiae very short and broad, with straight terminal

tooth, forming right angles to inner edge. The male with or without cephalic horn.

The author has found only two species from Gujarat.

Key to species *Caccobius* from Gujarat

- Elytra with brown strips
..... *meridionalis* Boucomont
- Elytra without strip..... *indicus* Harold

17. *Caccobius meridionalis* Boucomont

1914. *Caccobius meridionalis* Boucomont, *Ann. Mus. Civ. Genova*, XLVII : 239.

Diagnostic characters : Small, oval and very convex. The clypeus is bilobed and separated from the forehead by a curved carina. The prothorax with well marked posterior longitudinal groove. The front angles of the prothorax are rather blunt and the base is rounded. The front tibiae are very short and broad. The terminal tooth is very blunt and set obliquely in the male and long and sharp in female.

Distribution : India : Gujarat : Surat (Kator 7.8.1989), Bharuch (Hansot 18.8.1989). 5 Exs., also recorded from Maharashtra, Karnataka, Tamil Nadu.

Elsewhere : Sri Lanka.

18. *Caccobius indicus* Harold

1867. *Caccobius indicus* Harold, *Col. Hefte*, ii : 12.

Diagnostic characters : Broadly oval and convex, head short and broad, the clypeus bilobed and separated by a strong carina from the forehead. The prothorax having a slight transverse prominence in the middle. The front angles are sharp and hind angles obsolete. The terminal tooth of the front tibia of the male is blunt, thin and bent at oblique angle while in female it is sharp and not oblique.

Distribution : India : Gujarat : Junagarh (Satadar 1.9.1990, Manvador, 3.9.1990, Hashapur 4.9.1990). 6 Exs., also recorded from Karnataka, Kerala and Tamil Nadu.

Genus 7. *Onthophagus* Latreille

1802. *Onthophagus* Latreille, *Hist. Nat. Crust. et. Ins.* iii : 141.

1898. Dorbigny, *Labeille*, xxx : 126, 132 p.

1883. *Proagoderus* Lansberge, *Notes, Leyd. Mus.* V : 15.

1913. Dorbigny, *Ann. Soc. Ent. France.* LXXXII : 493.

1917. Mercus, *Arch. F. Nat. Aso.* IXXXIII : 1.

Diagnostic characters : Rather short, compact, smooth or clothed with hairs or setae. The clypeus fused with ocular lobes and variable in shape. The prothorax with lateral margin and angulate in the middle and rounded at the base. The legs stout, femora thick and front tibia armed with four but occasionally with three external teeth. The middle and hind tibiae dialating greatly from base to extremity. Elytra covering the abdomen and having a single lateral carina and seven striae. The author has been found seventeen species of the genus from Gujarat.

Key to the species of *Onthophagus* from Gujarat

- 1 Eyes large and prothorax with irregular scattered punctures..... *oculatus* Arrow
- Eyes not large and punctures on prothorax not scattered 2
2. Eyes small and prothorax with evenly distributed granules throughout
..... *variegatus* Fabricius
- Prothorax without evenly distributed granules throughout 3
3. Prothorax abruptly flattened at the hind angles and elytra granular *productus* Arrow
- Prothorax not abruptly flattened at the hind angles 4
4. Elytra more or less opaque and front angles of prothorax not very sharp *catta* Fabricius
- Front angles of prothorax are very sharp .. 5
5. Prothorax is very smooth and with scattered granules in its middle part
..... *bonus* Fabricius.
- Front angles of prothorax rather sharp and strongly punctured 6

6. Prothorax light brown with black punctures.
..... *rectecornutus* Lansberge
— Prothorax not strongly punctured and elytra
black 7
7. Prothorax sparsely punctured with blunt front
angles *seniculus* Fabricius
— Prothorax not sparsely punctured 8
8. Prothorax moderately punctured and front
angles bluntly punctured.....
..... *ramosus* Wiedemann
— Prothorax not moderately punctured 9
9. Prothorax not closely punctured and front
angles rather blunt *rana* Arrow
— Prothorax closely punctured and with opaque
sides 10
10. Prothorax uniformaly puntured and elytral
suture with minute elevation near the base.
..... *ephippioderus* Arrow
—Elytral suture without a minute elevation near
the base 11
11. Elytra shining and eyes very small
..... *kuluensis* Bates
— Eyes not very small..... 12
12. Elytral intervals sparsely granulate and entirely
black *semicinctus* Dorbigny
— Elytral intervals not granulate..... 13
13. Elytra not shining and very convex and
strongly striate..... *tragus* Fabricius
— Elytra not strongly striate 14
14. Elytra rather strongly striate and Elytral
interval very smooth *politus* Fabricius
— Elytral intervals not very smooth 15
15. Elytral intervals nearly flat and with fine
granules *ensifer* Boucomont
— Elytral intervals not flat and without granules
..... 16

16. Elytra decorated with orange luster and
clypeus is little produced and truncate
..... *cervus* Fabricius
— The clypeus produced bluntly pointed and
strongly reflexed *falsus* Gillet

19. *Onthophagus oculatus* Arrow

1931. *Onthophagus oculatus* Arrow, *Fauna of British India*,
Lamell. part-III, coprinae, 168-170 p.

Diagnostic characters : Oval and not very
convex. The head is large. The clypeus is little
produced and excised at the front margin and
separated from the forehead by the straight carina.
The side of the pro-thorax are straight and base is
rounded and its front angles are sharp. The vertex
of the male has a blunt prominence on each side
between the eyes and in female straight carina in
place of prominence.

Distribution : India : Gujarat : Surendranagar
(Chotila 13.3.1986). 6 Exs., also recorded from
Kerala, Pondicherry, Tamil Nadu.

Elsewhere : Sri Lanka.

20. *Onthophagus variegatus* Fabricius

1798. *Copris variegatus* Fabricius, *Ent. Syst. Suppl.*, 36 p.

1913. *Onthophagus variegatus* Dorbigny, *Ann. Soc. Ent.*
France LXXXII : 452.

Diagnostic characters : Oval and highly
convex. The clypeus is a little produced notched
in the middle. The front angles of the prothorax
are acutely produced and lateral sides are sinuate
in front and behind and its base is strongly rounded.
The posterior part of the male head having a pair
of straight parallel horns, and female having
carina.

Distribution : India : Gujarat : Kachchh- Bhuj
(Loriya 7.12.1993). 2 Exs., also recorded from
Punjab.

Elsewhere : Pakistan, Arabia, Egypt, Sudan,
Abyssinia, Somalia Senegal Angola, Tanganyika
Portugal, E. Africa.

21. *Onthophagus productus* Arrow

1907. *Onthophagus productus* Arrow, *Ann. Mag. Nat. Hist.* (7) XIX : 423.

Diagnostic characters : Oval and very convex, lower surface clothed with thin hairy setae, the clypeus is little produced in front, the front angles of prothorax are blunt and the hind angles well marked, and the base is strongly rounded. The 7th stria of the elytra is strongly curved. The head of male having a pair of curved, backwardly sloping horns which are united at the base by a curved carina and female with straight forehead carina.

Distribution : India : Gujarat : Rajkot (Gondal 6.9.1990). 5 Exs., also recorded from Uttar Pradesh, West Bengal, Rajasthan.

22. *Onthophagus catta* Fabricius

1787. *Scarabaeus catta* Fabricius, *Mant. Ins.*, i : 12.

1787. *Scarabaeus gazella* Fabricius, *Op. Cit. App.*, ii : 317.

1798. *Copris metallicus* Fabricius, *Ent. Syst. Suppl.*, 28p.

1787. *Copris antilope* Fabricius, *Op. Cit. App.* ii : 32.

1931. *Onthophagus catta* Arrow, *Fauna of British India*, Lamell. part III, coprinae 230-231 p.

Diagnostic characters : Broadly oval and convex. with a thin clothing of yellow setae upon the legs and lower surface. The head is circular with strongly reflexed front margin. The clypeus and forehead separated by a strong, feebly curved carina. The side of the prothorax are straight in front and sinuate behind. The front angles sharply produced and the hind angles obsolete, and the base is angulate in the middle. The head of male having a pair of slendered, outward curved horns and a little flattened at the base but not united, and the front tibia is elongate, slendered and curved, having long spur at extremity, female with vertex carina.

Distribution : India : Gujarat : Amreli (Chalala 26.7.1989, Babra 28.7.1989), Vadodara (Tilakwada 31.7.1989, Padra 1.8.1989), Surat (Dumas 6.8.1989, Kator 7.8.1989), Bharuch (Rajapardi 17.8.1989, Puktham village 19.8.1989), Jamnagar (Khambhalia Road 23.8.1990, Dhrol 24.8.1990,

Bhatiya 26.8.1990, Khambhalia Road 27.8.1990, Bhanvad 28.8.1990), Junagarh (Una 30.8.1990, Manvadar 3.9.1990), Rajkot (Gondal 6.9.1990, Padhari 7.9.1990, Tankara 8.9.1990), Bhavnagar (Trapas 11.9.1990, Sihor 12.9.1990 Vallabhipur 13.9.1990), Ahmedabad (Dholera 6.9.1991, Dholka 7.9.1991), Kheda (Dakor 9.9.1991, Tarapur 11.9.1991, Kapadvanj 12.9.1991, Kheda 13.9.1991), Gandhinagar (Chandrala 15.9.1991), Banaskantha (Dantiwada Dam 20.8.1992, Majadar village 23.8.1992, Ambaji 25.8.1992, Ratanpur Village 26.8.1992, Danta 27.8.1992), Sabarkantha (Vijaynagar 31.8.1992, Harsol 3.9.1992, Bayas 4.9.1992), Mahesana (Vijapur 8.9.1992, Amaliyasan 9.9.1992, Situse 10.9.1992, Patan 12.9.1992, Modera 13.9.1992, Dharoi Dam 14.9.1992, Visnagar 15.9.1992). 154 Exs., also recorded from Arunachal Pradesh, Haryana, Himachal Pradesh, Karnataka, Maharashtra, Punjab, Rajasthan, Uttar Pradesh, Kerala, and Tamil Nadu.

Elsewhere : Pakistan, Sri Lanka, Arabia, E. and W. South Africa, Madagascar.

23. *Onthophagus bonasus* Fabricius

1775. *Scarabaeus bonasus* Fabricius, *Syst. Ent.* 23 p.

1898. Dorbigny, *Labeille*. XXIX : 218.

1931. *Onthophagus bonasus* Arrow, *Fauna of British India*, Lamell. part III, coprinae, 231-232 P

Diagnostic characters : Very broadly oval and convex. The legs and sides of the body beneath clothed with yellowish setae. The head is semicircular in shape with strongly reflexed front margin. The clypeus is separated from the forehead by a strong curved carina. There is short acute erect horn in the middle and vertex with a pair of backwardly directed horns. The prothorax having a slight median groove. The front angles are acutely produced, the sides are feebly sinuate near the hind angles and the base is angulate in the middle. The front tibia of the male is elongate, slendered and curved with feeble external teeth, its inner extremity produced as a long slender tooth.

Distribution : India : Gujarat : Ahmedabad (Dehgam 22.2.1986), Mahesana (Taranga hill

18.3.1986), Panchmahal (Kalol 19.2.1988), Banaskantha (Devpura village 6.3.1989, N.S. Rathore, Chitrasini village 21.8.1992, Kapra village 22.8.1992, Ratanpur village 26.8.1992), Amreli (Chalala 26.8.1989), Mahesana (Amaliyasan 9.9.1992), Kachchh Bhuj (Loriya 7.12.1992). 30 Exs., also recorded from Andhra Pradesh, Arunachal Pradesh, Himachal Pradesh, Haryana, Karnataka, Maharashtra, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu.

Elsewhere : Pakistan, Myanmar, Siam, Tonkin, Cambodia, Afghanistan.

24. *Onthophagus rectecornutus* Lansberge

1883. *Onthophagus rectecornutus* Lansberge, *Notesleyd. Mus.* V : 49.

1907. Arrow, *Ann. Mag. Nat. Hist.* (7) XIX : 241.

Diagnostic characters : Oval and very convex, body covered with very minute and inconspicuous greish setae. The clypeus is semicircular, with strongly reflexed front margin. The vertex having a pair of unconnected backwardly sloping horns. The front angles are rather sharp and the sides are gently rounded in front and the base is strongly rounded. The front tibia of male is elongate and narrowed and its teeth are separated. In female the front tibia is broad and teeth are stout and close together.

Distribution : India : Gujarat : Surat (Kator 7.8.1989), Valsad (Chikhali 12.8.1989, Tithal 13.8.1989), Bharuch (Rajapardi, 17.8.1989, Hansot 18.8.1989, Puktham village 19.8.1989), 21 Exs., also recorded from Arunachal Pradesh, Bihar, Karnataka, Kerala, Tamil Nadu, Uttar Pradesh, Rajasthan.

Elsewhere : Bangladesh, Bhutan, Myanmar, Sri Lanka, Tonkin, Tenasseri.

25. *Onthophagus seniculus* Fabricius

1781. *Scarabaeus seniculus* Fabricius, *Spec. Ins.* I : 23.

1931. *Onthophagus seniculus* Arrow, *Fauna of British India* Lamell. Part III, Coprinae, 235-236 p.

Diagnostic characters : Broadly oval, moderately compact, smooth, not very shining

above. The head having straight, parallel carina and the basal joint of the antennae has serrate anterior edge. The prothorax has smooth, shining excavation just behind the front margin and a horizontal prominence behind each excavation. The clypeus of the male curves upward a little in front and its sides are nearly straight and the front tibia is little elongate with the teeth rather small. The head of female is almost semicircular in outline and the dorsal prothoracic prominence are slight and rounded.

Distribution : India : Gujarat : Amreli (Khambhalia 27.8.1989), Vadodara (Amalyara 2.8.1989), Surat (Dumas 6.8.1989, Kator 7.8.1989), Bharuch (Rajapardi 17.8.1989), Ahmedabad (Dholera 6.9.1991, Dholka 7.9.1991), Kheda (Dakor 9.9.1991, Kheda 13.9.1991), Gandhinagar (Chandrala 15.9.1991), 159 Exs., also recorded from Arunachal Pradesh, Rajasthan, Uttar Pradesh.

Elsewhere : Malaya Peninsula, Myanmar, China and Indo China.

26. *Onthophagus ramosus* Wiedemann

1823. *Copris ramosus* Wiedemann, *Zool. Mag.* II (i) : 13.

1931. *Onthophagus ramosus* Arrow, *Fauna of British India* Lamell, Part III, Coprinae, 236-238 p.

Diagnostic characters : Broadly oval, compact and moderately convex. The head almost semicircular and the clypeus is separated from the forehead by a slight rounded carina, and the vertex having a pair of backwardly inclined horns, united by a straight carina, between the eyes, which has a slight sharp point in the middle. The front angles of the prothorax are bluntly produced, the sides nearly straight and base is gently rounded. The male and female almost resembles in all respect except in the unemarginate last ventral sternite.

Distribution : India : Gujarat : Junagarh (Una 30.8.1990), Rajkot (Tankara 8.9.1990), Bhavnagar (Trapas 11.9.1990), 7 Exs. also recorded from Bihar, Himachal Pradesh, Karnataka, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Pondicherry, Punjab, Rajasthan, Uttar Pradesh.

Elsewhere : Siam.

27. *Onthophagus rana* Arrow

1931. *Onthophagus rana* Arrow, *Fauna of British India*, Lamell. part III, *Coprinae*, 236-269 p.

Diagnostic characters : Elongate-oval, compact and not very convex. The head is broad with straight front margin in the middle. The clypeus is separated from the forehead by a short straight carina. The front angles of the prothorax are blunt, lateral sides are gently curved in front and straight behind and the base is rounded. The metasternal shield is very smooth. There is a slight declivity in front of the prothorax in the male.

Distribution : India : Gujarat : Junagarh (Satadar 1.9.1990), 6 Exs., also recorded from Kerala.

28. *Onthophagus ephippiderus* Arrow

1907. *Onthophagus ephippiderus* Arrow, *Ann. Mag. Nat. Hist.*, (7) XIX : 425.

Diagnostic characters : Very broadly oval and convex. The head is produced in front. The prothorax completely margined with blunt front angles. The clypeus of male having a blunt curved process and a round carina behind, forehead with a recurved pointed process on each side and the vertex having slender, curved horn in the middle. The thorax with a cavity along with blunt process. The front tibia is a little elongate with broad terminal spur. The terminal spur of female is broad and narrow.

Distribution : India : Gujarat : Rajkot (Tankara 8.9.1990), 7 Exs., also recorded from Karnataka, Kerala and Tamil Nadu.

29. *Onthophagus kuluensis* Bates

1891. *Onthophagus kuluensis* Bates, *Entom. Suppl.*, XXIV : 12.

Diagnostic characters : Oval and moderately convex. The head is broad, the clypeus is nearly straight in front and separated from the forehead by a straight carina. The front angles of the prothorax are blunt, lateral margin are feebly

curved in front and the base is obtusely angulate in the middle. The male having a pair of nearly parallel horns, connected by a ridge and female with straight carina on vertex.

Distribution : India : Gujarat : Mahesana (Ganeshpur 16.3.1986), Surat (Kator, 7.8. 1989), Junagarh (Satadar 1.9.1990), Kheda (Dakor 9.9.1991), Kapadvanj 12.9.1991, Kheda 13.9.1991), 90 Exs., also recorded from Arunachal Pradesh, Himachal Pradesh, Haryana, Jammu & Kashmir, Punjab, Rajasthan and Uttar Pradesh.

30. *Onthophagus semicinctus* Dorbigny

1897. *Onthophagus semicinctus* Dorbigny, *Ann. Soc. Ent. France*, LXIV : 242.

1898. *Labeille*, XXIX : 215.

1907. *Onthophagus bufo* Arrow, *Ann. Mag. Nat. Hist.* (7) XIX : 420.

Diagnostic characters : Oval and not very convex. The head is broad with strongly rounded ocular lobes and the clypeus is a little produced and feebly excised in the front. The front angles of prothorax are not sharp, lateral margins are straight in front, sinuate behind and base is rounded. The male with a pair of unconnected parallel cephalic horns, sloping obliquely backward. The female with slightly curved forehead carina along with straight carina.

Distribution : India : Gujarat : Junagarh (Una 30.8.1990), 4 Exs., also recorded from Maharashtra.

Elsewhere : Pakistan.

31. *Onthophagus tragus* Fabricius

1792. *Scarabaeus tragus* Fabricius, *Ent. Syst.* I : 56.

1914. *Onthophagus tragus* Boucomont, *Ann. Mus. Civ. Genova*, XLVI : 229.

Diagnostic characters : Broadly oval and not very convex. The head with large eyes. The clypeal margin feebly bilobed in the middle and the sides are bluntly angular. The front angles of the prothorax are blunt, lateral margins are straight in front and feebly sinuate behind and base is gently rounded. The male having two parallel cephalic horns, arises from the inner margin of the eyes

and the front tibia armed with four external teeth and with small terminal spur. The vertex of the female has a strong tubercle and the front tibia with a elongate and strongly curved spur.

Distribution : India : Gujarat : Dangs (Ahwa 8.9.1989), Junagarh (Talala 31.8.1990), Bhavnagar (Sihor 12.2.1990). 9 Exs, also recorded from Karnataka, Orissa, Rajasthan.

Elsewhere : Myanmar, Tonkin, South China, Java.

32. *Onthophagus politus* Fabricius

1798. *Copris politus* Fabricius, *Ent. Syst. Suppl.*, 35 p.

1914. *Onthophagus politus* Boucomont, *Ann. Mus. Civ. Genova*, XLVI : 217.

Diagnostic characters : Small, broadly oval, compact and convex. The clypeus is feebly and bluntly bilobed in front and separated by straight carina from the forehead. The front angles of the prothorax are blunt, sides gently rounded and sinuate behind, and the base is rounded and finely margined. The inner apical angle of the front tibia of the male is produced as a thin triangular lamina, which is bent downward.

Distribution : India : Gujarat : Junagarh (Una 30.8.1990), Banaskantha, (Dantiwara Dam 20.8.1992, Chitrasini village 21.8.1992, Kapra village 22.8.1992, Majadar village 23.8.1992, Ambaji 25.8.1992, Danta 27.8.1992), Sabarkantha (Idar 29.8.1992, Kankrol 30.8.1992), Mahesana (Vijapur 8.9.1992, Amaliyasan 9.9.1992, Situse 10.9.1992, Patan 12.9.1992, Modera 13.9.1992, Dharoi Dam 14.9.1992, Visnagar 15.9.1992). 316 Exs., also recorded from Arunachal Pradesh, Bihar, Haryana, Himachal Pradesh, Karnataka, Tamil Nadu, Uttar Pradesh.

Elsewhere : Sri Lanka.

33. *Onthophagus ensifer* Boucomont

1914. *Onthophagus ensifer* Boucomont, *Ann. Mus. Civ. Genova*, XLIV : 220.

Diagnostic characters : Oval and moderately convex. The head is not very broad, and the clypeus and the ocular lobes are rounded. The front angles of the prothorax are a little produced

and fairly sharp, the lateral margins are straight in front and sinuate behind. The male having very long slendered, slightly flattened, backwardly directed and curved cephalic horn, arises from the middle of the forehead and extending upto the middle of the body. The female having a curved carina in place of horn.

Distribution : India : Gujarat : Ahmedabad (Dehgam 22.2.1989), Kheda (13.9.1991), 18 Exs., also recorded from Arunachal Pradesh, Andhra Pradesh, Kerala, Rajasthan, Tamil Nadu, Uttar Pradesh.

34. *Onthophagus cervus* Fabricius

1798. *Copris cervus* Fabricius, *Ent. Syst. Suppl.*, 31 p.

1801. *Copris cervus* Fabricius, *Syst. Elueth.*, I : 46.

1798. *Copris nuchidens* Fabricius, *Ent. Syst. Suppl.*, 31 p.

1877. *Onthophagus ceylonicus* Harold, *Ann. Mus. Civ. Genova*, X : 61.

1931. *Onthophagus cerus* Arrow, *Fauna of British India*, Lamell. part III, coprinae, 349-350 p.

Diagnostic characters : Oval and moderately convex. The clypeus is a little produced, its margins are strongly reflexed and straight in the middle. The front angles of prothorax are rather sharp. The lateral margins straight in front and sinuate behind. The male with a pair of cephalic horns, slopping backward, broad at the base, arises behind the eyes, but in female there is a strong carina and similar carina between the eyes.

Distribution : India : Gujarat : Bhavnagar (Palitana 25.2.1986), Jamnagar (Nikava 8.3.1986), Junagarh (Gir Forest 13.8.1988, R.N. Bhargava), Gandhinagar (Chandrala 15.9.1991). 11 Exs., also recorded from Andaman & Nicobar Island, Arunachal Pradesh, Kerala, Karnataka, Madhya Pradesh, Maharashtra, Pondicherry, Tamil Nadu, West Bengal, Uttar Pradesh.

Elsewhere : Sri Lanka.

35. *Onthophagus falsus* Gillet

1925. *Onthophagus falsus* Gillet, *Ann. Soc. Sci. Brux*, XLIV : 236.

1898. *Onthophagus cervus* Dobrigny, *Labcille* XXIX : 214.

Diagnostic characters : Broadly oval and moderately convex. The head is not very broad and the clypeus is a little produced. The front angles of the prothorax are rather sharply produced, the lateral margins are nearly straight in front and sinuate behind, the base is rounded. The male with pair of cephalic horns, which are unconnected, very broad and directed backward at base, arise from the posterior edge of the vertex.

Distribution : India : Gujarat : Jamnagar (Khambhalia 27.8.1990), 2 Exs., also recorded from Himachal Pradesh, Haryana, Jammu & Kashmir, Maghalaya.

Elsewhere : Pakistan, Bangladesh.

Genus 8. *Liatongus* Reitter

1893. *Liatongus* Reitter, *Varh. Ver Brunn*, XXXI : 166.

Diagnostic characters : Rather elongate, scutellum present and very small. Elytra without posterior fringe of bristles or setae and other characters has nearly of *Onthophagus*. The author has found only two species from Gujarat.

Keys to species of *Liatongus* from Gujarat

1. Not very elongate, elytra and prothorax very lightly punctured *martialis* Harold
- Very elongate, elytra yellow with black spots and the elytral intervals minutely and lightly punctured *rhadamistus* Fabricius

36. *Liatongus martialis* Harold

1879. *Oniticellus martialis* Harold, *Col. Hefte*, XVI : 227.

1931. *Liatongus martialis* Arrow, *Fauna of British India* Lamell. part III, Coprinae, 370-371 p.

Diagnostic characters : Broadly oval and convex. The front margins of the head is rounded. The front angles of the prothorax strongly produced and blunt. The male with a long slender, recurved horn, arising between the eyes and the prothorax slopes strongly from the front to middle and having a small tubercle in the middle and a short longitudinal carina on each side of it and short distance from it.

Distribution : India : Gujarat : Junagarh (Gir Forest 3.3.1986), 4 Exs., also recorded from Rajasthan, Uttar Pradesh.

Elsewhere : Myanmar.

37. *Liatongus rhadamistus* Fabricius

1775. *Scarabaeus rhadamistus* Fabricius, *Syst. Ent.* 22 p.

1789. Oliver, *Ent.*, I (3) : 185 p. 28 pl., 243 fig.

1931. *Liatongus rhadamistus* Arrow, *Fauna of British India*, Lamell., part III, Coprinae, 374-375 p.

Diagnostic characters : Elongate oval and a little flattened above. The head is a almost semicircular and with very slight prominence on each side of the middle, and a flattened rhomboidal area between the eyes. The prothorax is about as long as its wide with very blunt front angles. The sides nearly straight to beyond the middle. The head of the male having a subangular frontal carina uniting the lateral suture and the female with slight median tubercle in place of frontal carina.

Distribution : India : Gujarat : Surat (Dumas 6.8.1989). 7 Exs., also recorded from Madhya Pradesh, Maharashtra, Tamil Nadu.

Elsewhere : Sri Lanka.

Genus 9. *Oniticellus* Serville

1825. *Oniticellus serville*, *Encycp. Meth.*, X : 356.

1856. Lacordaire. *Gen. Col.* III : 110

1893. Reitter, *Verh. Ver.*, Brunn, XXXI : 165

1901. *Tiniocellus* Pereira, *Trans. S. Afr. Phil. Soc.* XII : 116.

Diagnostic Characters : Elongate and scutellum present. Elytra flat and not completely covered the abdomen and having the fringe of stiff hairs at hind margin. Both sexes are alike. The four species of the genus have been found from Gujarat.

Key to species of *Oniticellus* from Gujarat

1. Head with carinae and prothorax sparingly punctured *pallipes* Fabricius
- Prothorax not sparingly punctured 2
2. Prothorax closely punctured *pallens* Oliver.

- Head without carinae 3
 3. Prothorax closely punctured and dorsal surface opaque *spinipes* Roth
 — Dorsal surface very smooth and shining.....
 *cinctus* Fabricius

38. *Oniticellus pallipes* Fabricius

1781. *Scarabaeus pallipes* Fabricius, *Spec. Ins.*, I : 33
 1908. *Oniticellus pallipes* Arrow, *Ann. Mag. Nat. Hist.* (8) I : 179.

Diagnostic characters : Narrowly elongate. The head is short and broad, the clypeal margin is straight in front and vertex is hollowed. The prothorax having slight posterior median groove and with almost rectangular front angles, the sides are strongly rounded and the base is angulate in the middle. The prothorax having a spot, a little behind the front margin in the middle, a similar one on each side of the last, one on each side of the middle and another in the same line near the outer margin and a pair near the middle of the base, the base and median spot upon the pygidium. The male having strong curved carina between the clypeus and the frons and an angular carina just behind it. The front tibia is less broad with sharp and shorter four teeth.

Distribution : India : Gujarat : Surat (Vyara 4.8.1989, Dumas 6.8.1989), Valsad (Tithal 13.8.1989), Bharuch (Rajapardi 17.8.1989). 7 Exs. also recorded from Haryana, Himachal Pradesh, Jammu and Kashmir, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh.

39. *Oniticellus pallens* Oliver

1789. *Scarabaeus pallens* Oliver, *Ent.*, I (3) : 170, 33 Pl. 203 Fig.
 1931. *Oniticellus pallens* Arrow, *Fauna of British India*, Lamell. part III, Coprinae, 377-378 p.

Diagnostic characters : Rather narrowly elongate, The head is short and broad. The clypeus is straight in front and vertex is hollowed. The front angles of the prothorax are rectangular,

lateral margins are strongly bent in the middle and the base is obtusely angulate in the middle. The dorsal surface of the prothorax having a triangular spot on each side of the middle, a pair of spots near the middle of the base, the front tibia of the male is broad and armed with four, not very stout external teeth and the tibial external teeth of the female are stout.

Distribution : India : Gujarat : Kachchh-Bhuj (Kandla 6.12.1993, Loriya 7.12.1993, Nalia 9.12.1993). 12 Exs., also recorded from Haryana, Himachal Pradesh, Rajasthan, Uttar Pradesh.

Elsewhere : Arabia, Algeria, Egypt, Pakistan, Somalia.

40. *Oniticellus spinipes* Roth

1851. *Oniticellus spinipes* Roth, *Arch. F. Nat.*, XVII (I) : 128.
 1900. *Tiniocellus spinipes* Pereira, *Trans. Phil. Soc. Afr.*, XII : 116.
 1891. *Oniticellus imbellis* Bates, *Entom. Suppl.* XXIV : 13.
 1908. *Oniticellus modestus* Arrow, *Ann. Mag. Nat. Hist.* (8) I : 182.

Diagnostic characters : Elongate oval and very flat above. The head is short and broad and without carina, the clypeal margin is feebly emarginate in the middle. The prothorax having an impressed longitudinal line upon the basal half, rather deep behind, the front angles are blunt and the hind angles obsolete, the lateral sides are rounded and the base is gently rounded. The front tibia of the male is broad and armed with four short and sharp external teeth, almost at right angles, and very strong in female.

Distribution : India : Gujarat : Surat (Kator 7.8.1989). 3 Exs., also recorded from Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Uttar Pradesh.

Elsewhere : Abyssinia, East and West Africa, Rhodensia, Transval, Uganda.

41. *Oniticellus cinctus* Fabricius

1775. *Scarabaeus cinctus* Fabricius, *Syst. Ent.*, 30 p.

1931. *Oniticellus cinctus* Arrow, *Fauna of British India*, Lamell. part III, Coprinae, 370-380 p.

Diagnostic characters : Oblong oval, not very convex and shining black. The head is without carina or elevations, the clypeus is short with a slight depression just behind the middle of the front margin. The front angles of the prothorax are rounded and the hind angles almost obsolete, the sides, are rounded and straight in front and behind, and the dorsal, posterior half having deeply impressed longitudinal line, the front tibia of the male is produced at the extremity into a broad, blunt and slightly hooked process and armed with four short external teeth, placed at right angles, and the tibial external teeth of the female are longer and stout.

Distribution : India : Gujarat : Ahmedabad (Dehgam 22.2.1986), Junagarh (Bhavnagar Road, 16.8.1988, R.N. Bhargava), Surat (Vyara 4.8.1989, Dumas 5.8.1989), Junagarh (Manvadar 3.9.1990). 17 Exs., also recorded from Arunachal Pradesh, Assam, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Annam, Bangladesh, Malay Peninsula, Myanmar, Siam, South China.

Genus 10. *Drepanocerus* Kirby

1828. *Drepanocerus* Kirby, *Zool. Jour.* III : 521;

1856. Lacordaire, *Gen. Col.*, III : 111.

1851. *Ixodina* Roth, *Arch. Nat.* XVII (1) : 128.

Diagnostic characters : Elongate and flattened and clothed with erect scale like hairs. Clypeus bidentate. Prothorax very uneven and scutellum distinct. Elytra flat not covered the sides of abdomen. Legs long and slendered. The males generally with horn.

Only single species of the genus has been found from Gujarat.

42. *Drepanocerus exsul* Sharp

1875. *Oniticellus exsul* Sharp. *Col. Heffe* XIII : 53.

Diagnostic characters : Elongate, subrectangular and very flat above. The head is

flat, very broad in front, the sides is bidentate, the teeth feeble and not far apart. The prothorax having slight broad elevation in front and with a transverse depression near the middle. The lateral margins converging towards the base, strongly rounded in front, nearly straight behind and the base obtusely angular in the middle. Scutellum is long and narrow. The outer striae and the side of the elytra are sinuous and the striae are abruptly deflected and bear three prominence on each sutural intervals, with stiff bristles. The middle and hind tibia are slender and bear minute bristles at their outer edge, armed with three very blunt teeth. The front tibia of the male is strongly curved at inner edge.

Distribution : India : Gujarat : Jamnagar (Kalavad 8.3.1986), Surendranagar (Chotila 13.3.1986), Junagarh (Gir forest 13.8.1988, R.N. Bhargava, Trapas 11.9.1990). 9 Exs., also recorded from Meghalaya.

Genus 11. *Onitis* Fabricius

1798. *Onitis* Fabricius, *Ent. Syst.*, Suppl., 2 p.

1856. Lacordaire, *Gen. Col.*, III : 103.

1875. Lansberge. *Ann. Soc. Ent. Belg.*, XVIII : 49.

Diagnostic characters : Oblong with stout legs and without front tarsi. Head is not broad and the prothorax without process or excavation but having a pit on each lateral side near the middle. Scutellum visible but minute. The front tibiae armed with four external teeth. Abdomen completely covered by a elytra.

The author has been found six species of the genus from Gujarat.

Key to species of *Onitis* from Gujarat

1. Clypeus without carina and clypeo frontal carina simple and entire *siva* Gillet.
- Clypeus with a carina 2
2. Prothorax very lightly punctured
..... *lama* Lansberge
- Prothorax not very lightly punctured and clypeo-frontal carina not simple 3
3. Prothorax springly punctured and clypeo frontal

- carina widely interrupted in the middle
 *falcatus* Fabricius
- Prothorax not springly puncture and clypeo frontal carina not widely interrupted 4
4. Prothorax strongly and closely punctured and clypeo frontal carina interruptly curved
 *philemon* Fabricius
- Prothorax not strongly and closely punctured and clypeo frontal carina not interruptly curved 5
5. Prothorax unevely punctured and its basal impressions tuberculate, clypeo frontal carina strongly elevated, acuminate in the middle .
 *castaneus* Redtenbacher
- Prothorax rugose in front and punctured behind, clypeo-frontal interrupted carina having another sharply elevated carina in front of it
 *brahma* Lansberge

43. *Onitis siva* Gillet

1917. *Onitis siva* Gillet, *Ann. Soc. Ent. Belg.* LV : 313.

Diagnostic characters : Elongate oval and moderately convex. The clypeal margin is strongly rounded, and the clypeus is separated from the frons by a strongly elevated and curved carina. The prothorax having a trace of a longitudinal median groove posteriorly in the middle, uniting with the close and narrow basal foveae, the front angles are acutely rectangular and the hind angles obsolete. The front legs of the male are elongate, femur having a very strong spine at the middle of the posterior edge and the tibiae are cylindrical, strongly curved anteriorly, armed with four sharp outer teeth. The hind femur is little hollowed on its lower face and has hooked tooth just beyond the middle on its anterior edge and the female is without teeth.

Distribution : India : Gujarat : Banaskantha (Palanpur 12.10.1964, V.C. Agrawal). 4 Exs., also recorded from Arunachal Pradesh, Kerala, Rajasthan, Tamil Nadu, Uttar Pradesh.

44. *Onitis lama* Lansberge

1875. *Onitis lama* Lansberge, *Ann. Soc. Ent. Belg.*, XVIII : 123.

Diagnostic characters : Rather narrowly oval and very convex. The head having strongly elevated and slightly acute frontal carina, a short straight, transverse clypeal carina and an trisinate vertex carina extending from eye to eye. The front angle of prothorax are rather blunt, sides strongly rounded and the base is almost completely rounded. The front femur of the male having a very sharp, oblique tooth beyond the middle of its lower edge and the hind femur with a tooth near the end of its lower edge. The front tibia of the female is broad and armed with four external teeth and a small articulated terminal spur.

Distribution : India : Gujarat : Bhavnagar (Sihor 12.9.1990), Ahmedabad (Dholera 6.9.1991), Banaskantha (Chitrasini village 21.8.1992, Majdar 23.8.1992, Danta 27.8.1992), Sabarkantha (Idar 29.8.1992, Kankrol 30.8.1992, Harsol 3.9.1992), Mahesana (Situse 10.9.1992, Modera 13.9.1992, Visnagar 15.9.1992). 81 Exs., also recorded from Haryana, Punjab, Rajasthan, Uttar Pradesh.

45. *Onitis falcatus* Wulf

1786. *Scarabaeus falcatus* Wulf, *Deser. Cap. Ins.*, 14 p., 2Pl. 17 fig.

1875. *Onitis falcatus* Lansberge, *Ann. Soc. Ent. Belg.*, XVIII : 126.

1848. *Onitis himalayicus* Redtenbacher, *Hugel's Kaschmir* IV (2) : 518.

Diagnostic characters : Rather narrowly oval and convex. The clypeus is elliptical and clypeo frontal carina is widely interrupted in the middle and with a short frontal tubercle behind it. The prothorax without a well marked median groove and the base is strongly rounded and has basal foveae. The front tibia of the male is elongate, armed with four short external teeth, two or three minute teeth before the middle of the lower surface, and a sharp incurved terminal process, and the middle femur has a minute tooth near the end of lower edge. The front tibia of the female is rather uniformly curved and armed at the tip with an articulated spur.

Distribution : India : Gujarat : Kachchh-Bhuj (Bhuj 5.12.1993, Loriya 7.12.1993). 11 Exs. also

recorded from Arunachal Pradesh, Assam, Bihar, Haryana, Karnataka, Meghalaya, Manipur, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, W. Bengal.

Elsewhere : Bangladesh, Malay Peninsula, Myanmar, Philippine Island, South China.

46. *Onitis philemon* Fabricius

1801. *Onitis philemon* Fabricius, *Syst. Eleut.*, I : 30

1875. *Onitis distinctus* Lansberge, *Ann. Soc. Ent. Belg.*, XVIII : 138.

Diagnostic characters : Oval, not very elongate and not very convex. The clypeus is parabolic with an feeble emargination in the middle. The clypeus is separated from the frons by a interrupted carina, with a short transverse carina just before it and a conical tubercle just behind it, the prothorax is without well marked medina line, and the front angles are rectangular and the hind angles obsolete, the sides are straight in front and strongly rounded in the middle and the base is obtusely angulate in the middle. The middle femur of the male has a sharp tooth near the end of lower edge and the hind trochanter is little toothed beneath. The front tibia of the female is broad, armed with four strong external teeth and an articulated terminal spur.

Distribution : India : Gujarat : Vadodara (Tilakwada 31.7.1989), Surat (Vyara 4.8.1989, Kator, 7.8.1989), Valsad (18.8.1989), Junagarh (Una 1.9.1990, Satadar 1.9.1990, Manvadar 3.9.1990, Hashapur 4.9.1990), Rajkot (Tankara 8.9.1990), Ahmedabad (Dholera 6.9.1991, Dholka 7.9.1991), Kheda (Dakor 9.9.1991, Vasad 10.9.1991, Tarapur 11.9.1991, Kapadvanj 12.9.1991, Kheda 13.9.1991), Banaskantha (Dantiwada Dam 20.8.1992, Majadar village 23.8.1992, Danta 27.8.1992), Sabarkantha (Idar 29.8.1992, Kankrol 30.8.1992, Vijaynagar 31.8.1992, Amaliyasan 9.9.1992, Situse 10.9.1992, Patan 12.9.1992, Modera 13.9.1992, Dharoi Dam 14.9.1992, Visnagar 15.9.1992), Kachchh Bhuj (Loriya 7.12.1993). 135 Exs., also recorded from Arunachal Pradesh, Assam, Bihar, Haryana, Himachal Pradesh, Karnataka, Kerala, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Sri Lanka.

47. *Onitis castaneus* Redtenbacher

1848. *Onitis castaneus* Redtenbacher, *Hugel's Kaschmir*, IV (2) : 517.

1848. Lansberge, *Ann. Soc. Ent. Belg.*, XVIII : 144.

Diagnostic Characters : Short, compact and convex. The outer margin of the clypeus is strongly reflexed and straight in the middle and has a long transverse arcuate carina and the frons has a strongly elevated entire carina and the vertex is strongly excavated. the front angles of the prothorax are rather blunt, the sides are bisinuate and the base is distinctly lobed in the middle. The front femur of the male has strong oblique spine near the middle of its anterior edge and the middle tibia has two strong process at its outer edge. The front tibia of the female is broad and bears four strong external teeth.

Distribution : India : Gujarat : Sabarkantha (Berna village 6.11.1964, R.N. Bhargava, Danta 6.11.1964, Y.P. Sinha), Banaskantha (Palanpur 12.10.1964, V.C. Agrawal), 8 Exs., also recorded from Arunnachal Pradehs, Assam, Bihar, Rajasthan, Uttar Pradesh, West Bengal.

Elsewhere : Pakistan.

48. *Onitis brahma* Lansberge

1875. *Onitis brahma* Lansberge, *Ann. Soc. Ent. Belg.*, XVIII : 142.

Diagnostic characters : Rather elongate, parallel sided. The clypeal margin strongly reflexed and a little excised in the middle, forming two obtuse angles. the Clypeus is separated from the frons by a interrupted carina, with a sharply elevated transverse carina, a little in front of it and a truncate tubercle, a little behind. The prothorax with a posterior median groove uniting behind with the basal foveae, the front angles are right angles and the hind angles almost obsolete. In the male, the front legs are elongate, femur with a blunt process, a little before the extremity, the tibia is slendered, strongly curved in its anterior half, armed with four sharp external teeth, the middle femur has a sharp tooth near the middle

of its lower edge and the hind femur is also having a sharp, outwardly directed tooth at its upper edge near the base. The front tibia of the female is armed with four external strong teeth and an articulated terminal spur.

Distribution : India : Gujarat : Panchmahal (Pavagarh 18.2.1988, Tuva 20.2.1988, Paplod 21.2.1988), 5 Exs., also recorded from Andhra Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu.

Genus 12. *Chironitis* Lansberge

1875. *Chironitis* Lansberge, Ann. Soc. Ent. Belg., XVIII : 19.

1994. *Chironitis* Reitter, Verh. Ver. Brunn, XXXI : 98.

Diagnostic characters : Oblong and rather depressed. Head not long and front margin of clypeus is reflexed. Prothorax having a small foveae on each side of the middle. Scutellum very small and sharply pointed. The front tibiae armed with four external teeth and middle and hind tibiae strongly dilated at the extremity. The male without frontal tarsi and female with frontal tarsi.

The author has found only one species from Gujarat.

49. *Chironitis indicus* Lansberge

1875. *Chironitis indicus* Lansberge, Ann. Soc. Ent. Belg., XVIII : 45.

Diagnostic characters : Oblong and rather depressed. The front margin of the clypeus is strongly reflexed and having a short transverse posterior carina and separated from the frons by another carina. The prothorax is broader than elytra, the lateral margins are strongly dilated in the middle, convergent and nearly straight from there to the front and hind angles, the basal foveae are narrow. The front femur having a sharp strong tooth near the end of its anterior edge, and the tibia is long slendered, strongly curved and armed with four small external teeth. The clypeo frontal carina of the female having a sharp tubercle in the middle.

Distribution : India : Gujarat : Jamnagar (Bhatia 26.8.1990), Rajkot (Tankara 8.9.1990), 6 Exs., also recorded from Karnataka, Maharashtra, Tamil Nadu.

Elsewhere : Pakistan.

DISCUSSION

All together forty nine species belonging to twelve genera have been studied from Gujarat, collected from the dung of herbivorous mammals except the representatives of genus *Gymnopleurus* Illiger which were collected from the human faecal matter. On the basis of leg structure, the dung beetles are divided into four tribes, i.e.- Scarabaeini, Sisyphini, Coprini, and Penelini. The genus *Gymnopleurus* is characterised by the presence of two or four lobed clypeus and possession of all six tarsi. The representative of the genus *Sisyphus* Latreille look like spider due to the presence of long legs and clothing of setae. The legs of *Catharsius* Hope are short, the front tibia armed with three external teeth and four posterior tibiae are dialating strongly from base to extremity and each with two transverse carina, the middle tibia with two and the hind tibia with one terminal spur. The front tibia of the genus *Copris* Geoffroy armed with three external teeth and the four posterior tibiae are strongly dialating from base to extremity and each with two transverse carina at the outer edges, the middle tibia is with two and the hind tibia with one terminal spur. The legs of the genus *Phalops* Erichson are of moderate length, the middle and hind tarsi broad and flattened and the genus *Caccobius* Thoms is very small with short legs, the front tibia very short and broad, its terminal tooth not placed obliquely as usual. The species of the genus *Onthophagus* Latreille are having usually stout legs, the femora very thick, the tibia armed with four but occasionally with three teeth, with minute denticles above and sometimes between them, the middle and hind tibia dialating greatly from base to extremity. The front tarsi slendered and short and middle and hind tarsi a little flattened. The genus *Liatongus* Reitter has

nearly all the features of *Onthophagus* Latreille except the presence of scutellum. The legs of *Oniticellus* Serville are fairly stout, the middle and hind tibiae moderately broad at the extremity and basal joint of tarsi is much longer than the second. The genus *Drepanocerus* Sharp has a long and slendered legs, the front tibia armed with four external teeth and serrate at the base. The Front tarsi short, middle and hind are long. The front legs of the genus *Onitis* Fabricius are without tarsi and femora with spines. The genus *Chironitis* Lansberge has not very long legs. The front tibia armed with four external teeth, middle and hind tibia are strongly dilated at the extremity, the basal joint of tarsi is twice as long as second.

SUMMARY

Total forty nine species belonging to twelve genera from Gujarat were recorded, out of forty nine, forty one species have been recorded first time from Gujarat. All these species are belonging to tribe Scarabaeini, Sisyphini, Coprini and the representative of tribe Penelini are not found.

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REFERENCES

- ARROW, G.J. 1931. Fauna of British India Including Ceylon and Burma, Lamellicornia part-III Coprinae, Taylor and Francis, London. 1-428.
- SEWAK, R. 1985. On a collection of dung beetles (*Coleoptera* : *Scarabaeidae* : *Coprinae*) from Gujarat. *Okoassay* 2 (2) : 33-35 p.

INSECTA : DIPTERA

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INTRODUCTION

The Diptera comprise mosquitoes, midges and flies and are highly specialized insect presenting a great diversity of forms and habits. The majority of adult Diptera frequent flowers causing pollination and feed chiefly on nectar and plant sap or on liquids exudated from rotting organic matter. Some prey upon various insects and there are a few having developed the habit of sucking blood, thereby a number of them taking an important role in transmitting certain dreaded diseases, viz., malaria, trypanosomiasis, leishmaniasis, filariasis, dengue fever, encephalitis and several other viral infections of man and animals. The dipterous larvae are close behind the adults in economic importance. Majority of them live in water, in rotting flesh, in decaying fruits or other organic materials. There are some others living inside live plant tissues or animal tissues (causing myiasis).

The study of Diptera fauna of Gujarat has a century old history. In spite of this, our knowledge still remain extremely poor due to its extreme climate, inaccessible desert areas and few over all surveys. The Diptera materials were collected by V.G. Mazumdar (1969) and A.N.T. Joseph (1988).

Further, the report of some earlier workers does not indicate specific distribution. As such the fauna considered here is solely based on the works where specific distribution is furnished.

So far as our knowledge goes out of 6093 species under 1075 genera of 148 subfamilies belonging to 87 families in India only 106 species under 70 genera belonging to 25 families are represented in the Gujarat state. More important

of the workers who contributed on Diptera fauna of Gujarat are Roy (1954), Joseph and Parui (1992), Brunetti (1923), Advani & Vazirani (1981), Datta & Pal (1985), Mitra *et al.* (2002) and Banerjee & Mitra (2002 & 2004).

SYSTEMATIC ACCOUNT

LIST OF SPECIES

Suborder NEMATOCERA

Family 1. PSYCHODIDAE

Subfamily PSYCHODINAE

1. *Psychoda alternata* Say

Family 2. PHLEBOTOMIDAE

2. *Phlebotomus (Euphlebotomus) argentipes*

Annandale & Brunetti

3. *Phlebotomus (Paraphlebotomus) sergenti* Parrot

Family 3. CULICIDAE

Subfamily ANOPHELINAE

4. *Anopheles (Anopheles) barbirostris* van der Wulp

5. *Anopheles (Cellia) annularis* van der Wulp

6. *Anopheles (Cellia) culicifacies* Giles

7. *Anopheles (Cellia) fluviatilis* James

8. *Anopheles (Cellia) jamesii* Theobald

9. *Anopheles (Cellia) jeyporiensis* James

10. *Anopheles (Cellia) multicolor* Camboulin

11. *Anopheles (Cellia) pallidus* Theobald

12. *Anopheles (Cellia) pulcherrimus* Theobald

13. *Anopheles (Cellia) splendidus* Koidzumi

14. *Anopheles (Cellia) stephensi* Liston

15. *Anopheles (Cellia) subpictus* Grassi

16. *Anopheles (Cellia) tessellatus* Theobald
 17. *Anopheles (Cellia) theobaldi* Giles
 18. *Anopheles (Cellia) turkhudi* Liston
 19. *Anopheles (Cellia) vagus* Donitz
 20. *Anopheles (Cellia) varuna* Iyenger

Suborder BRACHYCERA

Family 4. STRATIOMYIDAE

Subfamily STRATIOMYINAE

21. *Adoxomyia heminopla* (Wiedemann)

Subfamily SARGINAE

22. *Sargus metallinus* Fabricius

Family 5. TABANIDAE

Subfamily PANGONIINAE

23. *Philoliche longirostris* (Hardwicke)

Subfamily TABANINAE

24. *Tabanus (Tabanus) striatus* (Fabricius)

Family 6. ASILIDAE

Subfamily LAPHRIINAE

25. *Laxenecera albibarbis* Macquart

26. *Laxenecera flavibarbis* Macquart

27. *Nusa bhargavi* Joseph and Parui

28. *Nusa elva* (Walker)

Subfamily DASYPOGONIINAE

29. *Ommatius hradskyi* Joseph and Parui

30. *Ommatius indicus* Joseph and Parui

31. *Ommatius ponti* Joseph and Parui

32. *Michotomia aurata* (Fabricius)

33. *Stichopogon inaequalis* (Loew)

34. *Stichopogon meridionalis* Oldroyd

35. *Stichopogon tomentosus* Oldroyd

Subfamily ASILINAE

36. *Astochia pseudoguptai* Joseph and Parui

37. *Clephyroneura pulla* Oldroyd

38. *Philodicus ceylanicus* Schiner

39. *Philodicus femoralis* Ricardo

40. *Promachus duvaucelii* (Macquart)

41. *Promachus rufimystaeus* (Macquart)

Family 7. BOMBYLIIDAE

Subfamily TOXOPHORINAE

42. *Toxophora javana* Wiedemann

Subfamily BOMBYLIINAE

43. *Bombylius maculatus* Fabricius

44. *Bombylius orientalis* (Macquart)

Subfamily ANTHRACINAE

45. *Petrorossia albofulva* (Walker)

46. *Petrorossia nigrofemorata* (Brunetti)

47. *Authrax bipunctatus* (Fabricius)

48. *Argyroamoeba duvaucelii* Macquart

Subfamily EXOPROSOPINAE

49. *Thyridanthrax (Exhylanthrax) absalon*
(Wiedemann)

50. *Exoprosopa (Exoprosopa) flammea* Brunetti

51. *Exoprosopa (Exoprosopa) gujaratica* Nurse.

52. *Exoprosopa (Exoprosopa) insulata* (Walker)

53. *Litorhynchus lar* (Fabricius)

54. *Ligyra aurantiaca* (Guerin-Meneville)

55. *Ligyra oenomaus* (Rondani)

56. *Systoechus nivialis* (Brunetti)

Family 8. PIPUNCULIDAE

57. *Tomosvaryella limpidipennis* (Brunetti)

Suborder CYCLORRHAPHA

Family 9. SYRPHIDAE

Subfamily SYRPHINAE

58. *Ischiodon scutellaris* (Fabricius)

59. *Baccha (Allobaccha) sapphirina* Wiedemann

60. *Paragus (Paragus) serratus* (Fabricius)

Subfamily MILESIINAE

61. *Eristalinus (Merodonoides) multifarius*
(Walker)

62. *Mesembrius bengalensis* (Wiedemann)

63. *Phytomya (Phytomya) argyrocephala*
Macquart

64. *Phytomya (Phytomya) errans* (Fabricius)

Family 10. CONOPIDAE

Subfamily CONOPINAE

65. *Archiconops erythrocephala* (Fabricius)

66. *Physocephala munda* (Brunetti)

Family 11. TEPHRITIDAE

67. *Euphranta (Staurella) crux* (Fabricius)

Family 12. OTITIDAE

68. *Physiphora demandata* (Fabricius)

Family 13. Sepsidae

69. *Australosepsis frontalis* (Walker)
 70. *Sepsis cynipsea* Linnaeus
 71. *Sepsis nitens* Wiedemann
 72. *Saltella setigera* Brunetti

Family 14. AGROMYZIDAE

Subfamily PHYTOMYZINAE

73. *Liriomyza trifolii* (Burgess)

Family 15. CHLOROPIDAE

74. *Pachylophus rufescens* (de Meijere)

Family 16. EPHYDRIDAE

75. *Paralimna hirticornis* De Meijere

Family 17. HIPPOBOSCIDAE

76. *Hippobosca variegata* Megerle

Family 18. NYCTERIBIIDAE

Subfamily CYCLOPODIINAE

77. *Cyclopodia sykesii* (Westwood)
 78. *Leptocyclopodia (Leptocyclopodia) ferrari*
ferrari (Rondani)

Subfamily NYCTERIBIINAE

79. *Basilina (Paracyclopodia) roylei* (Westwood)
 80. *Basilina (Tripselia) blainvillii aminculata*
 (Speiser)

Family 19. STREBLIDAE

Subfamily BRACHYTARSINAE

81. *Brachytarsina sinhai* Vazirani & Advani
 82. *Raymondia (Brachyotheca) lobulata* (Speiser)

Subfamily ASCODIPTERINAE

83. *Ascodiperon namrui* Maa

Family 20. MUSCIDAE

Subfamily MUSCINAE

84. *Musca (Musca) domestica* Linnaeus

Subfamily PHAONIINAE

85. *Atherigona (Atherigona) approximata* Malloch

Family 21. CALLIPHORIDAE

Subfamily CALLIPHORINAE

86. *Bengalia torosa* (Wiedemann)

Subfamily CHRYSOMYINAE

87. *Chrysomya megacephala* (Fabricius)

Subfamily RHINIINAE

88. *Stomorhina discolor* (Fabricius)

Family 22. SARCOPHAGIDAE

89. *Parasarcophaga (Parasarcophaga) albiceps*
 (Meigen)
 90. *Parasarcophaga (Parasarcophaga) hirticeps*
 Wiedemann
 91. *Parasarcophaga (Parasarcophaga) dux*
 Thomson

Family 23. TACHINIDAE

Subfamily PHASIINAE

Tribe **Cylindromyiini**

92. *Cylindromyia wiedemanni* Crosskey

Subfamily TACHININAE

Tribe **Voriini**

93. *Hystricovoria bakeri* Townsend
 94. *Voria ruralis* (Fallen)

Subfamily GONIINAE

Tribe **Siphonini**

95. *Peribaea orbata* (Wiedemann)
 96. *Peribaea suspecta* (Malloch)

Tribe **Carceliini**

97. *Carcelia (Senometopia) illota* (Curran)

Tribe **Sturmiini**

98. *Cadurcia lucens* Villeneuve
 99. *Sturmiopsis inferens* Townsend

Tribe **Goniini**

100. *Goniophthalmus halli* Mesnil

Tribe **Eryciini**

101. *Nealsomyia rufipes* (Villeneuve)
 102. *Pseudoporichaeta indica* (Gardnar)

Family 24. GASTEROPHILIDAE

Subfamily GASTEROPHILINAE

103. *Gasterophilus pecorum* (Fabricius)

Family 25. OESTRIDAE

Subfamily HYPODERMATINAE

104. *Przhevalskiana silensus* (Brauer)
 105. *Hypoderma lineatum* (Villers)

Subfamily OESTRINAE

106. *Cephalopina titillator* (Clark)

Key to the families of DIPTERA

1. Body of leathery texture. Head placed in a curved excavation of the thorax or bent back upon thorax; mouth imperfect, palpi absent 2
 - Body devoid of leathery texture; head free, mouth generally well developed, with a more or less prominent proboscis; palpi present 3
2. Head folding back on dorsum of thorax; wingless species NYCTERIBIIDAE
 - Head not folding back on dorsum of thorax; winged species STREBLIDAE
3. Wings absent or very small; coxae widely separated; ectoparasites of birds or mammals HIPPOBOSCIDAE
 - Wings well developed; coxae very close, usually not ectoparasites but if so, body flattened dorsoventrally & coxae widely separated 4
4. Six or more freely joined antennal segments; antennae often long & plumose 5
 - Five or less antennal segments, 3rd antennal segment often with light rings or with a style or large bristle or arista 7
5. Wings short, densely hairy, broadly oval, pointed at apex & held roof like over body at rest PSYCHODIDAE
 - Wings usually long & narrow, or if broad, then not pointed at apex; wings held flat over body at rest; setae or scales may occur on wing margins or veins but wings not densely hairy 6
6. Wings with scales, palpi long CULICIDAE
 - Wings with hairs, palpi short PHLEBOTOMIDAE
7. Third antennal segment with rings 8
 - Third antennal segment with an elongate style or bristle 9
8. Calypters small or vestigial; discal cell small, about as long as wide STRATIOMYIDAE
 - Calypters large & distinct; discal cell at least twice as long as wide TABANIDAE
9. Radial vein appearing 4-branched 10
 - Radial vein appearing 3-branched 11
10. Top of head distinctly concave and eyes bulging when viewed from front; body elongated, sometimes robust and hairy, face very hairy ASILIDAE
 - Top of the head not concave; eyes and body variable; face typically not hairy BOMBYLIIDAE
11. Anal cell longer than 2nd basal cell B₂ with apex typically pointed and closed near wing margin; frontal suture lacking 12
 - Anal absent or short, closed distant from posterior wing margin; frontal suture present or absent 14
12. Proboscis longer than head; face with distinct grooves below antennae CONOPIDAE
 - Proboscis very short, longer than head, face lacking grooves 13
13. First posterior cell closed at or close to wing margin and usually stalked apically; spurious vein between 3rd and 4th longitudinal veins; eyes not enlarged SYRPHIDAE
 - First posterior cell open at wing margin, spurious vein lacking; eyes greatly enlarged, surrounding most of head PIPUNCULIDAE
14. Mouth parts vestigial or absent; body bee-like 15
 - Mouth parts well developed; body bristled 16
15. Cell P1 widening towards wing apex GASTROPHILIDAE
 - Cell P1 narrowing towards wing apex or closed OESTRIDAE
16. Second antennal segment lacking longitudinal seam; inner calypter small or absent; thorax

- typically lacking complete transverse suture 17
- Second antennal segment with longitudinal seam; inner calypter usually large; thorax usually with transverse suture 21
17. Sc vein extending to costa or terminating close to it, anal cell present 20
- Sc vein not extending to costa anal cell present or absent 18
18. Tip of Sc vein bent perpendicularly towards costa, anal cell usually with pointed posterior tip, wings banded or spotted TEPHRITIDAE
- Characters not as above 19
19. Costa broken near end of Sc or R1 vein and close to humeral cross vein EPHYDRIDAE
- Costa only broken near end of vein Sc or R1 20
20. Anal cell absent; large, often shiny, raised triangular area surrounding ocelli CHLOROPIDAE
- Anal cell present; ocelli not surrounded by large triangular area AGROMYZIDAE
21. Head spherical; body cylindrical; abdomen often narrows basally; palps vestigial SEPSIDAE
- Body shape variable; palps usually well developed OTITIDAE
22. Hypopleura usually lacking stiff bristles and without setae, or if hypopleural setae present, then pteropleural bristles absent or cell P1 not narrowing towards wing tip MUSCIDAE
- Hypopleura and pteropleura with stiff bristles; cell P2 narrowing or closed toward wing tip 22
23. Postscutellum developed as convex protuberance; stiff bristles usually on abdominal tergites TACHINIDAE
- Postscutellum undeveloped; abdominal bristles typically absent 23
24. Antennal arista usually plumose throughout; 2 notopleural bristles; body often metallic green or blue CALLIPHORIDAE
- Antennae arista typically plumose only on basal half; 3-4 notopleural bristles; body non-metallic SARCOPHAGIDAE

Suborder NEMATOCERA

Family PSYCHODIDAE

Minute moth-like flies, whole body being covered with long coarse hairs, commonly found in damp and shady situations.

Subfamily PSYCHODINAE

Genus *Psychoda* Latreille1. *Psychoda alternata* Say

1824. *Psychoda alternata* Say, in Keating. *Major Long's second Expedition* (Appendix), 2 : 358.

Diagnosis : Body entirely clothed with hair, varying from yellowish grey to whitish; eyes black with very large facets; antennae fifteen pointed; the genital process of the male with superi or appendages consisting of two subequal joints; wings with only normally blackish grey hair; scale-spots wholly absent; the second longitudinal vein forks barely beyond the base of the 3rd vein; the fork of the anterior branch of this 2nd vein a little beyond that of the 4th vein; legs of the same colour as the body.

Distribution : India : Gujarat, Bihar, Himachal Pradesh, Karnataka, Kerala, Uttar Pradesh and West Bengal.

Elsewhere : Myanmar; Cosmopolitan.

Family PHLEBOTOMIDAE

Commonly called sandfly, occurs in dark or dark or shady damp situations. Females suck blood of vertebrates including man causing irritation. Some species of *Phlebotomus* are vectors of Kala-azar and oriental sore.

Genus *Phlebotomus* Rondani & BerteSubgenus *Euphlebotomus* Theodor

1948. *Euphlebotomus* Theodor, *Bull. ent. Res.*, **39** : 98.

Type-species *Euphlebotomus argentipes* Annandale & Brunetti.

2. *Phlebotomus (Euphlebotomus) argentipes*
Annandale & Brunetti

1908. *Phlebotomus argentipes* Annandale & Brunetti, *Rec. Indian Mus.*, **2** : 101.

Diagnosis : Head brownish with concolourous bristly hairs; palpi 5 jointed, second joint more than half the length of the third; thorax covered with thick brownish yellow bristly hairs along with bunches of long bristly hairs; legs very long, femora much shorter than tibiae, metatarsus as long as the remaining tarsal joints combined, wing obtusely pointed at tip, second longitudinal vein (R_{2+3}) forks barely before the middle of wing, fifth vein (Cu_1) straight and long, sixth vein (Cu_2) sinuous; abdomen slender, cylindrical, covered with blackish bristly hairs; male genitalia with long and distinct structures.

Distribution : India : Gujarat Bihar, Gujarat, Kerala, Maharashtra, Tamil Nadu, Utter Pradesh and West Bengal.

Elsewhere : Sri Lanka.

Genus *Paraphlebotomus* Theodor3. *Phlebotomus (Paraphlebotomus) sergenti* Parrot

1917. *Phlebotomus sergenti* Parrot, *Bull. Soc. Path. Exot.*, **10** : 564.

1973. *Phlebotomus (Paraphlebotomus) sergenti*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, **1** : 247

Distribution : India : Gujarat, Kashmir, Punjab.

Elsewhere : Mediterranean; Middle East; Pakistan.

Family CULICIDAE

The culicidae or mosquitoes are of great medical importance for the cause of transmission of some serious or even fatal diseases of man and animals. Females of most species suck blood and

while doing so, some turn out to be vectors of diseases like malaria, filariasis, dengue fever and Japanese encephalities and certain other viral infections. The family Culicidae is represented by 17 species under 1 genus in Gujarat, of which few are incriminated as pests or vectors. The habits and habitats of most of the species are well known.

Genus *Anopheles* Meigen**Key to subgenera of the Genus *Anopheles* Meigen**

1. Wing completely dark or with maximum 3 dark infuscations covering both costa and first longitudinal vein; male coxite with 2 parabasal spines and 1 internal spine.....
.....*Anopheles* Meigen
- Wing with at least 4 infuscated areas on costa and first longitudinal vein; male coxite with 4 or 5 parabasal spines, internal spine absent
.....*Cellia* Theobald

Subgenus *Anopheles* Meigen4. *Anopheles (Anopheles) barbirostris*
van der Wulp

1884. *Anopheles barbirostris* van der Wulp. *Notes Leyden Mus.*, **6** : 248.

1873. *Anopheles (Anopheles) barbirostris*, Hardy and Delfinado, *A Catalogue of Diptera of the Oriental Region* **1** : 268.

Diagnosis : Comparatively large mosquito with chaggy appearance, having a tuft of black-scales on 7th Sternite.

Distribution : India : Gujarat (Kutch Serula village, Ukhaldia), Andamans, Rajasthan, Tamil Nadu, West Bengal.

Elsewhere : Bangladesh, Indonesia, Kalimantan, Kampuchea, Laos, Malaysia, Myanmar, Nepal, N. Borneo, Moluccas, Pakistan, Sri Lanka, S. China, Timor, Thailand and Vietnam.

Subgenus *Cellia* Theobald**Key to the species of the subgenus *Cellia* Theobald**

1. Tip of the hind tarsi not white 2
- Tip of the hind tarsi white 10

2. Tarsi of front legs with broad pale bands .. 3
— Tarsi of front legs unbanded or only with narrow bands 5
3. Femora with tibiae speckled ... *stephensi* Liston
— Femora with tibiae not speckled 4
4. Palpi of female with dark preapical area equal to or nearly equal to the pale apical band ...
..... *subpictus* Grassi
— Palpi of female with dark preapical area half or less than half the length of the apical broad band *vagus* Donitz
5. Thorax with obvious scales 6
— Thorax with hairs or hairlike scales 8
6. Tip of female palpi dark 7
— Tip of female palpi not dark
..... *jeyporiensis* James
7. Fossae in both sexes covered with scales
..... *multicolor* Comboulin
— Fossae devoid of scales *turkhudi* Liston
8. Female palpi with two broad pale apical bands, as broad or broader than the intervening dark area *varuna* Iyenger
— Female palpi with subapical pale band narrow, intervening area very broad 9
9. Fringe spots well marked at all vein except 6; some erect pale scales in front of thorax; vein 1 pale in basal area *fluviatilis* James
— Fringe spot on two veins only except rarely; no pale scales or very few in front of thorax; vein 1 internal to inner dark costal spot with dark spot; third vein mostly dark
..... *culicifacies* Giles
10. Hind tarsi with only one segment or less white, commonly with white bands above this
..... *tessellatus* Theobald
— Hind tarsi with a continuous white area embracing atleast two terminal segments. 11
11. Femora and tibiae not speckled 12
— Femora and tibiae speckled 14
12. Hind tarsi $3\frac{1}{4}$ segments continuously white; abdomen heavily clothed with broad scales, which form lateral tufts except on the last few segments *pulcherrimus* Theobald
— Hind tarsi $3\frac{1}{2}$ or less segments continuously white; abdomen with almost rather narrow scales not forming tufts except on last few segments 13
13. Vein 5 mainly dark; or with at least a dark spot about the middle near the origin of the branch *annularis* van der Wulp
— Vein 5 continuously pale except at base and apex *pallidus* Theobald
14. Hind tarsi with only two segments completely white *theobaldi* Giles
— Hind tarsi with three segments completely white 15
15. Female palpi with two broad apical pale bands and a narrow band and conspicuous speckling; male palpi with shaft banded and spotted with white *splendidus* Koidzumi
— Female palpi with broad apical pale bands or two narrow pale bands, without speckling; male palpi with shaft dark
..... *jamesii* Theobald
5. *Anopheles (Cellia) annularis* van der Wulp
1884. *Anopheles annularis* van der Wulp., *Notes Leyden Mus.*, 6 : 249
1973. *Anopheles (Cellia) annularis*, Hardy and Dellinado. *A Catalogue of Diptera of the Oriental Region*, 1 : 273.
- Distribution* : India : Gujarat (Kachchh, Bharuch, Kaira, Ahmedabad, Panchmahal): in India widespread in all regions except Andamans and Lakshdweep.
- Elsewhere* : It is a widespread species in Oriental region from Afghanistan and Pakistan through India to 'Indo China' and the Philippines, to Sri Lanka and China.

6. *Anopheles (Cellia) culicifacies* Giles

1901. *Anopheles culicifacies* Giles, *Entomologist's mon. Mag.*, **37** : 197.
 1973. *Anopheles (Cellia) culicifacies*, Hardy and Delfinado, *A Catalogue of Diptera of the Oriental Region*, **1** : 274.

Distribution : India : Gujarat (Ahmadabad, Bharuch, Kaira, Kucchh, Panchmahal), all over India except Andaman and Lakshadweep.

Elsewhere : Afghanistan, Bahrein, Bangladesh, Iran, Indo-China, Myanmar, Nepal, Oman, Pakistan, Sri Lanka, Southern China.

7. *Anopheles (Cellia) fluviatilis* James

1902. *Anopheles fluviatilis* James, *Scient. Mem. Offrs. Med. sanit. Deps. India* **2** : 31.
 1973. *Anopheles (Cellia) fluviatilis*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, **1** : 274.

Distribution : India : Gujarat (Kuchchh, Panchmahal), Widespread in India but has so far not reported from Tamil Nadu, Andamans and Lakshadweep.

Elsewhere : Extensively distributed in the Oriental region and parts of the West Asian subregion, Afghanistan, Bangladesh Bahrein, Iraq, Iran, Kazakh, Myanmar, Nepal, Oman, Pakistan, South China, Thailand, U.S.S.R.

8. *Anopheles (Cellia) jamesii* Theobald

1901. *Anopheles jamesii* Theobald *Monogr. Cul.* **1** : 134
 1973. *Anopheles (Cellia) jamesii*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, **1** : 274

Distribution : India : Gujarat, Assam, Goa, Madhya Pradesh, Orissa, West Bengal.

Elsewhere : Nepal, Bangladesh, Myanmar, Indo-China, China, Sri Lanka.

9. *Anopheles (Cellia) jeyporiensis* James

1902. *Anopheles jeyporiensis* James, *Scient. Mem. Offrs Med. sanit. Deps. India*, **2** : 32
 1973. *Anopheles (Cellia) Jeyporiensis*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region* **1** : 275

Distribution : India : Gujarat, Kashmir, Punjab, Rajasthan, Haryana, Himachal Pradesh, Orissa.

Elsewhere : Nepal, Bangladesh, Myanmar, Indo-China, Thailand and China.

10. *Anopheles (Cellia) multicolor* Camboulin

1902. *Anopheles multicolor* Camboulin, *C.r. hebd, Seanc. Acad. Sci., Paris*, **135** : 704.
 1973. *Anopheles (Cellia) multicolor*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, **1** : 276.

Distribution : India : Gujarat (Panchmahal).

Elsewhere : Afghanistan, Cyprus, North Africa, Pakistan, West Asia.

11. *Anopheles (Cellia) pallidus* Theobald

1961. *Anopheles pallidus* Theobald, *Monogr. Cul.* **1** : 134.
 1973. *Anopheles (Cellia) pallidus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, **1** : 176.

Distribution : India : Gujarat (Panchmahal), fairly well distributed in India but not so far been reported from Rajasthan, Andamans, Lakshadweep.

Elsewhere : Bangladesh, Indonesia, Nepal, Myanmar, Malaysia, Sri Lanka, Thailand.

12. *Anopheles (Cellia) pulcherrimus* Theobald

1902. *Anopheles pulcherrimus* Theobald, *Proc. R. Soc.*, **69** : 369.
 1973. *Anopheles (Cellia) pulcherrimus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, **1** : 277.

Distribution : India : Gujarat (Panchmahal), Punjab, Uttar Pradesh.

Elsewhere : Afghanistan, Bahrein, Iran, Iraq, Israel, Lebanon, Pakistan, Saudi Arabia, Syria, Turkey, U.S.S.R.

13. *Anopheles (Cellia) splendidus* Koidzumi

1920. *Anopheles splendidus* Koidzumi, *Daiwan Ken Kyujo Hokoku (Rep. Formosa Gov.)*, **8** : 23.

1973 *Anopheles (Cellia) splendidus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 1 : 277.

Distribution : India : Gujarat, Assam, Andhra Pradesh, Goa, Himachal Pradesh, Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Punjab, Sikkim Tamil Nadu, West Bengal.

Elsewhere : Afghanistan, Bangladesh, China, Indo-China, Nepal, Myanmar, Thailand, Taiwan.

14. *Anopheles (Cellia) stephensi* Liston

1901. *Anopheles stephensi* Liston, *Indian Med. Gaz.*, 36 : 441.

1973. *Anopheles (Cellia) stephensi* Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 1 : 277.

Distribution : India : Gujarat (Ahmadabad, Bharuch, Deesa, Ellichpur, Kaira, Kuchchh, Panchmahal), Karnataka.

Elsewhere : Afghanistan, Bangladesh, Behrein, Iraq, Iran, Myanmar, Oman, Saudi Arabia, South China, Thailand.

15. *Anopheles (Cellia) subpictus* Grassi

1899. *Anopheles (Cellia) subpictus* Grassi, *Re. R. Acad. Lineei*, 8 : 560.

1973. *Anopheles (Cellia) Subpictus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 1 : 278.

Distribution : India : Gujarat (Ahmadabad, Bharuch, Kaira, Kuchchh, Panchmahal), Lakshadweep, Tamil Nadu.

Elsewhere : Afghanistan, Iran to New Guinea, Mariana Island, South China.

16. *Anopheles (Cellia) tessellatus* Theobald

1901. *Anopheles tessellatus* Theobald, *Monogr. cul.*, 1 : 175.

1973. *Anopheles (cellia) tessellatus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 1 : 178.

Distribution : India : Gujarat (Kaira, Panchmahal), Andamans, Lakshadweep.

Elsewhere : Bangladesh, Borneo, Indochina, Indonesia, Maldives, Myanmar, Malaysia, Molucca, Nepal, Philippines, Sri Lanka, South China, Sulawesi.

17. *Anopheles (Cellia) theobaldi* Giles

1901. *Anopheles theobaldi* Giles, *Ent. Mon. Mag.* 37 : 198.

1973. *Anopheles (Cellia) theobaldi*. Hardy and Delphinado, *A Catalogue of the Diptera of the Oriental Region*, 1 : 279.

Distribution : India : Gujarat (Single Khanch village : Ukhalda), Maharashtra, Uttar Pradesh, West Bengal

Elsewhere : Bangladesh, Myanmar, Nepal, Pakistan.

18. *Anopheles (Cellia) turkhudi* Liston

1901. *Anopheles turkhudi* Liston, *Indian Med. Gez.* 36 : 441.

1973. *Anopheles (Cellia) turkhudi*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 1 : 179.

Distribution : India : Gujarat(Kuchchh, Panchmahal), Karnataka, Himachal Pradesh, Madhya Pradesh, Rajasthan.

Elsewhere : Afghanistan, Aden, Egypt, Eritrea, Ethiopia, Israel, Morocco, Pakistan, Sudan, Saudi Arabia, Somalialand and Yeman.

19. *Anopheles (Cellia) vagus* Donitz

1902. *Anopheles vagus* Donitz, *Z. Hyg. Infekt Krankh.*, 41 : 80.

1973. *Anopheles (Cellia) vagus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 1 : 279.

Distribution : India : Gujarat (Ahmadabad, Kaira, Panchmahal), Andamans.

Elsewhere : Sri Lanka to New Guinea, Molucca, Hong Kong.

20. *Anopheles (Cellia) varuna* Iyenger

1924. *Anopheles (Cellia) varuna* Iyenger, *Indian J. Med. Res.*, 12 : 24.

Distribution : India : Gujarat (Panchmahal), Andhra Pradesh, Lakshadweep, Orissa, West Bengal.

Elsewhere : Bangladesh, Myanmar, Nepal, Sri Lanka, South China, Thailand.

Suborder BRACHYCERA

Family STRATIOMYIDAE

The Stratiomyidae, commonly known as 'soldier flies' are often colourful. Adults are frequent visitors of woods, dense vegetation and grass meadows in the vicinity of water source. Many are found in flower gardens. Larvae are found in both terrestrial and aquatic environment and they are carnivorous or saprophagous. This family is represented by a single species occurring in Gujarat State.

Key to the subfamilies

1. Wing with anterior cross-vein joining prefurca to discal cell SARGINAE
— Wing with anterior cross-vein joining Rs to discal cell STRATIOMYINAE

Subfamily STRATIOMYINAE

Genus *Adoxomyia* Bezzi

21. *Adoxomyia heminopla* (Wiedemann)

1819. *Clitellaria heminopla* Wiedemann, *Zool. Mag.*, 1(3) : 30.

Diagnosis : Medium, black species, antennal segments 1 & 2 black, 3 reddish brown to yellow; thorax without definite hair stripes, but with a dark medium stripe surrounded by 4 spots arranged in a square; abdomen generally black; all femora and tibiae anteriorly and posteriorly brownish orange, rest black; wings grey, yellowish brown at centre.

Distribution : India : Gujarat, Bihar, Delhi, Madhya Pradesh, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Subfamily SARGINAE

Genus *Sargus* Fabricius

22. *Sargus metallinus* Fabricius

1805. *Sargus metallinus* Fabricius, *Syst. Antliat.*, 258.

Material examined : 2 exs., Gir forest, coll. V.G. Mazumdar, dt. nil. 1969.

Diagnosis : The adults are varying from brilliant metallic violet blue to bright green in with colour wings pale yellowish grey or pale brownish and legs pale yellow.

Distribution : India : Widespread in the Oriental region.

Family TABANIDAE

Key to the subfamilies

1. Hind tibiae with no spurs, ocelli usually absent TABANINAE
— Hind tibia with spurs, ocelli usually present PANGONINAE

Subfamily PANOGONIINAE

Genus *Philoliche* Wiedemann

23. *Philoliche longirostris* (Hardwicke)

1823. *Pangonia longirostris* Hardwicke, *Trans. Linn. Soc. Lond.*, 14 : 135.

1975. *Philoliche longirostris*, Delfinado and Hardy, *A Catalogue of the Oriental Region*, 2 : 43.

Distribution : India : Gujarat.

Elsewhere : Nepal, Tibet.

Subfamily TABANINAE

Genus *Tabanus* Linnaeus

Subgenus *Tabanus* Linnaeus

24. *Tabanus (Tabanus) striatus* Fabricius

1787. *Tabanus striatus* Fabricius, *Mantissa Insect.*, 2 : 356.

Diagnosis : Antenna with rather short & broad, orange flagellar plate, dorsal tooth obtuse, annuli orange to black; abdomen generally black, with a strong median stripe on terga 3-6 and 2 sublateral strips on terga 1-4, both of whitish tomentum & hairs.

Distribution : India : Gujarat, Arunachal Pradesh, Assam, Delhi, Himachal Pradesh, Jammu

& Kashmir, Karnataka, Kerala, Madhya Pradesh, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Bhutan, Myanmar.

Family ASILIDAE

The Asilidae, or robber flies, comprises one of the largest and abundant families of Diptera. Their adults and larvae are both predaceous, feeding on other insects, especially on phytophagous insects, and these therefore help to maintain the natural balance of insect populations. This family comprises 14 species under 9 genera occurring in the Gujarat State.

Key to the subfamilies

1. Palpus one segmented, medium to robust bristly flies; marginal cell closed, first flagellomere long and slender with short bristle bearing micro-segment ASILINAE
- Palpus two segmented 2
2. Marginal cell open, first flagellomere spindle shaped with apical microsegment, fourth posterior cell generally open or closed in the margin; females generally with circlet of spines on acanthophorites DASYPOGONINAE
- Marginal cell closed, first flagellomere rod-like or clavate with apical pit, fourth posterior cell generally closed or stalked LAPHRIINAE

Subfamily LAPHRIINAE

Key to genera of the subfamily LAPHRIINAE

1. Ambient vein present, first flagellomere slender, elongate with conspicuous long setae, first posterior cell not narrowed throughout *Laxenecera* Macquart
- Ambient vein complete, first flagellomere bare, first posterior cell narrow throughout *Nusa* Walker

Genus *Laxenecera* Macquart

Key to the species of genus *Laxenecera* Macquart

1. Epandrium bears a spinous projection ventrally

at apex; acutellar disc with golden yellow setae *flavibarbis* Macquart

— Epandrium without such a projection; scutellar disc with pale yellow setae *albibarbis* Macquart

25. *Laxenecera albibarbis* Macquart

1838. *Laxenecera albibarbis* Macquart, *Dipt. exot.*, 1 (2) : 195.

Distribution : India : Gujarat (Vadodara, Rajkot), Assam, Bihar, Himachal Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, West Bengal.

26. *Laxenecera flavibarbis* Macquart

1838. *Laxenecera flavibarbis* Macquart, *Dipt. exot.*, 1 (2) : 194.

Distribution : India : Gujarat (Vadodara, Pipae), Goa, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Genus *Nusa* Walker

Key to species of the genus *Nusa* Walker

- First posterior cell closed to wing margins; male genitalia black and yellowish-brown with pale yellow base *elva* (Walker)
- First posterior cell closed before wing apex; male genitalia wholly black *bhargavai* Joseph & Parui

27. *Nusa bhargavai* Joseph and Parui

1992. *Nusa bhargavai* Joseph and Parui, *Rec. zool. Surv. India*, 92 : 124.

Distribution : India : Gujarat (Junagarh dist. : Veraval : Kukus Vada and Gorakmandi; Rajkot dist. : Rajkot).

28. *Nusa elva* (Walker)

1849. *Asilus elva* Walker, *List Dipt. Colln. Br. Mus.*, 2 : 445.

1975. *Nusa elva*, Oldroyd, *A Catalogue of the Diptera of the Oriental Region*, 2 : 115.

Distribution : India : Gujarat (Junagarh dist. :

Nr. Sidhakar, Varaval Dari; Rajkot dist. : Targharia).

Subfamily DASYPOGONINAE

Key to genera of the subfamily DASYPOGONINAE

1. Arista long with filament 2
 — Arista without filament. Ocelli with a pair of well developed bristles; male genitalia downturned with a hood like cover formed by ninth tergite *Stichopogon* Loew
2. First flagellomere attenuate; very long, as long as or longer than the basal two segments together; arista short with pectinate hairs clustered at tip *Michotamia* Macquart
 — First flagellomere very short, usually much shorter than combined length of scape and pedicel; arista very long with pectinate hairs in one or two rows .. *Ommatius* Wiedemann

Genus *Ommatius* Wiedemann

Key to species of the genus *Ommatius* Wiedemann

- All femora wholly black
 *hradskyi* Joseph & Parui
- All femora not wholly black 2
- Epandrium dorsally produced at apex
 *indicus* Joseph & Parui
- Epandrium not dorsally produced at apex ...
 *ponti* Joseph & Parui

29. *Ommatius hradskyi* Joseph and Parui

1983. *Ommatius indicus* Joseph and Parui, *Ent. Scand.*, 14 : 93.

Distribution : India : Gujarat, Tamil Nadu.

30. *Ommatius indicus* Joseph and Parui

1983. *Ommatius indicus* Joseph and Parui, *Ent. scand.*, 14 (1) : 86

Distribution : India : Gujarat (Gandhinagar), Andhra Pradesh, Karnataka, Kerala, Tamil Nadu.

31. *Ommatius ponti* Joseph and Parui

1984. *Ommatius ponti* Joseph and Parui, *Orient. Ins.*, 18 : 58.

Distribution : India : Gujarat (Junagarh dist. : Veraval), Rajasthan, Uttar Pradesh.

Elsewhere : Pakistan.

Genus *Michotamia* Macquart

32. *Michotamia aurata* (Fabricius)

1794. *Asilus aurata* Fabricius, *Ent. syst.*, 4 : 387.

1975. *Michotamia aurata*, Oldroyd, *A Catalogue of the Diptera of the Oriental Region*, 2 : 130.

Diagnosis : Mystax pale yellow; antennal scape and pedicel orange yellow. First flagellomere black; thorax black with dense grayish-yellow and grey tomentum; scutum with a mediolongitudinal black stripe; legs yellowish brown and pale yellow; basal half of wing pale yellow, rest infuscated; tergites 1-4 and 7 yellowish brown, remaining tergites black; male genitalia dark brown and yellowish brown.

Distribution : India : Gujarat (Vadodara dist : Borada), West Bengal.

Elsewhere : Celabes Myanmar, Pakistan, Taiwan.

Genus *Stichopogon* Loew

Key to the species of the genus *Stichopogon* Loew

1. Fore femora partly or wholly orange 2
 — Fore femora black *inaequalis* (Loew)
2. Lamella of female rather bare with pointed tuft of golden setae *meridionalis* Oldroyd
 — Lamella of female tomentose, without tuft of setae *tomentose* Oldroyd

33. *Stichopogon inaequalis* (Loew)

1874. *Dasyogon inaequalis* Loew, *Linn. Ent.*, 2 : 505.

1975. *Stichopogon inaequalis*, Oldroyd, *A Catalogue of the Diptera of the Oriental Region*, 2 : 129.

Distribution : India : Gujarat (Mahasana dist. : Taranga hills, Gandhinagar dist. : Indore, Ahmadabad dist.: Vastrapur), Andhra Pradesh, Andamans, Bihar, Maharashtra, Rajasthan, Tamil Nadu.

Elsewhere : Greece and Portugal.

34. *Stichopogon meridionalis* Oldroyd

1948. *Stichopogon meridionalis* Oldroyd, *Ent. Mon. Mag.*, **84** : 261.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : Sri Lanka.

35. *Stichopogon tomentosus* Oldroyd

1948. *Stichopogon tomentosus* Oldroyd, *Entomologists mon. Mag.*, **84** : 263.

Distribution : India : Gujarat (Baroda dist. : Pipae), Andamans, Bihar, Karnataka, Rajasthan.

Subfamily ASILINAE

Key to the genera of the subfamily ASILINAE

1. Submarginal cells three 2
— Submarginal cells two 3
2. Radial fork longer than second posterior cells; apex of marginal cells bulbous; antennae closed together; in female tenth segment with numerous short spines, the apical pair longer, stout *Philodicus* Loew
— Radial fork shorter than second posterior cells; apex of marginal cells not bulbous; antennae wide apart; in female tenth segment without spine *Promachus* Loew
3. Epandrium with apical parolobi, arched forward; hypandrium, and gonopod strongly arched downwards forming a conspicuous gap between them; anterior basitarsus conspicuously long, swollen and stout; costa of wing of normal shape *Astochia* Beaker
— Epandrium slender and without apical parolobe; hypandrium and gonopod though arched downwards but not forming a conspicuous gap

between them; anterior basitarsus of normal shape and size; in male costa of wing conspicuously bulged outwards
..... *Clephydroneura* Becker

Genus *Astochia* Beaker

36. *Astochia pseudoguptai* Joseph and Parui

1987. *Astochia pseudoguptai* Joseph and Parui, *Bull. zool. Surv. India*, **8** : 100

Diagnosis : Mystax pale yellow, antennae black, base and apex of pedicel and base of lower side, flagellum brownish yellow; scutum black with a medio longitudinal slate grey stripe divided by grey stripe; scutellum with mostly white hairs and a few black hairs on disc, border with two black bristles; leg with coxae, trochanter, femur and tarsus dark brown, tibiae pale yellow with black apex; wings infuscated but medially almost hyaline; abdomen black with a transverse grey band at posterior border, male genitalia black with mixed black and white hairs.

Distribution : India : Gujarat (Junagarh dist. : Sidokar, Madhal River bridge), Rajasthan, Sikkim.

Genus *Clephydroneura* Becker

37. *Clephydroneura pulla* Oldroyd

1938. *Clephydroneura pulla* Oldroyd, *Ann. Mag. nat. Hist.*, (11) **1** : 467.

Diagnosis : Face white tomentose; nuptax white, antennae black with black hairs; thorax brown with a medio-longitudinal stripe distinctly divided over its full length; leg dark brown; wing infuscated at apex which extends posteriorly up to fifth posterior cells; abdomen brownish, all terga with white band anteriorly, and laterally with one or two bristles.

Distribution : India : Gujarat (Gandhinagar), Karnataka, Tamil Nadu, Andhra Pradesh.

Genus *Philodicus* Loew

Key to species of the genus *Philodicus* Loew

1. Fore femur armed with weak bristles below; mystax white; scutellum with sparse white and black hairs on disc *femoralis* Ricardo

— Fore femur with long hairs below; mystax black and white; scutellum with black hairs on disc
..... *ceylanicus* Schiner.

38. *Philodicus ceylanicus* Schiner

1868. *Philodicus ceylanicus* Schiner, in *Reise der Oesterreichen fregatte Novara*, Dipt. : 179.

Distribution : India : Gujarat, (Junagarh dist. : Veraval Dari, Dharol, Jamnagar, Dist. : Dwarka, Rajkot dist. : Targhoria), Andamans, Kerala, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Sri Lanka.

39. *Philodicus femoralis* Ricardo

1921. *Philodicus femoralis* Ricardo, *Ann. Mag. nat. Hist.* (9) 8 : 190.

Distribution : India : Gujarat (Junagarh dist. : Veraval), Arunachal Pradesh, Bihar, Goa, Kerala, Meghalaya, Orissa, Rajasthan.

Elsewhere : Myanmar.

Genus *Promachus* Loew

40. *Promachus duvaucelii* (Macquart)

1883. *Trupanea duvaucelii* Macquart, *Dipt. Exot.* 1 (2) : 97.

1975. *Promachus duvaucelii*, Oldroyd, *A Catalogue of the Diptera of the Oriental Region*, 2 : 152.

Diagnosis : Mystax yellow with a few black hairs on upper part; scutum with a pair longitudinal stripes, rest covered with yellow hairs; scutellum also covered with concolourous hairs as on scutum; legs black with predominant black hairs; wing yellowish with an obscure streak in the marginal and first submarginal cells; first three abdominal segments with tufts of reddish-yellow pubescence, epandrium large, club-shaped hypandrium small, both with black hairs.

Distribution : India : Gujarat, Andhra Pradesh, Delhi, Madhya Pradesh, Punjab, Uttar Pradesh, West Bengal.

41 *Promachus rufimystaceus* (Macquart)

1849. *Trupanea rufimystaceus* Macquart, *Dipt. exot. Suppl.*, 4-8.

1975. *Promachus rufimystaceus*, Delfinado & Hardy, *A Catalogue of the Diptera of Oriental Region*, 2 : 154.

Distribution : India : Gujarat.

Elsewhere : Java.

Family BOMBYLIDAE

The members of the family Bombyliidae known as bee-flies are usually dominant in the tropics and subtropics. They are one of those economically important group of the suborder Brachycera, and act as pollinators in forests, and agricultural crops.

Key to the subfamilies

1. Praefurca comparatively long; 2nd longitudinal vein originating (in knee-shaped form) from it approximately opposite anterior cross vein (at almost half way between origin of praefurca and the cross vein, and this only in some species *Argyromoeba*); antenna widely separated at base; frons in ♂ nearly as wide as in ♀ 2
 - Praefurca comparatively short; 2nd longitudinal vein originating acutely (not in knee-shaped form) always much nearer to origin of praefurca than of anterior cross vein; antennae nearly always approximate at base; eyes in ♂ normally contiguous or nearly so, sometimes distinctively separated; frons in ♂ always much narrower than ♀ 3
 2. Antennal style with a pencil of hairs at end; metapleura bare; squamae with a hairy fringe ANTHRACINAE
 - Antennal style devoid of hairs at end; metapleura hairy; squamae with scaly fringe EXOPROSOPINAE
 3. Head as wide as or a little wider than thorax; abdomen more or less cylindrical, bare or with bristly hairs; antennae very long, especially 1st joint; thorax more or less humped, generally with conspicuous bristle; 2nd longitudinal vein with loop TOXOPHORINAE
 - Head generally narrower than thorax; abdomen

short and rounded; frequently with dense furry pubescence; antennae approximate at base; thorax generally arched; 2nd longitudinal vein never with a strong loop near tip
..... BOMBYLIINAE

Subfamily TOXOPHORINAE

Genus *Toxophora* Meigen42. *Toxophora javana* Wiedemann

1821. *Toxophora javana* Wiedemann, *Dipt. exot.*, : 179.

Diagnosis : Antennae very long; prominent, horizontal, approximate at the base; vertex very small, black with a pair of strong ocellar bristles; thorax black, humped with a coating of very small, oblong, bronish scales lying flat on the surface; abdomen black, long narrow, with a layer of small brownish scales as on the thorax; three posterior cells.

Distribution : India : Gujarat, Tamil Nadu, Uttar Pradesh.

Elsewhere : Java, Krakatau.

Subfamily BOMBYLIINAE

Genus *Bombylius* Linnaeus**Key to the species**

1. Wings with a brown suffusion across middle, abdomen with bright red & white pubescence at tip *orientalis* Macquart
- Wings without suffusion across middle, abdomen without such pubescence at tip
..... *maculatus* Fabricius

43. *Bombylius maculatus* Fabricius

1775. *Bombylius maculatus* Fabricius, *Syst. Ent.*, 803.

Distribution : India : Gujarat, Orissa, Tamil Nadu.

44. *Bombylius orientalis* Macquart

1840. *Bombylius orientalis* Macquart, *Dipt. Exot.*, 2(1) : 90.

Distribution : India : Gujarat, Karnataka, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Sri Lanka.

Subfamily ANTHRACINAE

Key to the genera

1. Body large, hairy; third antennal joint short, onion shaped (sometimes more conical), with styliform prolongation always bisected near tip, and bearing an apical pencil of hairs
..... *Argyromoeba* Schiner
- Body small, less hairy; third antennal joint forming a style-like cone with microscopic apical bristle, no pencil of hairs 2
2. Body hairy; wing almost clear
..... *Anthrax* Scopoli
- Body bare; wing membrane wrinkled, not clear
..... *Petrorossia* Bezzi

Genus *Petrorossia* Bezzi**Key to the Species**

1. 2nd vein originating in a knee just beyond half way between base of discal cell and anterior cross vein, upper branch of 2nd vein forming a very distinct downward loop towards its end
..... *nigrofemorata* (Brunetti)
- 2nd longitudinal vein normally with a distinct curve, followed by a distinct downward one just before tip, anterior cross vein at one third of discal cell, placed some distance beyond tip of praefurca *albofulva* (Walker)

45. *Petrorossia albofulva* (Walker)

1852. *Anthrax albofulva* Walker, *Insecta Saundersiana*, 1 : 182.

Distribution : India : Gujarat, Uttar Pradesh.

46. *Petrorossia nigriformorata* (Brunetti)

1909. *Argyromoeba nigrofemorata* Brunetti, *Rec. Indian Mus.*, 3 : 219.

Distribution : India : Gujarat, Uttar Pradesh.

Genus *Anthrax* Scopoli47. *Anthrax bipunctatus* (Fabricius)

1805. *Anthrax bipunctata* Fabricius, *Syst. Antl.*, 118

1920. *Argyromoeba bipunctata*, Brunetti, *Fauna of British India, Diptera*, 2 : 217.

1975. *Anthrax bipunctatus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 2 : 175.

Diagnosis : Frons blackish-grey with black hairs, vertex blackish grey rather shining with some brown hairs on hind margin. Thorax black, moderately shining, with grey sparse pubescence, wings very dark blackish brown at base, the colour diminishing distally and posteriorly, but the highest part of the wing at heart pale brown.

Distribution : India : Gujarat (Surat), Assam, Bihar, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Bangladesh, Pakistan.

Genus *Argyromoeba* Schiner

48. *Argyromoeba duvaucelii* (Macquart)

1840. *Anthrax duvaucelii* Macquart, *Dipt. exot.*, 2(1) : 63.

Diagnosis : Body moderate; antennae black, with a slight greyish-white shimmer; vertex with a distinct but short and deep indentation, thorax dark, sides of thorax with long thick greyish-white scaly pubescence; the dorsum with sparse yellowish short hairs round the edges; abdomen blackish grey, 2nd segment distinctly but greatly longer than the five remaining ones; venter blackish with short white hairs; wings almost clear, costa slightly darker, several isolated spots present, devoid of baso-costal oblique band, anal cell open.

Distribution : India : Gujarat, Himachal Pradesh, Uttar Pradesh, West Bengal.

Elsewhere : Pakistan.

Subfamily EXPROSOPINAE

Key to the genera

1. Prefurca larg, 2nd longitudinal vein originating at right angles from and approximately opposite to anterior cross vein 2
- Prefurca short, 2nd longitudinal vein originating actually from and near to the origin of prefurca than that of anterior cross vein ..
..... *Systoechus* Loew.
2. Ocellar tubercle a long way from vertex;

antennal segment 3 like an elongated cone, with a style divided from it by a distinct suture; wing with 3 to 4 submarginal cells; claws usually with a long sharp basal tooth 3

— Ocelli more or less close to vertex, antennal style mostly not divided by a suture; wing with 2 submarginal cells only; claws usually without basal tooth, or at most with a small and obtuse tubercle *Thyridanthrax* Osten Sacken

3. Antennal segment 3 with a terminal style bearing a microscopic bristle; submarginal cells in wing 3 4

— Antennal segment 3 with terminal style bearing a minute appendage; submarginal cells in wing 4 *Ligyra* (Newman)

4. Projecting proboscis longer than oral cavity; wings with peculiar neuration and pattern; front tibiae beset with spicules
..... *Litorhyncus* (Macquart)

— Non-projecting proboscis, shorter than oral cavity; wing ptttern variable or absent; front tibiae generally smooth
..... *Exoprosopa* (Macquart)

Genus *Thyridanthrax* Osten Sacken

Subgenus *Exhyalanthrax* Becker

49. *Thyridanthrax (Exhyalanthrax) absalon* (Wiedemann)

1828. *Anthrax absalon* Wiedemann, *Analecta Ent.*, : 24.

Diagnosis : Head semicircular; proboscis short; antennae porrect, short, wide apart at base, 1st joint short, cylindrical, 2nd cup shaped, 3rd varying from elongate conical to flat onion-shaped; thorax quadrate, with rounded angles; abdomen flat, oblong; wings brown with more or less hyaline spots.

Distribution : India : Gujarat, Maharashtra, Orissa, Tamil Nadu.

Elsewhere : Sri Lanka, Malaysia.

Genus *Exoprosopa* (Macquart)

Key to the species

1. Wings dark brown with narrow lighter border *gujratica* Nurse

- Wings light grey, always with a pattern of dark bands or spots..... 2
2. wings yellow at base, with two broad brown bands one before and one beyond middle
..... *flammea* Brunetti
- Wings dark brown at base, dark part of wing with isolated dark spots..... *insulata* (Walker)

50. *Exoprosopa (Exoprosopa) flammea* Brunetti

1909. *Exoprosopa (Exoprosopa) flammea* Brunetti, *Rec. Indian Mus.*, 2 : 466.

Distribution : India : Gujarat, Bihar, Kerala.

Elsewhere : Sri Lanka.

51. *Exoprosopa (Exoprosopa) gujaratica* Nurse

1922. *Exoprosopa gujaratica* Nurse, *J. Bombay nat. Hist. Soc.*, 28 : 636 (M F).

1975. *Exoprosopa (Exoprosopa) gujaratica* Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 2 : 181.

Distribution : India : Gujarat(Deesa), Maharashtra.

52. *Exoprosopa (Exoprosopa) insulata* (Walker)

1852. *Anthrax insulata* Walker, *Insecta Saundersiana*, 1 : 172.

Distribution : India : Gujarat, Karnataka, Madhya Pradesh, Meghalaya, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Nepal, Sri Lanka.

Genus *Litorhynchus* Macquart

53. *Litorhynchus lar* (Fabricius)

1781. *Bibio lar* Fabricius, *Sp. Ins.*, 2 : 414.

1920. *Exoprosopa lar*, Brunetti, *Fauna of British India, Diptera*, 2 : 194

1975. *Litorhynchus lar*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 2 : 180.

Material examined : Junagarh dist : 1 ex., Veraval, Garakmandi, coll. A.N.T. Joseph, 16. viii.1988; Rajkot dist : 2 exs., coll. A.N.T. Joseph,

21.viii.1988; Junagarh dist : 2 exs., Kukulsvada, coll. A.N.T. Joseph, 15.viii.1988.

Diagnosis : Head dark nut-brown, with a slight pink or orange tint, covered with short black pubescence and a few minute elongate pale brownish-yellow scales or scale-like hairs on lower-part, with sparse pubescence, covered with very short depressed yellowish brown scale-like hairs, sides of thorax dull orange-brown; wings clear, with a broad basal and median transverse band, the later sometimes reaching hind border, both bands joined on the costa; a somewhat isolated species.

Distribution : India : Gujarat (Surat), Assam, Bihar, Kerala, Karnataka, Maharashtra, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Australia and Sri Lanka.

Genus *Ligyra* Newman

Key to the species

1. Wing dark blackish brown, without any considerable clear or nearly clear part
..... *aurantiaca* (Guérin-Méneville)
- Wing with apical part and considerable portion of posterior half practically clear.....
..... *oenomaus* (Rondani)

54. *Ligyra aurantiaca* (Guérin-Méneville)

1844. *Anthrax aurantiaca* Guérin-Méneville, *Icon. du regne anim. Dipt.*, 3 : 539.

Distribution : India : Gujarat, Arunachal Pradesh, Bihar, West Bengal.

55. *Ligyra oenomaus* (Rondani)

1875. *Hyperalonia oenomaus* Rondani, *Annali Mus. Civ Stor. nat. Giacomo Doria*, 7 : 453.

Distribution : India : Gujarat, Arunachal Pradesh, Assam, Sikkim, West Bengal.

Elsewhere : Borneo, Malaysia, Philippines.

Genus *Systoechus* Loew

56. *Systoechus nivalis* (Brunetti)

1912. *Systoechus nivalis* Brunetti, *Rec. Indain Mus.*, 7 : 472.

Diagnosis : Frons & face blackish grey, covered with bristly hairs, antennal joint 3 elongated, slender; proboscis long; labium extended; head dark grey with whitish hair on the underside; thorax & abdomen with pale yellowish bristly pubescens; venter with whitish hair, wings pale grey, costal cell dark grey, base of wing yellowish.

Distribution : India : Gujarat, Uttaranchal.

Family PIPUNCULIDAE

Genus *Tomosvaryella* Aczel

57. *Tomosvaryella limpidipennis* (Brunetti)

1912. *Pipunculus limpidipennis* Brunetti, *Rec. Indian Mus.*, 7 : 491.

Diagnosis : Head with frons of uniform width, greyish, with a silvery white shimmer when seen from above; antennae blackish, 3rd joint white with silver shimmer, arista black; thorax dark aeneous grey, moderately shining, bare; last abdominal segment bears in the male a knob like process, and with female a long horny process bent under the venter, wings quite clear.

Distribution : India : Gujarat, Maharashtra, Orissa, West Bengal.

Suborder CYCLORRHAPHA

Family SYRPHIDAE

Popularly known as "hover" and "flower" flies, the syrphids as adults are mainly flower visitors and important pollinating agents. The larvae devour aphids, scale insects and other soft bodies insects or are even saprophagous. Seven species of this family representing two subfamilies are reported from Gujarat.

Key to the Subfamilies of family SYRPHIDAE

1. Pronotum bare; abdomen with 5 pregenital segments in male SYRPHINAE
- Pronotum pilose; abdomen with 4 pregenital segments in male MILESIINAE

Subfamily SYRPHINAE

Key to the genera of subfamily SYRPHINAE

1. Face arched, not hollowed below frontal

prominence; always more or less yellow

..... *Paragus* Latreille

- Face hollowed below frontal prominence, produced against central knob, or to upper mouth edge, or to both 2

2. Abdomen conspicuously constricted at base.

..... *Baccha* Fabricius

- Abdomen not conspicuously constricted at base

..... *Ischiodon* Sack

Genus *Ischiodon* Sack

58. *Ischiodon scutellaris* (Fabricius)

1805. *Scaeva scutellaris*, Fabricius *Syst. Antl.* : 252.

1975. *Ischiodon scutellaris*, Hardy and Delfinado, *A Catalog of Diptera of the Oriental region*, 2 : 315.

Material examined : Junagarh district : 3 exs., Veraval, Gurakmandi, Coll. A.N.T. Joseph, 16.vii.1988; Rajkot district; 5 exs., Targharia, coll. A.N.T. Joseph, 21.viii.1988; Rajkot district : 3exs., Bedi, coll. A.N.T. Joseph, 23.viii.1988.

Diagnosis: Frons and face bright sulphur yellow, dorsum shining aeneous; black from anterior to hind margin, side margins broadly bright yellow or yellowish-white, from shoulder to behind wing base; third antennal joint elongate almost twice as long as broad.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : S.E. Asia to Japan, Australia, Hawaii, Micronesia.

Genus *Baccha* Fabricius

59. *Baccha (Allobaccha) sapphirina* Wiedemann

1830. *Baccha sapphirina* Wiedemann. *Aussereurop Zweif Insekt*, 2 : 96.

1975. *Baccha (Allobaccha) sapphirina*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 2 : 322.

Diagnosis : Head shining black, thorax shining aeneous black, dorsum with short white pubescence; wings quite clear, abdomen very distinctly contracted at base.

Distribution : India : Gujarat (Deesa), Maharashtra, Rajasthan, Tamil Nadu.

Elsewhere : Africa, Aden, Taiwan, New Guinea, Sri Lanka.

Genus *Paragus* Laterille

60. *Paragus (Paragus) serratus* (Fabricius)

1805. *Mulio serratus* Fabricius, *Syst. Antl.* : 186.

1975. *Paragus (Paragus) serratus*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 2 : 327.

Material examined : Junagadh district : 1 ex., Veraval, Gurakmandi, coll. A.N.T. Joseph, 16. viii, 1988.

Diagnosis : Eye with 3 vittae of white hairs; scutellum small, black with yellow margin, strongly denticulate posteriorly; abdomen yellow with brown markings; punctata; tergites 3 and 4 each with a whiteish band on each anteriorly.

Distribution : India : Gujarat, Assam, Bihar, Goa, J & K, Karnataka, Kerala, Madya Pradesh, Maharashtra, Orissa, Punjab, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Java, Nepal, Pakistan, Sri Lanka, Africa.

Subfamily MILESIINAE

Key to the genera of subfamily MILESIINAE

1. Eyes pilose *Eristalinus* Rondani
- Eyes bare 2
2. Marginal cell (R.) open at wing margin; bare species *Mesembrius* Rondani
- Marginal cell closed; pubescent species
..... *Phytomia* Guerin Meneville

Genus *Eristalinus* Rondani

61. *Eristalinus (Merodonoides) multifarius* (Walker)

1852. *Eristalis multifarius* Walker, *Inst. Saund. Dipt.*, 1 : 248

1975. *Enistalinus (Merodonoides) multifarius*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region* 2 : 350.

Diagnosis : Eyes light reddish brown, quite bare with two very distinct black stripes on disc in addition to inner and hind border dark; wings pale grey, second longitudinal vein distinctly curved down-wards in a loop near tip; hind femora greatly thickened.

Distribution : India : Gujarat (Deesa), Assam, Madhya Pradesh, Rajasthan, Tamil Nadu.

Elsewhere : Java, Malaya, Nepal, Sri Lanka, Vietnam.

Genus *Mesembrius* Rondani

62. *Mesembrius bengalensis* (Wiedemann)

1819. *Eristalis bengalensis* Wiedemann, *Zool. Mag.*, 1 : 16

1975. *Mesembrius bengalensis*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 2 : 356.

Diagnosis : Frons and face wholly covered with yellow tomentum and concolourous pubescence, thorax bright yellow with three longitudinal black stripes, wings pale grey.

Distribution : India : Gujarat (Deesa), Assam, Bihar, Karnataka, West Bengal.

Elsewhere : Australia, Java, Kertes to New Guinea and Nepal.

Genus *Phytomia* Guérin Méneville

Key to the species of the genus *Phytomia* Guérin Méneville

1. Antennae wholly orange, arista orange, errans quite bare *errans* (Fabricius)
- Antennae reddish brown or blackish brown, erita orange but very distinctly plumose on basal half *argyrocephala* Macquart

Subgenus *Phytomia* Guérin-Méneville

63. *Phytomia (Phytomia) argyrocephala* (Macquart)

1842. *Eristalis argyrocephalus* Macquart, *Dipt. Exot.*, 2 (2) : 45

1923. *Megaspis argyrocephalus*, Brunetti, *Fauna Brit. India, Diptera*, 3 : 201

1975. *Phytomia (Phytomia) argyrocephala*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region 2* : 357

Distribution : India : Gujarat (Deesa), Bihar, Karnataka, Kerala, Tamil Nadu, West Bengal.

Elsewhere : Java, Laos, Myanmar, Sumatra, Sumbawa.

64. *Phytomia (Phytomia) errans* (Fabricius)

1787. *Megaspis errans*, Fabricius, *Mantissa, Insect.*, 2 : 337

1975. *Phytomia (Phytomia) errans* Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region, 2* : 357

Material examined : Rajkot district : 1 ex., Bedi, coll. A.N.T. Joseph, 23.viii.1988.

Distribution : India : Gujarat Assam, Bangalore, Bihar, Sukna, Kerala.

Elsewhere : Jawa, Borne, Sumatra and China.

Family CONOPIDAE

Subfamily CONOPINAE

Key to the genera of subfamily CONOPINAE

1. Abdominal segments 2 and 3 nearly equal in length and equally stout
 *Archiconopsis* Kroeber
- Abdominal segment 2 markedly longer than segment 3, abdomen wasp like pedunculate
 *Physocephala* Schiner

Genus *Archiconopsis* Kroeber

65. *Archiconopsis erythrocephala* (Fabricius)

1794. *Conops erythrocephalus* Fabricius, *Ent. Syst.*, 4 : 392.

1975. *Archiconopsis erythrocephala*, Hardy and Delfinado. *A Catalogue of the Diptera of the Oriental Region, 2* : 375.

Diagnosis : Head orange with silvery-white reflection, lower part of frons and antennae black basal half of proboscis, reddish brown, rests black; thorax black; humeri dull orange with whitish reflections; pleura black with silvery-white reflections and with a broad silvery-white stripe

from behind the humeri to middle coxae; legs dark brown except anterior femur reddish brown with black apex; wings blackish brown with violet tinge; abdomen violet black, male with last segment white dusted.

Distribution : India : Gujarat (Deesa), Bihar, Maharashtra, Sikkim, Tamil Nadu, West Bengal.

Elsewhere : Africa; Indo China; Celebes; China; Myanmar; Sri Lanka.

Genus *Physocephala* Schiner

66. *Physocephala munda* (Brunetti)

1912. *Physocephala mundus* Brunetti, *Rec. Indian Mus.*, 7 : 496.

1923. *Physocephala munda*, Brunetti, *Fauna British india, Diptera*, 3 : 361.

Diagnosis : Head pale lemon yellow; cheeks with silvery reflections; antennae bright orange brown; proboscis brownish-yellow with black tip; thorax orange brown with humeral region and posterior margin golden yellow dusted; scutellum orange-brown; legs bright orange brown with basal half of tibiae lemon yellow; wing clear with a blackish band between 1st to 3rd longitudinal veins; abdomen bright orange brown, hind margins of 1st and 2nd segments whitish or gold dusted; 3rd and 4th segments gold dusted.

Distribution : India : Gujarat (Deesa), Orissa.

Elsewhere : Quetta; Pakistan.

Family TEPHRITIDAE

The fruit flies as members of family Tephritidae are commonly known as from and easily recognizable and natural family of almost cosmopolitan distribution.

The wings are as a rule conspicuously marbled; an ovicast that is honey and flattened is also an important characteristic of such flies.

Genus *Euphranta* Loew

Subgenus *Staurella* Bezzi

67. *Euphranta (Staurella) crux* (Fabricius)

1794. *Musca crux* Fabricius, *Ent. Syst.*, 4 : 358.

Diagnosis : Occiput, vertex and face shining; frons opaque with few blackish hairs in the middle, a small black streak on each side between vibrissal edge; antennal arista with long hairs on upper side; bristles of thorax black, dorsum with yellow pubescence, metanotum dark reddish brown, very shining in the middle; scutellum light brown; abdomen with black pubescence and black bristles, 5th segment black with yellow tip at both sexes, 6th in female yellow; wing with in brownish cross-bands interrupted by clear streaks, wing tip with a cross shaped double band between 4th and 5th veins, and apical band between 2nd and 3rd and 4th veins.

Distribution : India : Gujarat, Bihar, West Bengal.

Family OTITIDAE

Genus *Physiphora* Fallén

68. *Physiphora demandata* (Fabricius)

1798. *Musca demandata* Fabricius, *Ent. Syst., Suppl.* : 564.

Diagnosis : Face and antenna brownish yellow, proboscis black; thorax & scutellum instrons green, the later with 2 pairs of bristles; wing hyaline, first posterior cell close to the margin; all femora brownish, rest of legs light coloured; abdomen concolourous with thorax.

Distribution : India : Gujarat.

Elsewhere : Pakistan; Europe; Central Asia; North Africa; S. Arabia; Iraq, Iran, Seychelles; North & South America.

Family SEPSIDAE

Key to the genera

1. Basal cells 1 and 2 confluent 2
- Basal cells 1 and 2 distinct *Sepsis* Fallén
2. Scutellum as long as wide, upper surface flat, with 2 pairs of strong apical and strong basal scutellar bristles, fronto-orbital bristles developed *Saltella* Robineau-Desvoidy

- Scutellum shorter than half of width, upper surface slightly convex, with 2 pairs of strong apical and small basal scutellar bristles, fronto-orbital bristle vestigial *Australosepsis* Malloch

Genus *Australosepsis* Malloch

69. *Australosepsis frontalis* (Walker)

1860. *Sepsis frontalis* Walker, *J. Proc. Linn. Soc. Lond., Zool.* 4 : 163.

Diagnosis : Head, thorax and scutellum brownish yellow, the later with single pair of bristles at its border; legs wholly yellow, front femur of male with a row of strong bristles covering 3/4th of its length; wing without any infuscation at the end of r_{3+4} which distinguishes the only other known Oriental species *niveipennis* (Becker).

Distribution : India : Gujarat, Andhra Pradesh, Kerala, Maharashtra, Punjab.

Elsewhere : Borneo, Sulawesi, Sri Lanka, Taiwan, Lesser Sunda Islands, Malaysia, Philippines, Singapore, New Caledonia.

Genus *Sepsis* Fallén

Key to the species

1. Wing with a deep squarish spot at the end of r_{2+3} ; postalar bristles weak; hypopleural process long and slender with small projection at base *cynipsea* (Linnaeus)
- Wing without a dark spot at the end of r_{2+3} ; postalar bristles strong; hypopleural process short, slender and without projection at base *nitens* Wiedemann

70. *Sepsis cynipsea* Linnaeus

1761. *Sepsis cynipsea* Linnaeus, *Fauna Suec.* 11. *Edit.* : 459.

Distribution : India : Gujarat Bihar, Gujarat, Himachal Pradesh, Uttar Pradesh, West Bengal.

Elsewhere : Nepal, Europe, North Africa, Central Asia, Japan.

71. *Sepsis nitens* Wiedemann1824. *Sepsis nitens* Wiedemann, *Analecta Ent.* : 57.

Distribution : India : Gujarat, Andhra Pradesh, Assam, Bihar, Madhya Pradesh, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Jawa, Sri Lanka, Lesser Sunda Islands, Pakistan, Taiwan, Philippines; Australian religion and Japan.

Genus *Saltella* Robineau-Desvoidy72. *Saltella setigera* Brunetti1909. *Saltella setigera* Brunetti, *Rec. Indian Mus.*, 3 : 368.

Diagnosis : Fore femur thickened on basal two-thirds, with 6 strong spines on upper side, 6 shorter spines towards inner side; tarsal segments 2 of mid and hind legs black.

Distribution : India : Gujarat, Kerala.

Elsewhere : Nepal.

Family AGROMYZIDAE

Popularly known as "leaf miners", agromyzids are minute to small size flies of agricultural importance. The larvae tunnelling through and damaging leaf, root, stem, flowers buds and fruits of agricultural and ornamental plants. Only one species is represented from the state. However National Zoological Collection holds 4 exs., (Paratypes) of proposed new species *Pseudonapomyza gujaratica* by Shah (subfamily PHYTOMYZINAE) from Anand.

Subfamily PHYTOMYZINAE

Genus *Liriomyza* Mik73. *Liriomyza trifolii* (Burgess)1880. *Oscinis trifolii* Burgess, *U.S. Dept. Agr. Ret.* 1879 : 200-2071991. *Liriomyza trifolli* Kapadia, *J. Applied Ent.* 5 : 79 81.

Diagnosis : Distinctive Characters are the yellow hind margin of the ye and the mat greyish black mesonotum, with acrostichals irregularly in some four rows in front but sparse or even lacking behing the second dorsocentral.

Distribution : India : Gujarat.

Elsewhere : France, Hungary, Kenya, Western Europe, Yugoslavia.

Family CHLOROPIDAE

Genus *Pachylophus* Loew74. *Pachylophus rufescens* (de Meijere)1904. *Myrmemorpha rufescens* de Meijere, *Bijdr. Dierk.*, 17-18 : 113.

Diagnosis : Frons not projecting beyond eye in front, concolourous with frontal triangle; thorax smooth, with 1 posterior notopleural bristle; halteres white; distance between 2 cross veins; only little more length of posterior cross vein; edite triangle in male genetalia.

Distribution : India : Gujarat, Assam, Bihar, Himachal Pradesh, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Family EPHYDRIDAE

Genus *Paralimna* Loew75. *Paralimna hirticornis* de Meijere1913. *Paralimna hirticornis* de Meijere, *Bijdr. Dierk.*, 19 : 65.

Diagnosis : Underside of head contrastingly milky white; a velvety black spot present between two antennae; mesonotum shining with velvety black supra alar spot; fore femora with profuse flatened bristles; venter of thorax and abdomen wholly white.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : Myanmar, Sri Lanka, Formosa, Nepal, Pakistan, Philippines, New Guinea, West Iran.

Family HIPPOBOSCIDAE

Genus *Hippobosca* Linnaeus76. *Hippobosca variegata* Megerle

1803. *Hippobosca variegata* Megarle, *Appendix Cat. Insect.*
: (14) (unpaginated).

Diagnosis : Head not impinged on thorax; wings present, squama of wing fringed with short, white pubescence; femora thickly covered with long hairs, tibiae with scanty pubescence scattered all over.

Distribution : India : Gujarat Cosmopolitan.

Family NYCTERIBIIDAE

Key to subfamilies of the NYCTERIBIIDAE

- Coxae 1 in profile at least 2.5 times as long as wide; thoracic and abdominal ctenidia always well developed, with coarse blunt teeth. Parasitic on Megachiroptera
..... CYCLOPODINAE
- Coxae 1 in profile at most 2 times as long as wide, thoracic and abdominal ctenidia occasionally absent, with slender pointed teeth. Parasitic on Microchiroptera
..... NYCTERIBIINAE

Key to the genera of the subfamily CYCLOPODINAE

- Tibiae with 2 rings. Head moderately compressed laterally. Palpi slender, tapering with a long terminal seta. Haltere grooves open. Abdominal tergites v in male as long as or longer than tergite iv. No rows of specialized spines at the hind margin of sternite v in male. Anal sclerite present or absent in female
..... *Leptocyclopodia* Theodor.
- Tibiae with 3 rings. Head flattened dorsoventrally, palpi laterally compressed broad with short terminal seta. Haltere grooves either open or partly or completely closed by a covering flap. Abdominal tergites v and vi in male always much shorter than preceding tergites. Anal sclerite present in female *Cyclopodia* Kolenati

Genus *Cyclopodia* Kolenati77. *Cyclopodia sykesii* (Westwood)

1834. *Nycteribia sykesii* Westwood. *Proc. zool. Soc. Lond.*,
2 : 137.

1981. *Cyclopodia sykesii*, Advani and Vazirani, *Proc. zool. surv. India, Occ paper* 2 : 46.

Diagnosis : Vertex studded with short hairs; eyes large with two ocelli on a round pigmented base; palpi slender twisted distally; thorax flat, as long as broad, posterior border with a row of short hairs in the middle and a row of long hairs at sides; legs long and slender, front coxae much longer than broad and covered with short hairs dorsally; tibiae with three rings and with long and short hairs on dorsal and lateral surfaces; in female tergite 2 highly chitinized, dark brown colour, tergites 3-5 membranous, tergite 6 narrow with long setae, tergite 7 conical and smooth; in male tergite 1 small, tergite 2-4 broad, tergite 5-6 narrow, all tergites bear rows of hairs and setae dorsally and laterally, in male phallosome strongly developed with a doesal sclerotized plate anteriorly.

Distribution : India : Gujarat, Assam, Bihar, Dadra & Nagar Haveli, Karnataka, Kerala, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Myanmar, Maldives, Pakistan and Sri Lanka.

Genus *Leptocyclopodia* TheodorSubgenus *Leptocyclopodia* Theodor78. *Leptocyclopodia (Leptocyclopodia) ferrari ferrarii* (Rondani)

1878. *Nycteribia ferrarii* Rondani. *Annali Mus. Civ. Stor. Nat. Giacomo Doria*, 12 : 151.

1981. *Leptocyclopodia ferrari ferrarii*, Advani and Vazirani, *Rec. zool. Surv. India, Occ paper* 2 : 49.

Diagnosis : Vertex bare except for 2-4 setae on antero-dorsal margin; metasternum of thorax lacking distinct posterior fringe; abdomen heavily sclerotized and distinctly segmented between basal

and apical sclerites; anterior margin of systemite 1+2 with quite deep and narrow notch or slit at middle; male genital clasper of normal hardly shorter than anal segments.

Distribution : India : Gujarat, Andaman Islands, Andhra Pradesh, Maharashtra, Tamil Nadu, West Bengal.

Elsewhere : Borneo, Cambodia, China, Java, Malaya, Myanmar, Sri Lanka, Simeule Island, Thailand and Vietnam.

Subfamily NYCTERIBIINAE

Genus *Basilis* Miranda Ribeire

Key to the subgenera of the genus *Basilis* Miranda Ribeire

1. Eyes absent *Tripselia* Scott
— Eyes present *Paracyclopodia* Scott

Genus *Paracyclopodia* Scott

79. *Basilis (Paracyclopodia) roylii* (Westwood)

1834. *Nycteribia roylii* Westwood, *Proc. zool. Soc. Lond.* 2 : 138

1981. *Basilis (Paracyclopodia) roylii*, Advani and Vazirani, *Rec. zool. surv. India, Occ. paper 2* : 55

Distribution : India : Gujarat, Bihar, Rajasthan, Tamil Nadu, Uttar Pradesh.

Elsewhere : Afghanistan, Pakistan and Sri Lanka.

Subgenus *Tripselia* Scott

80. *Basilis (Tripselia) blainvillii amiculata* (Speiser)

1907. *Cyclopodia amiculata* Speiser, *Rec. Indian Mus.*, 1 : 296.

1981. *Basilis (Tripselia) blainvillii amiculata* Advani & Vazirani, *Rec. zool. Surv. India, Occ. Paper 2* : 55

Distribution : India : Gujarat, Maharashtra, Rajasthan, West Bengal.

Elsewhere : Indonesia, Java, Sumatera, Sri Lanka.

Family STREBLIDAE

The Streblidies of either sex are blood sucking obligatory ectoparasite of bats like the Nycteribiidae and exhibit almost similar habits. The Gujarat State is known to hold 3 species under different genera and subfamilies that are usually host specific.

Key to subfamilies of the family STREBLIDAE

1. Sexes similar. Wings with 5 well sclerotised longitudinal veins and 2 cross veins. Anal veins short, forming an anal cell or reduced or absent BRACHYTARSINAE
— Sexes markedly different. Male with small reduced head, free living. Female with head capsule much reduced. Wings with 3 or 4 well sclerotised longitudinal veins ASCODIPTERINAE

Subfamily BRACHYTARSINAE

Key to the genera of the subfamily BRACHYTARSINAE

1. Eyes single faceted. Head rounded or conical in profile, funnel shaped, without ventral depression for the fore coxae. postvertex extending between the lateroverites *Brachytarsina* Macquart
— Eyes absent. Head flattened, with ventral depression for the fore coxae. Post vertex not extending between lateroverites *Raymondia* Frauenfeld

Genus *Brachytarsina* Macquart

81. *Brachytarsina sinhai* Vazirani & Advani

1976. *Brachytarsina sinhai* Vazirani & Advani, *Orient Ins.* 10 (3) : 453.

Diagnosis : Head yellowish brown dorsally, vertex laterally covered with sparse, long and short setae, post vertex round with bearing short setae; palpi oval, rounded anteriorly; thorax yellowish brown; prescutum longer than scutum; scutellum more or less triangular shaped with many long and short setae, posterior legs stouter than other pairs, all femora and tibiae covered with short

setae dorsally and small and thin ventrally, fifth tarsal segment very broad with 2 claws; costal vein thickly setose, first longitudinal veins (R_1) not parallel with costal vein, second vein (R_{2+3}) strongly bent towards apex, third veins (R_{4+5}) and fourth vein (M_{1+2}) parallel near wing margin; abdomen without segmentations in both sexes tergite 2 with 2 plates on either side bearing strong setae on the surface and margins; proctiger cup-shaped with 6 dorsal long, setae; sternite 1+2 fused, triangular, sternite 3-6 also fused.

Distribution : India : Gujarat, Rajasthan.

Genus *Raymondia* Frauenfeld

82. *Raymondia (Brachyothea) lobulata* Speiser

1900. *Raymondia lobulata* Speiser. *Arch. Natur-gesch.*, 66(1) : 51.

1981. *Raymondia (Brachyothea) lobulata*, Advani & vaziran, *Rec. zool. Surv. India, Occ. Paper 2* : 36.

Distribution : India : Gujarat, Punjab, Rajasthan, Tamil Nadu.

Elsewhere : Afghanistan and Malay.

Subfamily ASCODIPTERINAE

Genus *Ascodipteron* Adencamer

83. *Ascodipteron namrui* Maa

1965. *Ascodipteron namrui* Maa, *J. Med. Ent.*, 1 : 311.

Diagnosis : Larger species, Gena broad, broadly rounded anteriorly with 40-55 pigmented pegs. Theca in dorsal view markedly narrower anteriorly, truncate triangular, with straight sides.

Distribution : India : Gujarat, Rajasthan.

Elsewhere : Egypt, Israel.

Family MUSCIDAE

The member of the Family Muscidae are commonly known as 'Housefly', showing more affinity towards human inhabitants. They are small

to medium sized flies, metallic or non-metallic in colour.

Key to subfamilies

- 1. Pteropleuron at least with a few fine hairs ...
..... MUSCINAE
- Pteropleuron base PHAONIINAE

Subfamily MUSCINAE

Genus *Musca* Linnaeus

Subgenus *Musca* Linnaeus

84. *Musca (Musca) domestica* Linnaeus

1758. *Musca domestica* Linnaeus, *Syst. Nat. Ed.*, 10 : 596.

Diagnosis : Four black vittae on thorax, inner pair terminating towards posterior end, propleural depression with fine setulose hairs; suprasquamal ridge without black setulae, all post de strong; mid tibia without av and ad setae.

Distribution : India : Gujarat, Andaman Islands, Andhra Pradesh, Assam, Bihar, Goa, Himachal Pradesh, Karnataka, Kashmir, Mahaarashtra, Nagaland, Punjab, Tripura, Sikkim, Cosmopolitan.

Subfamily PHAONIINAE

Genus *Atherigona* Rondani

Subgenus *Atherigoan* Randoni

85. *Atherigona (Atherigona) approximata* Malloch

1925. *Atherigona approximata* Malloch, *Mem. Dep. Agric. India (ent. Ser.)*, 8 : 118.

1977. *Atherigona (Atherigona) approximata*, Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 3 : 492.

Diagnosis : Males have entirely yellow palpi, inter frontalia and fore femur. Presence of several erect anterodorsal hairs on segment 2-5 of the fore tarsus. Subcosta without dark smudge. The fore tibia is yellow in colour of which tip is more darker. The abdominal tergites 2 and 5 lack dark spots.

Distribution : India : Gujarat Delhi, Gujarat, Rajasthan and Tamil Nadu.

Family CALLIPHORIDAE

Key to the subfamilies

1. Base of stem vein of wing bare dorsally
..... CALLIPHORINAE
- Base of stem vein of wing with long fine setulae dorsally 2
2. Thoracic squama bare dorsally, subcostal sclerite with fine pubescence RHININAE
- Thoracic squama haired dorsally, subcostal sclerite setulose CHRYSOMYINAE

Subfamily CALLIPHORINAE

Genus *Bengalia* Robineau-Desviody

86. *Bengalia torosa* (Wiedemann)

1819. *Musca torosa* Wiedemann, *Zool. Mag.*, 3 : 21.

Diagnosis : Body brown but much paler on lateral margins of thorax; gena with short brown setulae beyond anterior half, rest yellowish, parafacialia with black setulae, vibrissae inserted beyond mouth margin; fore femur without fringe on anteroventral surface without distinct protuberance, tergum 4 without median marginal bristles.

Distribution : India : Gujarat, Tamil Nadu, West Bengal.

Elsewhere : Formosa, Jawa, Pakistan, Philippines, Sri Lanka.

Subfamily CHRYSOMYINAE

Genus *Chrysomya* Robineau-Desviody

87. *Chrysomya megacephala* (Fabricius)

1794. *Musca megacephala* Fabricius, *Syst. Ent.*, 4 : 312.

Diagnosis : Eyes in males with markedly enlarged facets on upper 2/3rd, lower 1/3rd with small facets, parafacialia and genae yellowish orange, both covered with yellowish-white hairs,

antennal segment 3 entirely orange, mesonotum with 2 short, narrow longitudinal black stripes anteriorly and a small black triangle on humeral callus; abdomen greenish-blue with purple reflection, male hypopygium slightly projecting, superior elasper much reduced and lightly chitinized.

Distribution : India : Gujarat (Present record).

Subfamily RHININAE

Genus *Stomorhina* Rondani

88. *Stomorhina discolor* (Fabricius)

1794. *Musca discolor* Fabricius, *Syst. Ent.*, 4 : 320.

Diagnosis : Antenna and palpus brown, wing with cell Res narrowly open; abdomen yellowish with black bands posteriorly on terga 1 and 2 and with a median longitudinal black stripe.

Distribution : India : Gujarat, Arunachal Pradesh, Assam, Bihar, Kerala, Manipur, Meghalaya, Tripura, Uttar Pradesh, West Bengal.

Elsewhere : Other parts of the Oriental region; Molucas.

Family SARCOPHAGIDAE

The Sarcophagidae or 'flesh flies' are generally found on vegetation, flowers, excrement or decaying plant and animal materials. Larvae generally are saprophagous or coprophagous.

Subfamily SARCOPHAGINAE

Genus *Parasarcophaga* Johnston & Tiegs

Key to the subgenera of
Parasarcophaga Johnston & Tiegs

1. Ventralia not pedunculated
..... *Liosarcophaga* Enderlein
- Ventralia pedunculated
..... *Parasarcophaga* Johnston & Tiegs

Key to species of subgenus
Parasarcophaga Johnston & Tiegs

1. Palpi and genital segment 2 black; sternite 5 without uniformly wide arm

.....*albiceps* (Meigen)

— Palpi yellow and genital segment 2 red; sternite 5 with uniformly wide arm

.....*hirtipes* (Wiedemann)

89. *Parasarcophaga (Parasarcophaga) albiceps* (Meigen)

1826. *Sarcophaga albiceps* Meigen, *Syst. Besch. europ. Zweifl. Insekt.*, 3 : 22

1977. *Parasarcophaga (Parasarcophaga) albiceps* Hardy and Delfinado. *A Catalog diptera of the Oriental Region*, 3 : 571.

Material examined : Junagarh district : 3 exs., Veraval, Garakmandi, coll. A.N.T. Joseph, 16.vii.1988; Rajkot district : 2 exs., Targharia, coll. A.N.T. Joseph, 21.viii.1988.

Distribution : India : Wide spread in India.

Elsewhere : China, Kalimantan, Malaysia, Nepal, Philippines, Ryukyu Island, Taiwan and Thailand, Bismarck Archipelago, Europe, Hawaii, Israel, Japan, Korea, New Britain, New Guinea, Solomon Is. and Turkey.

90. *Parasarcophaga (Parasarcophaga) hirtipes* (Wiedemann)

1830. *Sarcophaga hirtipes* Wiedemann, *Auss. Zweifl. Ins.* 2 : 361.

1977. *Parasarcophaga (Parasarcophaga) hirtipes*, Hardy and Delfinado, *A Catalog of the Diptera Oriental Region* 3 : 571.

Distribution : India : Gujarat, Karnataka, Punjab, Rajasthan, Tamil Nadu.

Elsewhere : Egypt, Europe and Palaerctic Asia.

Subgenus *Liosarcophaga* Enderlin

91. *Parasarcophaga (Liosarcophaga) dux* (Thomson)

1868. *Sarcophaga dux* Thomson, *K. Svenska Fregatton. engenes Resa, Dipt.*, 2 : 534.

1979. *Parasarcophaga (Liosarcophaga) dux*, Nandi, *Oriental Ins.* 13 (1-2) : 190.

Diagnosis : Lateral verticals wanting; propleura bare, single presutural acrostichals, posterior dorsocentrals 5, the anterior 3 weak; mid femur with comb and fringe at base, hind tibia double fringed; apex of paraphallus pointed with a subapical process having bifurcated apex.

Distribution : India : Gujarat, Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chandigarh, Delhi, Goa, Haryana, Himachal Pradesh, Jammu & Kashmir, Kerala, Maharashtra, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal.

Elsewhere : Australia, Bangladesh, China, E. Malaysia, Hainan Island, Jawa, Japan, Kalimantan, Korea, New Guinea, Ryukyu Island, Sri Lanka, and Taiwan.

Family TACHINIDAE

Known as “tachina” flies, the tachinids are free living as adults visiting flowers and vegetation while the larvae are obligatory endoparasites mainly of insects. Quite a few have been employed as biological control agents against different insect species but a few others, the so called “oosy” flies cause serious damage to sericultural industry.

11 species under 10 genera representing 3 subfamilies of this family are known from Gujarat mainly through the works of Crosskey (1976, 1977).

Key to the subfamilies of family TACHINIDAE

1. Prosternum hairy GONIINAE

— Prosternum bare 2

2. Arista bare; facial ridge and praefacial bare; reclinate orbital setae absent or inconspicuous; presutural intra alars setae absent; only 2 post intralar setae present; abdominal tergites T_{1,2} not excavate to hind margin PHASIIINAE

— Forms without such combination of characters present simultaneously TACHININAE

Subfamily PHASIINAE

Tribe *Cylindromyiini*Genus *Cylindromyia* Meigen92. *Cylindromyia wiedemanni* Crosskey

1819. *Ocyptera bicolor* Wiedemann, Zool. Mag. Kiel, 1 (3) : 37.

1976. *Cylindromyia wiedemanni* Crosskey, Bull. Brit. Mus. (nat. Hist.)Ent., 26 (suppl.) : 170.

Diagnosis : Palpi absent; propleuron haired or bare; cell Rs with well developed petiole; basal node of R4+5 with tiny inconspicuous hairs; abdomen cylindrical or sub fuciform.

Distribution : India : Gujarat, Kerala, Tamil Nadu.

Elsewhere : Sri Lanka and Southern Yemen.

Subfamily TACHININAE

Tribe *Voriini*Key to the genera of tribe *Voriini*

1. Parafacial with a strong procitinate setae at upper end near lower most frontal seta; arista with its second segment not elongate
..... *Voria* Robineau-Desvoidy
- Parafacial bare at its upper end; arista with its second segment at least twice as long as broad
..... *Hystricovoria* Townsend

Genus *Hystricovoria* Townsend93. *Hystricovoria bakeri* Townsend

1928. *Hystricovoria bakeri* Townsend, Philipp. J. Sci. 34 : 395.

Diagnosis : Parafacial bare; eyes bare; facial ridges bare but for the small setulae near vibrissae; prosternum bare; M2 appendix shorter than second section of M between m-cu and the bend.

Distribution : India : Gujarat, Uttar Pradesh, Tamil Nadu.

Elsewhere : Western Australia, Ethiopian region, Philippines.

Genus *Voria* Robineau-Desvoidy94. *Voria ruralis* (Fallen)

1810. *Tachina ruralis* Fallen, K. Venkska Vetensk Akad. Handl. (2), 31 : 265.

1976. *Veria ruralis* Crosskey, Bull. Brit. Mus. (nat. Hist.) Ent., 26. (Suppl.) : 188.

Diagnosis : Head black, brown or peristome, covered with greish hairs on forehead and back of head; labium blackish antennae and thorax black; arista thickened for about half its length, the second segment not elongate; parafacial with one or more proctinate setae at the upper end.

Distribution : India : Gujarat, Assam, Karnataka, Kashmir, Uttar Pradesh.

Elsewhere : Australia, America (North and South), Carasia, Ethiopian region, Japan, Mexico, Nepal, New Gunea, Pakistan and Taiwan.

Subfamily GONIINAE

Key to the tribes of subfamily GONIINAE

1. Prealar setae short and weak, usually shorter than first post intra alar seta and much shorter than first post dorsocentral seta
..... SIPHONINI
- Prealar seta moderately or vey strong in relation to the size of the other mesonotal setae, much longer than first post intra alar seta and usually longer than first post dorsocentral seta. 2
2. Frons exceptionally broad, ocellar setae reclinate GONIINI
- Frons narrow or only moderately broad, ocellar setae proclinate or absent 3
3. Eyes very large, occupying almost the whole side of the head, the gena reduced to a narrow strip below the eye that is not as deep as the width of the third antennal segment or of the frons CARCELIINI
- Eyes relatively smaller, genal depth at least as much as the width of the third antennal segment or of the frons 4

4. Vibrissae inserted at a level above that of the epistomal margin. Inner posterior angle of the lower calypter well developed with inner margin abutted closely against scutellum
..... STURMIINI

— Vibrissae inserted on a level with a epistomal margin. Inner posterior angle of lower calypter usually rather rounded with inner margin not closely following the edge of the scutellum
..... ERYCIINI

Tribe Siphonini

Genus *Peribaea* Robineau-Desvoidy

Key to the species of the genus *Peribaea* Robineau-Desvoidy

1. Setulae on upper surface of 1st vein not extending from apex to the point of bifurcation of 2nd and 3rd vein *suspecta* Malloch

— Setulae on upper surface of 1st vein extending from apex to the point proximal to bifurcation of 2nd and 3rd vein *orbata* (Wiedemann)

95. *Peribaea orbata* (Wiedemann)

1830. *Tachina orbata* Wiedemann, *Aussereuropaische zweifflugelige Insekten*, 2 : 336

1976. *Peribaea orbata*, Crosskey, *Bull. Brit. Mus. (nat. Hist.) Ent.* 26 (sepl.) : 213.

Distribution : India : Gujarat, Andhra Pradesh, Assam, Kerala, Madhya Pradesh, Rajasthan, Tamil Nadu, West Bengal.

Elsewhere : Indonesia, Africa, Australia, Malaysia, Melanesia, Micronesia, Middle East, Philippines, Sri Lanka and Thailand.

96. *Peribaea suspecta* (Malloch)

1924. *Actia suspecia* Malloch, *Ann. Mag. Nat. Hist.* (9) 13 : 409.

1976. *Peribaea suspecta*, Crosskey, *Bull. Brit. Mus. (nat. Hist.) ent.*, 26 (Suppl.) : 214.

Distribution : India : Gujarat Bihar, Gujarat, Maharashtra; Sudan and Uganda.

Tribe Carceliini

Genus *Carcelia* Robineau Desvoidy

Subgenus *Senometopia* Macquart

97. *Carcelia (Senometopia) illota* (Curran)

1927. *Zenillia illota* Curran, *Bull. ent. Res.*, 17 : 328.

1977. *Carcelia (Senometopia) illota* Hardy and Delfinado, *A Catalogue of the Diptera of the Oriental Region*, 3 : 669.

Diagnosis : Eyes haired; hind coxa bare on the posterodorsal surface; mid tibia without a submedian v seta. Humeral callus with the three main seta standing in a line or almost so; four post dc setae; intermediate abdominal segment without discal seta.

Distribution : India : Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Tamil Nadu, West Bengal.

Elsewhere : Tanzania.

Tribe Sturmiini

Key to the genera of tribe Sturmiini

1. Eyes densely haired ... *Sturmiopsis* Townsend

— Eyes bare or almost so
..... *Cadurcia* Villeneuve

Genus *Cadurcia* Villeneuve

98. *Cadurcia lucens* Villeneuve

1926. *Cadurcia lucens* Villeneuve, *Revue zool. afr.* 14 : 244.

Diagnosis : Black with shining thorax; abdomen extensively covered with white pollinosity on T4 and T5; ocellar setae strong; 3 stpl setae; eyes bare or almost so, mid tibia with one ad setae; second supra lars seta reduced and weaker than pre alar seta.

Distribution : India : Gujarat, Punjab, Uttar Pradesh.

Elsewhere : Indonesia, Mauritius, Nigeria, Southern Africa.

Genus *Sturmiopsis* Townsend99. *Sturmiopsis inferens* Townsend

1916. *Sturmiopsis inferens* Townsend, *Proc. U.S. natn. Mus.* 51 (No. 2152) : 313.

Diagnosis : Small and broad; thorax and abdomen black; later brownish beneath; inter segmental joints yellowish; head with two or three pairs of reclinate orbital setae; eyes densely haired; parafacial completely haired.

Distribution : India : Gujarat, Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh.

Elsewhere : Indonesia, Malaysia and Nepal.

Tribe Goniini

Genus *Goniophthalmus* Villeneuve100. *Goniophthalmus halli* Mesnil

1956. *Goniophthalmus halli* Mesnil, In Linder, *Fliegen Palaearkt Reg.*, 64g : 548.

Diagnosis : Head thorax and scutellum yellowish; abdomen black, reddish on sides; parafacial bare; scutellum with two pairs of marginal setae (basal and subapical); facial ridges setose on most of their height; three stpl setae.

Distribution : India : Gujarat, Karnataka, Tamil Nadu.

Elsewhere : Africa and Yemen.

Tribe Eryciini

Key to the genera of the tribe Eryciini

1. Eyes haired ... *Pseudoperichaeta* Br. & Berg.
— Eyes bare *Nealsomyia* Mesnil

Genus *Nealsomyia* Mesnil101. *Nealsomyia rufipes* (Villeneuve)

1937. *Alsomyia rufipes* Villeneuve, *Bull. Annl. Soc. ent. Belg* 77 : 407.

1976. *Nealsomyia rufipes* Crosskey, *Bull. Brit. Mus. (nat. Hist.) Ent.*, 26 (Suppl.) : 251.

Diagnosis : Arista normal not thickened on more than half its length; basal segments short; eyes haired; two or three sternopleural setae; second costal sector bare ventrally; abdomen yellow, broad little arched, without discal setae; female abdomen orange reddish.

Distribution : India : Gujarat, Karnataka, Punjab, Tamil Nadu.

Elsewhere : Pakistan.

Genus *Pseudoperichaeta* Bracier & Bargaenstorm102. *Pseudoperichaeta indica* (Gardner)

1940. *Euhapalivora indica* Gardner, *Indian J. Ent.* 2 : 179.

1976. *Pseudoperichaeta indica*, Crosskey, *Bull. Brit. Mus. (nat. Hist.) Ent.*, 26 (suppl.) : 152.

Diagnosis : Eyes hairy; parafacial bare; four sternopleural setae; facial ridge setulose on more than half its height; apical scutellars setae directed upwards or half upwards; second supra alars setae weak; much shorter than the preapical setae.

Distribution : Gujarat, Maharashtra.

Family GASTEROPHILIDAE

The Gasterophilidae or 'botflies' as adults are rarely encountered but the larvae are found as parasites of some animals like equines and elephants.

Subfamily GASTEROPHILINAE

Genus *Gasterophilus* Leach103. *Gasterophilus pecorum* (Fabricius)

1794. *Oestrus pecorum* Fabricius, *Ent. syst.*, 4 : 230

1985. *Gasterophilus pecorum*, Datta & Pal. *Journ. Beng. Nat. Hist. Soc.* 4 (2) : 96-110.

Diagnosis : Media of wing (M) straight. Lower marginal cross vein not developed; wings entirely dark or with broad and deep blackish or brownish infuscations.

Distribution : India : Gujarat, Punjab and Uttar Pradesh.

Elsewhere : Palaerctic and Ethiopian regions.

Family OESTRIDAE

The Oestridae commonly known as 'Warble flies' The larvae of this group usually lives as a subcutaneous parasite in the bodies of mammals.

Subfamily HYPODERMATINAE

Key to the genera of the subfamily HYPODERMATINAE

1. First posterior cell narrowly open
..... *Przhevalskiana* Grunin
- First posterior cell distinctly closed or even petiolate *Hypoderma* Latreille

Genus *Przhevalskiana* Grunin104. *Przhevalskiana silenus* (Brauer)

1858. *Hypoderma silenus* Brauer, *Verh. Zool. bot. Ges. Wien.* 8 : 460.

1977. *Przhevalskiana silenus* Hardy and Delfinado. A Catalogue of the Diptera of the Oriental Region 3 : 701.

Distribution : India : Gujarat Bengal, Gujarat, Himachal Pradesh, Kashmir, Punjab.

Elsewhere : Pakistan, Palaeartic region.

Genus *Hypoderma* Latreille105. *Hypoderma lineatum* (Villers)

1789. *Oestrus lineatum* Villers, *Linn. Ent.*, 3 : 349

1977. *Hypoderma lineatum*, Hardy and Delfinado. A Catalogue of the Diptera of the *Oriental Region* 3 : 700.

Distribution : India : Gujarat, Himachal Pradesh, Kashmir, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere : Pakistan, Hawaii and Holarctic region.

Subfamily OESTRINAE

Genus *Cephalopina* Strand106. *Cephalopina titillator* (Clark)

1816. *Oesrus titillator* Clark. Suppl. Sheet : 4.

1977. *Cephalopina titillator*, Hardy and Delfinado, A Catalogue of the Diptera of the Oriental Region. 3 : 701.

Diagnosis : Front and face nearly parallel sides, upper part dull greenish gray, having on each side three rather bright, orange brown, elongate spots narrowly out lined with whitish grey, antenna with first two joints very small, pale yellowish, whole dorsum more or less dusted with golden yellow. Wings nearly colourless.

Distribution : India : Gujarat, Punjab, Sikkim.

Elsewhere : Pakistan, Middle East, North & North-east Africa.

SUMMARY

Diptera fauna of Gujarat so far known, holds approximately 106 species under 70 genera pertaining to 25 families that represent only about 1.73% of the species (total 6,093) and 6.51% of the genera (total 1,075) of known Diptera fauna of the Indian Union. Considering the total area of the state (about 1.96 lakh sq. kms) which is approximately 5.9% of that of Indian Union (about 32.87 sq. kms), therefore, Diptera fauna of the State appears to be rather scanty. Uniform topographic and climatic features prevailing in the state possibly accounts for such dearth of faunal component as well as the near absence of endemism in it. 4 species, 2 each from families Culicidae and Asilidae representing 3.77% of total species strength of the state are endemic while 5 species, one each from families Culicidae, Tephritidae, Hippoboscidae, Muscidae and Tachinidae occurring in the state (approximately 4.7% of the total) are cosmopolitan in distribution.

Faunal affinity of the state with areas outside Oriental region appears to be maximum with Palaeartic region since 39 species occurring in the state (representing nearly 38.67% of the total) are common to that region and the palaeartic affinity is also prevalent in almost all the families represented in Gujarat fauna. 22 Species occurring in the state belongs to families Culicidae, Bombyliidae, Syrphidae, Sepsidae, Ephydriidae,

Calliphoridae, Sarcophagidae and Tachinidae (i.e., approximately 20.75% of the total) are common to Australia, Philippines, New Guinea and/or Pacific islands while only 16 species belonging to families Culicidae, Syrphidae, Muscidae, Gastrophilidae, Sarcophagidae and Tachinidae are common to Ethiopian fauna (about 15.1% of the total no. of species).

Within Oriental region, it is interesting to note that, commonness of faunal element of the state of Gujarat is maximum with northern India (57 species, i.e., approximately 53.77% of total) closely followed by southern India/Sri Lanka (52 species, i.e., 49% of total). 36 species (i.e., approximately 34% of total) and 28 species (i.e., approximately 26.4% of total) are common to Indo-china and Malaysia respectively.

Family Culicidae and Asilidae, each represented by 17 species (16.03% of the total) are best represented families in the Diptera fauna

of Gujarat, followed by Bombyliidae (15 species, i.e., 14.15% of the total), Tachinidae (11 species, i.e., 10.37% of the total), Syrphidae (7 species, i.e., 6.6% of the total), Sepsidae and Nycteribidae (4 species each, i.e., 3.77% of the total) and Strebtidae, Calliphoridae, Oesteridae and Sarcophagidae (3 species each, i.e., 2.83% of the total). Rest of the families are represented by 1 or 2 species in the Diptera fauna of Gujarat.

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REFERENCES

- Advani, R. and Vazirani, T.G. 1981. Studies on ectoparasites of bats of Rajasthan and Gujarat (India). *Rec. zool. Surv. India (Occ paper)* **22** : 1 -155.
- Banerjee, D. and Mitra, B. 2002. Beeflies (Bombyliidae : Diptera) of the Thar Desert. *Insect Environmental*. **7** (4) : 190-191.
- Banerjee, D. and Mitra, B. 2002. Some beeflies (Bombyliidae : Diptera) of the Thar Desert. *Rec. zool. Surv. India*. **103** (1-2) : 65-71.
- Barnard, P.J. 1934. *The fauna of British India including Ceylon and Burma, Diptera Culicidae* **5**, 463 pp. Taylor and Francis, London.
- Brunetti, E. 1912. *The Fauna of British India including Ceylon and Burma, Diptera, Nematocera*, 1 (excluding Chironomidae and Culicidae) **XXX** + 581 pp. Taylor and Francis, London.
- Brunetti, E. 1923. *The Fauna of British India including Ceylon and Burma, Diptera, Pipunculidae, Syrphidae, Conopidae and Oestridae*, **3** : xi + 424 pp. Taylor and Francis, London.
- Brunetti, E. *The Fauna of British India including Ceylon and Burma, Diptera, Brachycera*, **2** : ix + 401 pp.
- Christophers, S.R. 1933. *The Fauna of British India Including ceylon and Burma, Diptera culicidae* **4** : 371 pp. Taylor and Francis, London.
- Datta, M and Pal, T.K. 1985. A synopsis of the Indian Gasterophilidae (Diptera) *J. Beng. Nat. Hist. Soc. (n.s.)*, **4** : 96 -110.

- Delfinado, M.D. and Hardy, D.E. (ed). 1973. *A Catalogue of Diptera of Oriental Region, Nematocera*, **1** : 1-681, Univ. of Hawaii Press, Honolulu.
- Delfinado, M.D. and Hardy, D.E. (ed.) 1975. *A Catalog of Diptera of the Oriental Region. Brachycera*, **2** : 1-459. Univ. of Hawaii Press, Honolulu.
- Delfinado, M.D. and Hardy, D.E. (ed.) 1977. *A Catalog of Diptera of the Oriental Region, Cyclorrhapha* **3** : 1-854. Univ. of Hawaii Press, Honolulu.
- Joseph, A.N.T. and Parui, P. 1992. Asilidae (Diptera) from Gujarat, India. *Rec. zool. Surv. India* **92** : 123-129.
- Mitra, B., Parui, P. and Banerjee, D. 2002. Diptera fauna of Balaram-Ambaji Wildlife Sanctuaries, North Gujarat, India. *J. Interacademia*, **6** (4) : 498-511.
- Mitra, B., Sharma, R.M. and Parui, P. Inventory of the Trueflies (Diptera) of the Thar Desert. (in press).
- Roy, D.N. 1954. Entomology (medical and veterinary) **I** : 290 pp. Excelsior Press, Calcutta.
- Ratan Lal, 1960. Asilidae in Catalogue of Indian Insects. Part 29, ii + 77 pp. I.C.A.R., New Delhi.
- Rao, T. Ramachandra, 1984. *The Anophelines of India*, xvi + 518 pp. Malaria Research Centre (I.C.M.R.), New Delhi.
- Singh, S. and Ipe, M.I. 1973. The Agromyzidae from India. *Memories of the School of Entomology*, **1**, v + 286 pp.
- Tyagi, B.K. 1984. A note on the new records of some Anopheline mosquitoes from south Gujarat (India) *Geobios new reports*, **3** (2) : 149-151.
- Van Emden, F.T. 1965. *The Fauna of India and the adjacent countries, Diptera, Muscidae*, **7**, xiv + 647 pp.

INSECTA : HYMENOPTERA : FORMICIDAE

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INTRODUCTION

Among all the wide variety of insect life on earth, ants are one of the few forms universally recognised. This is because they are found in all terrestrial habitats such as seacoasts, deserts, deep in the soil and tips of the trees. They modify their immediate surroundings to suit their needs.

Ants have the most highly organised social life among all the insects. The major factor responsible for their ecological success is division of labour. They live in well-established community with hundreds and thousands of individuals of distinct forms.

In spite of ants being so common no information is available on them from Gujarat state.

Binghams (1903) fauna is the main source of knowledge on ants. Rothney (1889) published an extensive notes on ants of Bengal whereas Wroughton (1892) provided a good account on Formicidae mainly from Maharashtra. Chapman and Capco (1951) published a checklist of the ants of Asia. Roonwal (1975) discussed the plant pest status of *Dorylus orientalis*. Chhotani and Ray (1976) described the hymenopterous fauna of Rajasthan. Chhotani and Maiti (1977) worked on the ants of Andaman Islands. Pajni and Suri (1978) reported the Formicid Fauna of Chandigarh. Mathew (1980, 1983, 1984, 2000) dealt with the ants of North-east India. Sharma (1981) gave a short note on the ant of desert area. Gadagkar (1983) gave the species richness and diversity of Western Ghats, Karnataka. Ali (1991) reported the ants fauna of Karnataka. Tiwari

(1994, 1997, 1998) has worked on ants of South India and Delhi. Sunil Kumar (1997) worked the ant species richness of Bangalore whereas Rastogi gave the observations on ants behaviour in Bangalore. Bolton (1995) has dealt with taxonomic and zoogeographical census of the extant ant taxa (Hymenoptera : Formicidae). Bharti (2001) has given a checklist of ants of Northwest India. Tak (1995, 1996, 2000, 2001) has dealt with the ants of Rajasthan.

The present studies are based on the material collected by Dr. N. S. Rathore, Dr. Ram Sewak, Dr. R. N. Bhargava, Dr. V. C. Agarwal, Dr. R. C. Sharma, Dr. R. K. Singh, Dr. T. G. Vazirani and Dr. D. S. Mathur of DRS, ZSI during their faunistic surveys to different districts of Gujarat. We are grateful to them.

Abbreviation used

N. S. Rathore	N.S.R.
R. Sewak	R.S.
R. N. Bhargava	R.N.B.
V. C. Agarwal	V.C.A.
R. C. Sharma	R.C.S.
R. K. Singh	R.K.S.
T. G. Vazirani	T.G.V.
D. S. Mathur	D.S.M.

The manuscript deals with 41 ants species belonging to 20 genera under seven subfamilies of family Formicidae of order Hymenoptera.

All the 41 species of ants are new records from Gujarat.

SYSTEMATICS

Class INSECTA

Order HYMENOPTERA

Family FORMICIDAE

I. Subfamily PONERINAE Lepeletier

i. Tribe **Odontomachini** Mayr

1. *Anochetus punctiventris* Mayr
2. *Anochetus sedilloti* Emery
3. *Anochetus taylori* Forel

ii. Tribe **Leptogenyini** Forel

4. *Leptogenys (Lobopelta) processionalis* Jerdon

II. Subfamily DORYLINAE Leach

i. Tribe **Dorylini** Forel

5. *Dorylus (Typhlopone) labiatus* Shuckard
6. *Dorylus (Alaopone) orientalis* Westwood

III. Subfamily AENICTINAE

7. *Aenictus (Aenictus) brevicornis* Mayr

IV. Subfamily DOLICHODERINAE Forel

8. *Dolyichoderus bituberculatus* Mayr
9. *Tapinoma (Micromyrma) melanocephalum*
Fabricius

V. Subfamily FORMICINAE Lepeletier

i. Tribe **Camponotini** Forel

10. *Camponotus (Tanaemyrmex) compressus*
Fabricius
11. *Camponotus (Dinomyrmex) angusticollis*
Jerdon
12. *Camponotus basalis* Smith
13. *Camponotus (Tanaemyrmex) irritans*
Fred-Smith
14. *Camponotus (Orthonotomyrmex) sericeus*
Fabricius
15. *Polyrhachis (Myrmhopla) simplex* Mayr
16. *Polyrhachis (Myrma) punctillata* Mayr
17. *Polyrhachis (Campomyrma) clypeata* Mayr

ii. Tribe **Prenolepidini** Forel

18. *Prenolepis asea* Forel

iii. Tribe **Formicini** Forel

19. *Cataglyphis bicolor setipes* Emery

iv. Tribe **Oecophyllini** Forel

20. *Oecophylla smaragdina* Fabricius

v. Tribe **Plagiolepidini** Forel

21. *Acantholepis frauenfeldi bipartita* Forel
22. *Plagiolepis jerdoni* Forel

VI. Subfamily PSEUDOMYRMECINAE Emery

i. Tribe **Pseudomyrmini** Forel

23. *Tetraponera (Tetraponera) rufonigra* Jerdon
24. *Tetraponera (Tetraponera) allaborans* Walker

VII. Subfamily MYRMICINAE Lepeletier

i. Tribe **Crematogastrini** Emery

25. *Crematogaster contemta* Mayr
26. *Crematogaster subnuda* Mayr

ii. Tribe **Meranoplini** Emery

27. *Meranoplus bicolor* Guerin

iii. Tribe **Solenopsidini** Forel

28. *Solenopsis geminata* Fabricius
29. *Monomorium pharaonis* Linnaeus
30. *Monomorium (Monomorium) wroughtoni* Forel
31. *Monomorium (Xeromyrmex) indicum* Forel
32. *Monomorium destructor* Jerdon
33. *Monomorium (Parholcomyrmex) gracillimum*
var. *mayri* Forel
34. *Monomorium (Holcomyrmex) criniceps* Mayr
35. *Monomorium scabriceps* Mayr
36. *Monomorium (Holcomyrmex) glabrum* Ern.
Andre

iv. Tribe **Pheidolini** Emery

37. *Pheidole (Pheidole) wroughtoni* Forel
38. *Pheidole (Pheidole) sulcaticeps* Roger
39. *Pheidole (Pheidole) roberti* Forel

v. Tribe **Tetramoriini** Emery

40. *Tetramorium rothneyi* Forel
41. *Tetramorium sahatum* Forel

Ants are polymorphic social insects having three distinct forms - the perfect and fertile female, the male and a worker (major or minor). The largest forms of workers are soldiers.

IDENTIFICATION KEY IS BASED ON THE WORKER CASTE OF AN ANT

Key to the subfamilies of family FORMICIDAE

- I. Petiole of the abdomen one or two jointed
1. A more or less marked constriction between basal two segment of abdomen. Petiole one jointed subfamily PONERINAE
 2. No constriction between basal two segment of abdomen
 - (i). Opening at posterior end of gaster (acidopore) slit like.
 - a. Eyes never present, blind.
 - a' Petiole one jointed subfamily DORYLINAE
 - b' Petiole two jointed subfamily AENICTINAE
 - b. Eyes always present Petiole one jointed subfamily DOLICHODERINAE
 - (ii) Opening at posterior end of gaster (acidopore) terminal, circular and usually surrounded by a fringe of hairs. Petiole one jointed subfamily FORMICINAE
- II. Petiole of the abdomen two jointed
- (i) Petiole remarkably elongate, generally the anterior node is elongately petiolate, sometimes the posterior node is also petiolate, giving flexibility to the abdomen subfamily PSUEDOMYRMINAE
 - (ii) Petiole not so elongate, the anterior node with a long petiole anteriorly and a short petiole posteriorly subfamily MYRMICINAE

I. Subfamily PONERINAE

Key to genera of the subfamily PONERINAE

Petiole free with a flexible joint between it and the abdomen

- (i) Mandibles articulated close together in middle of front margin of head genus *Anochetus*
- (ii) Mandibles articulated wide apart at the lateral

angles of front margin of head
..... genus *Leptogenys*

Key to species of the genus *Anochetus*

- A. Basal abdominal segments closely punctured, opaque
- (i) Punctures on head and thorax more distinct not running into longitudinal striae
..... *A. punctiventris*
- B. Basal abdominal segment smooth, shining not opaque
- (i) Thickness from front to back of node of petiole at base equal to its height *A. sedilloti*
 - (ii) Thickness from front to back of node of petiole at base much less than its height ... *A. taylora*

Subfamily PONERINAE Lapeletier

Tribe **Odontomachini** Mayr

Genus *Anochetus* Mayr

1. *Anochetus punctiventris* Mayr

1878. *Anochetus punctiventris* Mayr, *Verh zool-bot Ges Wien.* xxviii : 659.

1900. Forel *J. Bombay nat. Hist. Soc.*, xiii : 59 & 63.

Material examined : Jamnagar district : 10 exs., N.S.R. coll., 09.02.1990.

Diagnostic characters : Length worker 3.5 4 mm.

Worker : Brownish, the abdomen a little dark in colour. Head convex in front, posteriorly a little emarginate. Mandibles placed very close together in the middle of the front of the head, elongate parallel the apex bent suddenly at right with three teeth, the intermediate tooth very small. Antennal carinae short, wide apart covering the base of the antennae. Antennae 12 jointed filiform. Alitrunk densely punctured, obliquely truncate posteriorly. Node of the petiole ovate rounded above smooth. Abdomen stout.

Distribution : India : Gujarat Jamnagar. Rajasthan, Southern and Western India, West Bengal, Sikkim, Meghalaya, Maharashtra.

Subfamily PONERINAE Lepeletier

Tribe **Odontomachini** Mayr

Genus *Anochetus* Mayr

2. *Anochetus sedilloti* Emery

1884. *Anochetus sedilloti* Emery, *Ann. Mus. Civ. Nat. Genova* 21 : 377 & 378 worker.

1900. Forel *J. Bombay nat. Hist. Soc.*, xiii : 59, worker.

Material examined : Jamnagar district : 1 ex., N.S.R. coll., 11.02.1990. Sabarkantha district : 1 ex., N.S.R. coll., 06.03.1992.

Diagnostic characters : Length worker 4.5
5 mm

Worker : Reddish brown with the abdomen dark brown in colour. Head smooth irregularly rectangular posteriorly emarginate, mandibles placed very close together in the middle of the front of the head. Mandibles tridentate at apex, the intermediate tooth very small. Antennal carinae short, wide apart covering the base of the antennae. Antennae 12 jointed filiform. Alitrunk broad and convex in front, rounded and slightly compressed posteriorly, the pronotum constricted into a neck anteriorly, the metanotum truncate posteriorly. Node of the petiole thick and conical, more convex in front than posteriorly. Abdomen smooth, polished and shining.

Distribution : India : Gujarat Jamnagar, Sabarkantha. Tamil Nadu, Western India, Rajasthan, Maharashtra.

Elsewhere : Northern Africa, Tunisia

Subfamily PONERINAE Lepeletier

Tribe **Odontomachini** Mayr

Genus *Anochetus* Mayr

3. *Anochetus taylori* Forel

1900. *Anochetus taylori* Forel, *J. Bombay nat. Hist. Soc.*, xiii : 60 & 63, worker.

Material examined : Rajkot district: 2 exs., R.S. coll., 08.09.1990.

Diagnostic characters : Length worker : 4.8 mm.

Worker : Dark castaneous brown, shining. Head, alitrunk and abdomen covered with scattered erect pale hairs. Head irregularly rectangular, posteriorly constricted, mandibles placed very close together in the middle of the front of the head. Mandibles tridentate at apex, the intermediate tooth very small. Antennal carinae short, wide apart, covering the base of the antennae. Antennae 12 jointed, filiform. Alitrunk broad and convex in front, rounded and slightly compressed posteriorly, the pronotum constricted into neck anteriorly, the metanotum truncate posteriorly. Node of the petiole smooth, thick, convex in front, flat almost concave posteriorly.

Distribution : India : Gujarat Rajkot. Rajasthan; Maharashtra (Poona); Western India; Karnataka; Tamil Nadu; Orissa.

Elsewhere : Belgium and the Nigiris.

Subfamily PONERINAE Lepeletier

Tribe **Leptogenyini** Forel

Genus *Leptogenys* Roger

4. *Leptogenys (Lobopelta) processionalis* Jerdon

1951. *Leptogenys (Lobopelta) processionalis* Jerdon, *Madras Jour. Lit. Sc.* 17 : 118 worker (*Ponera*).

Material examined : Panchmahal district : 2 exs., R.S. coll., 17.02.1988. Bharuch district : 6 exs., R.S. coll., 24.02.1988. Banaskantha district : 2 exs., R.N.B. coll., 29.12.89.

Diagnostic characters : Length worker : 8 - 9 mm.

Worker : Dark castaneous brown, smooth polished and shining. Head broad, rectangular as broad posteriorly as in front. Mandibles broad, longitudinally striate armed at the apex with four unequal teeth and denticulate along the inner margin. Antennal carinae short very close together, antennae stout, the scape just passing the top of the head, Alitrunk slightly narrower than the head, pro-meso and meso-metanotal sutures deeply marked. Claws pectinate. Node of petiole convex in front, flat posteriorly, abdomen massive.

Distribution : India : Gujarat Panchmahal, Banaskantha. Rajasthan Dungarpur; Karnataka, Tamil Nadu, Kerala, Meghalaya.

Elsewhere : Sri Lanka

II. Subfamily DORYLINAЕ Leach

Petiole one jointed. Mandibles without teeth on the masticatory margin.

Key to species of the genus *Dorylus*

- i. Antennae worker maj. 11 and worker min. 10 jointed *D. labiatus*
 ii. Antennae worker maj. and worker min. 9 jointed *D. orientalis*

Subfamily DORYLINAЕ Leach

Tribe Dorylini Forel

Genus *Dorylus* Fabricius

5. *Dorylus (Typhlopone) labiatus* Shuckard

1940. *Dorylus (Typhlopone) labiatus* Shuckard, *Ann. Mag. Nat. Hist.* 5 : 319, male.

Material examined : Vadodara district: 2 exs., N.S.R. coll., 22.07.1982. Mahesana district: Many exs., V.C.A. coll., 29.10.1964; 2 exs., N.S.R. coll., 23.02.1992. Valsad district: 2 exs., R.S. coll., 09.03.1988. Amreli district: 20 exs., R.C.S. coll., 24.09.1975; 2 exs., R.K.S. coll., 01.02.1989. Jamnagar district: 4 exs., N.S.R. coll., 13.01.1981; 8 exs., R.S. coll., 28.03.1999; 3 exs., R.S. coll., 26.08.1990; 8 exs., R.S. coll., 28.08.1990; 2 exs., N.S.R. coll., 31.01.1990; 2 exs., R.S. coll., 30.08.1990. Junagadh district: 3 exs., R.N.B. coll., 18.11.1990; 15 exs., R.S. coll., 31.08.1990. Panchmahal district: 1 ex., T.G.V. coll., 16.02.1975; 15 exs., R.S. coll., 19.02.1988. Rajkot district: 4 exs., R.S. coll., 06.09.1990. Surendranagar district: 10 exs., R.S. coll., 10.03.1986. Gandhinagar district : 12 exs., N.S.R. coll., 05.01.1988. Bhuj district: 15 exs., R.N.B. coll., 18.11.1990. Bhavnagar district: 1 ex., R.S. coll., 24.02.1986; 1 ex., N.S.R. coll., 24.01.1990. Banaskantha district : 8 exs., N.S.R. coll., 10.03.1992.

Diagnostic characters : Length worker maj. 6-8 mm.; worker min. 3.5

Worker (maj) : Castaneous yellow, polished smooth, shining and blind. Head rectangular, longer than its breadth, broader in front than posteriorly. No longitudinally impressed line on the head. Mandible with two teeth. Antennae worker maj. 11 and worker min. 10 jointed. Alitrunk rectangular depressed slightly constricted at the pro-mesonotal suture. Node of petiole longer than its breadth.

Distribution : India : Gujarat Mahesana, Vadodara, Valsad, Amreli, Jamnagar, Junagadh, Panchmahal, Rajkot, Surendranagar, Gandhinagar, Bhuj, Bhavnagar, Banaskantha. Rajasthan, Delhi, West Bengal (Kolkata), Chandigarh, Karnataka, Punjab.

Subfamily DORYLINAЕ Leach

Tribe Dorylini Forel

Genus *Dorylus* Fabricius

6. *Dorylus (Alaopone) orientalis* Westwood

1835. *Dorylus (Alaopone) orientalis* Westwood, *Proc. Zool. Soc. Lond.* 3 : 72, male.

1983. *Dorylus orientalis* Mathew, *Bull. Zool. Surv. India*; 5 (7) : 125-127

Material examined : Vadodara district: 2 exs., N.S.R. coll., 22.07.1982. Amreli district: 1 ex., R.K.S. coll., 01.02.1989. Junagadh district: 1 ex., R.N.B. coll., 18.11.1990.

Diagnostic characters : Length worker maj. : 5.5 mm.; worker min. : 2.5-3 mm.

Worker (maj.) : Castaneous brown with the abdomen generally lighter in colour than the head and alitrunk. Head rectangular occiput deeply emarginate, the head slightly wider anteriorly than posteriorly. A deeply impressed medial line present on the head. Alitrunk elongate, rounded anteriorly depressed and flat above, constricted at the pro-mesonotal suture. Node of the petiole broader than long, united with the abdomen.

Distribution : India : Gujarat-Vadodara,

Junagadh, Amreli. Rajasthan, Kerala, Orissa, Maharashtra, West Bengal (Darjeeling), Delhi, Tamil Nadu, Chandigarh, Punjab, Shillong, Uttar Pradesh, Assam, Karnataka, Meghalaya.

Elsewhere : Indonesia, Malaya-Peninsula, Sri Lanka, Myanmar, Nepal and China.

III Subfamily AENICTINAE

Tribe **Ecitonini** Forel

Genus *Aenictus* Shuckard

7. *Aenictus (Aenictus) brevicornis* Mayr

1878. *Aenictus (Aenictus) brevicornis* Mayr, (*Typhlatta*) *Verh. zool.-bot. Ges. Wien*, **28** : 668 & 689.

1901. Forel, *J. Bombay nat. Hist. Soc.*, **13** : 446, worker.

1964. *Aenictus brevicornis* Wilson, *Pacific Insects* **6** (3) : 451.

Material examined : Junagadh district : 2 exs., R.S. coll., 31.08.1990.

Diagnostic characters : Length worker : 2.5-3 mm.

Worker : Reddish yellow, head smooth and shining, thorax sculptured. Head rectangular very broad posteriorly, mandibles with three distinct teeth. Antennae very short and massive. Scape of the antennae about half length of the head. Alitrunk narrower than the head, pronotum convex smooth and shining basal portion of the metanotum passing by a gradual curve with sloping apical portion. Nodes of petiole rounded shining. Abdomen elongate oval.

Distribution : India : Gujarat-Junagadh. Rajasthan, NW Provinces, Chandigarh, Assam, West Bengal (Kolkata), Karnataka, Kerala (Calicut), Uttar Pradesh, Bangalore, Tamil Nadu.

IV. Subfamily DOLICHODERINAE Forel

Tribe **Dolichoderini** Emery

Genus *Dolichoderus* Lund

8. *Dolichoderus bituberculatus* Mayr

1862. *Dolichoderus (Hypoclinia) bituberculatus* Mayr, *Verh. zool.-bot. Ges. Wien* **12** : 705 worker.

Material examined : Mahesana district: 4 exs., N.S.R. coll., 25.02.1992.

Diagnostic characters : Length worker : 3 -3.5 mm.

Worker : Head and alitrunk black, abdomen dark brown, posterior end black. Head broadly oval, mandibles triangular, the masticatory margin broad with 8-10 teeth. Clypeus broad, anterior margin emarginate, eyes very flat. Antennae 12 jointed, scape long reaching beyond the posterior margin of head. Alitrunk the pronotum flat and margined anteriorly, the sides of the mesonotum raised into tubercles, the basal and the truncate inwardly curved and concave apical portions of the metanotum sub equal, the sides of the metlanotum flat smooth, margined above and posteriorly. Node of the petiole smooth, shining thick above than at base, abdomen shining broad at base, pointed at apex.

Distribution : India : Gujarat Mahesana. Sikkim, Western India, Karnataka.

Elsewhere : Myanmar, Tenasserin extending into the Malayan subregion Jawa.

Subfamily DOLICHODERINAE Forel

Tribe **Tapinomini** Emery

Genus *Tapinoma* Forster

9. *Tapinoma (Micromyrma) melanocephalum* Fabricius

1793. *Tapinoma (Micromyrma) melanocephalum* Fabricius, (*Formica*) *Ent. Syst.* **ii** : 353.

1895. Forel *J. Bombay nat. Hist. Soc.* **9** : 472, worker.

1983. *Tapinoma melanocephalum* Mathew. *Bull. Zool. Surv. India* **5**(1) : 125-127.

Material examined : Jamnagar district: Many exs., N.S.R. coll., 11.02.90; Many exs., N.S.R. coll., 08.02.1990. Sabarkantha district: Many exs., N.S.R. coll., 22.11.1986. Bhavnagar district: Many exs., N.S.R. coll., 27.01. 1990. Mahesana district: Many exs., R.N.B. coll., 27.01.1964; Many exs., N.S.R. coll., 23. 02.1992. Many exs., V.C.A. coll., 29.10.1964; Many exs., R.N.B. coll., 29.10. 1964. Patan district : Many exs., R.N.B. coll., 30.11.1964. Junagadh district : Many exs., D.S.M. coll., 08.04.1969. Kheda district : Many exs., N.S.R. coll., 21.02.1991

Diagnostic characters : Length worker : 1.5 mm.

Worker : Head and thorax dark brown in colour, abdomen yellowish white. Head longer than broad, oval, not emarginate, rounded posteriorly. Mandibles triangular broad with the masticatory margin equal to the outer margin and armed with minute teeth. Clypeus evenly convex, broader than high, its anterior margin slightly arched. Antennae thick the scape extending beyond the top of the head. The joints of the flagellum longer than broad. Alitrunk viewed from the side not emarginate, the pro-meso and meso-metanotal sutures distinct slightly constricted at the latter suture. Petiole with a distinct node. Base of the abdomen overhanging the pedicel.

Distribution : India : Gujarat : Jamnagar, Bhavnagar, Mahesana, Patan, Junagadh, Kheda. Rajasthan, Karnataka, Tamil Nadu (Salem distt.), Shillong, Chandigarh, Meghalaya, Bengal, Maharashtra, Orissa.

Elsewhere : Spread through the tropics of both the hemisphere, South America.

Subfamily FORMICINAE

Key to genera of subfamily FORMICINAE

A. Antennae 12 jointed, Maxillary pulpi 6 jointed

1. Antennae inserted at a perceptible distance from posterior margin of clypeus.

i. Alitrunk and node of petiole not spinous, basal two abdominal segment equal in length
..... *Camponotus*

ii. Alitrunk and node of petiole spinous, basal segment much longer than the 2nd
..... *Polyrhachis*

2. Antennae inserted immediately above posterior margin of clypeus, almost touching it

i. Antennal and clypeus hollows not confluent, distinct *Prenolepis*

ii. Antennal and clypeus hollows confluent.

a. Ocelli present. Node of petiole rounded. 4th joint of maxillary palpi nearly twice as long as 5th *Cataglyphis*

b. Antennae 12 jointed, maxillary palpi 5 jointed *Oecophylla*

B. Antennae 11 jointed, maxillary palpi 6 jointed.

i. Mesonotum and node of petiole bispinose or bidentate *Acanthalepis*

ii. Mesonotum and node of petiole without spines or teeth *Plagiolepis*

Key to species of the genus *Camponotus*

A. Thorax viewed from side forming a regular arch.

1. Head, alitrunk and abdomen black

i. Tibia of the legs prismatic. Head posteriorly narrow but not confluent to form a collar ..
..... *C. compressus*

ii. Tibia of the legs prismatic. Head posteriorly constricted so as to form a collar
..... *C. angusticollis*

2. Head, alitrunk and abdomen never all black or all yellow.

i. Tibia spined beneath. Head and abdomen black or dark castaneous red, alitrunk yellow.

a. Medial lobe of clypeus long, rectangular, the lateral margin acute *C. basalis*

b. Medial lobe of clypeus short not much produced, the lateral angles rounded
..... *C. irritans*

B. Regular arch of the thorax interrupted at the meso-metanotal suture by the mesonotum forming an angle with the mesonotum, basal portion of mesonotum horizontal flat or concave, apical portion excavate.

i. Tibia of legs spinous beneath. Node of petiole, thick globose *C. sericeus*

Subfamily FORMICINAE Lepeletier

Tribe Camponotini Forel

Genus *Camponotus* Mayr10. *Camponotus (Tanaemyrmex) compressus*
Fabricius

1789. *Camponotus compressus* Fabricius, *Formica. Mant. Ins. 1* : 307 worker : Smith (*Formica*), *Cat. 6* : 13, worker, female, male.

1892. *Camponotus maculatus* Fabricius, race *compressus* Fabricius, Forel, *J. Bombay nat. Hist. Soc.*, **7** : 239 & 240.

1925. *Camponotus (Tanaemyrmex) compressus* Emery, *C. Gen. Insect*, Fasc. **183** : 98

Material examined : Mahesana district : 1 ex., R.S. coll., 18.03.1996; many exs., R.S. coll., 17.03.1986; 4 exs., R.S. coll., 20.02.1986. Junagadh district: 2 exs., R.S. coll., 31.08.1990. Vadodara district: 3 exs., R.K.S. coll., 05.01.1989. Jamnagar district: 2 exs., R.C.S. coll., 13.09.1975. Surendranagar district: 3 exs., R.C.S. coll., 02.03.1986. Junagadh district: 5 exs., R.C.S. coll., 27.09.1975; 10 exs., R.C.S. coll., 24.09.1975. Rajkot district: 15 exs., N.S.R. coll., 17.02.1990; 4 exs., R.S. coll., 07.09.1990. Sabarkantha district: 2 exs., R.N.B. coll., 06.11.1964. Himmatnagar district : 1 ex., N.S.R. coll., 18.02.1991.

Diagnostic characters : Length worker : 13 mm.

Worker : Black opaque. Head sub triangular, very broad posteriorly. Mandibles triangular with seven teeth. Clypeus medially vertically carinate. Alitrunk narrower than the head, anteriorly produced into a collar. Node of the petiole oval, transverse convex in front, flat posteriorly. Tibia of the legs prismatic. Abdomen broad and massive.

Distribution : India : Gujarat-Mahesana, Junagadh, Vadodara, Jamnagar, Surendranagar, Rajkot. Assam, Rajasthan, Shillong, Tripura, Andamans, Chandigarh, Karnataka, Tamil Nadu, West Bengal, Meghalaya, Maharashtra, Punjab, Orissa.

Elsewhere : Sri Lanka, Myanmar, Russia, Arabia, Africa.

Subfamily FORMICINAE Lepeletier

Tribe CAMPONOTINI Forel

Genus *Camponotus* Mayr11. *Camponotus (Dinomyrmex) angusticollis* Jerdon

1851. *Camponotus (Dinomyrmex) angusticollis*, Jerdon, *Madras Jour. Lit. Sc.* **17** : 120, (*Formica angusticollis*).

Material examined : Junagadh district: 5 exs., R.S. coll., 31.08.1990; 8 exs., R.S. coll., 31.08.1990. Rajkot district: 2 exs., N.S.R. coll., 13.02.1990. Mahesana district: 1 ex., R.N.B. coll., 09.08.1988.

Diagnostic characters : Length worker min. : 12 mm.

Worker : Black opaque. Head subtriangular mandibles with 6 teeth. Clypeus with a very prominent medial vertical carina. Alitrunk elongate constricted to form a collar. Node of the petiole thick, the front at base flat, above very convex, the upper margin transverse and notched, posteriorly flat and truncate, tibia of the legs prism shaped, abdomen oval and massive.

Distribution : India : Gujarat Junagadh, Rajkot, Mahesana. Rajasthan, Assam, Meghalaya, Maharashtra, Western and Central India, Karnataka, Kerala, Tamil Nadu.

Elsewhere : Myanmar

Subfamily FORMICINAE Lepeletier

Tribe Camponotini Forel

Genus *Camponotus* Mayr12. *Camponotus basalis* Smith

1878. *Camponotus basalis* Smith, *2nd Yark. Misc., Hym.* p. 9, pl. fig. 1, female.

1902. *Camponotus maculatus* Fabricius, race *lobinieri*, Forel, *Ann. Soc. Ent. Belge.* xivi : 287.

Material examined : Rajkot district : 15 exs., R.S. coll., 04.03.1986; 1 ex., R.N.B. Coll., 29.11.1990. Junagadh district: 15 exs., R.S. coll., 04.03.1986.

Diagnostic characters : Length worker maj. : 8 mm.

Worker : Head and abdomen brown, antennae, legs alitrunk and petiole reddish yellow, abdomen in front with a large reddish yellow stain. Head rectangular, with the angles rounded as broad posteriorly as in front. Mandibles broadly triangular with 6-7 teeth. Clypeus with a distinct medial carina. Antennae long, scape passing the top of one third of its length. Abdomen long and narrow. Node of petiole broader, flatter, rounded above. Abdomen very large and massive.

Distribution : India : Gujarat -Rajkot, Junagadh. Kashmir.

Subfamily FORMICINAE Lepeletier

Tribe Camponotini Forel

Genus *Camponotus* Mayr

13. *Camponotus (Tanaemyrmex) irritans* Fred Smith

1857. *Camponotus (Tanaemyrmex) irritans*, Fr. Smith, *Journ. Proc. Linn. Soc. Lond. Zool.* 2 : 55, worker.

Material examined : Rajkot district: 10 exs., R.S. coll., 07.09.1990; 1 ex., N.S.R. coll., 13.02.1990. Bhuj district: 2 exs., N.S.R. coll., 25.02.1989. Jamnagar district: 2 exs., R.N.B. coll., 25.11.1990. Ahmedabad district: 2 exs., R.S. coll., 21.02.1986; 2 exs., N.S.R. coll., 16.02.1991.

Diagnostic characters : Length worker maj. : 8-10 mm.

Worker : Head and abdomen dark castaneous brown, antennae, alitrunk petiole and legs honey yellow. Head subtriangular, very convex in front with 7 teeth, clypeus raised along the medial carina. Alitrunk longer, narrower more compressed in front, flat posteriorly. Node of petiole narrow, conical convex in front, flat posteriorly. Abdomen short and narrow.

Distribution : India : Gujarat-Rajkot, Jamnagar, Ahmedabad, Bhuj. Karnataka, Rajasthan.

Elsewhere : Sri Lanka, Malay Peninsula, Bangkok.

Subfamily FORMICINAE Lepeletier

Tribe Camponotini Forel

Genus *Camponotus* Mayr

14. *Camponotus (Orthonotomyrmex) sericeus* Fabricius

1798. *Camponotus (Orthonotomyrmex) sericeus* Fabricius, *Ent. Syst. Suppl.* 1798 : 279.

1892. Forel, *J. Bombay nat. Hist. Soc.*, 7 : 223 & 231, worker.

Material examined : Ahmedabad district: 3 exs., R.N.B. coll., 21.11.1991. Surat district: 1 ex., R.K.S. coll., 02.08.1989; 1 ex., R.K.S. coll., 09.02.1989; 7 exs., R.K.S. coll., 10.01. 1989. Valsad district: 1 ex., R.K.S. coll., 18.01. 1989; 1 ex., R.K.S. coll., 19.01.1989. Junagadh district: 5 exs., D.S.M. coll., 09.04.1969. Jamnagar district: 1 ex., V.C.A. coll., 09.03. 1966. Bharuch district: 2 exs., R.K.S. coll., 22. 01.1989; 1 ex., R.S. coll., 24.02.1988. Panchmahal district: 3 exs., N.S.R. coll., 19.10.1992. Mahesana district: 1 ex., N.S.R. coll., 25.02.1992.

Diagnostic characters : Length worker maj. : 10 mm.

Worker : Black with the head blood red in colour. Abdomen with a dense silky golden pubescence hiding the sculpture. Head very broad, emarginate posteriorly, mandibles with 5 teeth. The anterior border of clypeus emarginate in the middle. Alitrunk broad in front, strongly compressed posteriorly, emarginate at the meso-metanotal suture, the basal face of the metanotum horizontal, flat the sides margined posterior face excavate. Node of petiole rounded knob like. Abdomen very broad globose.

Distribution : India : Gujarat - Ahmedabad, Surat, Valsad, Mahesana, Junagadh, Jamnagar, Bharuch. Chandigarh, Karnataka, Tamil Nadu, West Bengal, Meghalaya, Maharashtra, Punjab, Orissa, Rajasthan.

Elsewhere : Myanmar, Sri Lanka, Africa.

Key to species of genus *Polyrhachis*

A. Thorax more or less rounded above the sides not margined along their whole length.

i. Pro and metanotum with a spine on each side, mesonotum unarmed. Node of petiole (without median spines) with two spines...*P. simplex*

B. Thorax more or less flat above the sides margined along their whole length.

- i. Pronotum with a short spine, metanotum with a spine on each side, mesonotum unarmed. Node of petiole quadrispinous, the spines typically sub equal *P. punctillata*
- ii. Pronotum and mesonotum unarmed metanotum with broad triangular spine on each side pointing backward. Node of petiole quadrispinous, the median spines slightly longer than the lateral ones *P. clypeata*

Subfamily FORMICINAE Lepeletier

Tribe **Camponotini** Forel

Genus *Polyrhachis* Smith

15. *Polyrhachis (Myrmhopla) simplex* Mayr

1862. *Polyrhachis (Myrmhopla) simplex* Mayr, Verh. zool.-bot. Ges. Wien. 13 : 682 worker.

1893. Forel, *J. Bombay nat. Hist. Soc.*, viii : pp. 26 & 34, worker, female.

Material examined : Bharuch district : 3 exs., R.S. coll., 26.02.1988; 2 exs., R.K.S. coll., 22.01.1989; 15 exs., R.S. coll., 27.02.1988. Ahmedabad district: 15 exs., R.S. coll., 23.02.1986. Junagadh district: 15 exs., R.S. coll., 02.03.1986. Bhavnagar district: 1 ex., N.S.R. coll., 25.01.1990. Amreli district: 2 exs., R.K.S. coll., 01.02.1989.

Diagnostic characters : Length worker : 4.5 mm.

Worker : Black, head and thorax punctured, granulate, abdomen opaque, pubescence almost entirely absent. Head broadly oval, clypeus with a distinct medial vertical carina, the anterior margin incised in the middle, antennal carinae wide apart. Alitrunk narrower than the head, compressed posteriorly, pronotum and mesonotum longer than broad; pronotal spines very short and thick, directed obliquely outwards; metanotal spines erect, slightly divergent, the apex slightly bent outwards, legs stout tibia without hairs. Node

of the petiole broader than long, biconvex, with two spines on the upper lateral angles and two obtuse teeth in the middle between them, abdomen short, very convex above, globose.

Distribution : India : Gujarat Bharuch, Ahmedabad, Junagadh, Bhavnagar, Amreli. Chandigarh, Tamil Nadu, Rajasthan.

Subfamily FORMICINAE Lepeletier

Tribe **Camponotini** Forel

Genus *Polyrhachis* Smith

16. *Polyrhachis (Myrma) punctillata* Roger

1863. *Polyrhachis (Myrma) punctillata* Roger, *Berl. ent. Zeitschr.* 7 : 152, worker, female.

1893. Forel, *J. Bombay nat. Hist. Soc.* vii : 19 worker.

Material examined : Surat district: 1 ex., R.K.S. coll., 10.01.1989. Valsad district : 1 ex., R.K.S. coll., 18.10.1989.

Diagnostic characters : Length worker : 5.5 mm.

Worker : Black opaque with a very short and sparse covering of pale erect hairs and a thin fine silky pubescence. Head oval, very little broader posteriorly than in front, clypeus medially carinate, antennal carinae moderately wide apart. Alitrunk broad, narrowed posteriorly laterally incised at the pro-meso and meso-metanotal sutures, the former suture distinct, the latter nearly obsolete, the lateral angles armed with a strong triangular tooth pointing outwards, angles each with a strong basal portion of metanotum trapezoidal, the lateral posterior angles each with a very short erect tooth. Apical portion of metanotum concave, legs slender, tibia smooth without spines. Node of petiole biconvex quadridentate, the teeth equidistant one from the other, abdomen broadly oval, very convex above.

Distribution : India : Gujarat Surat, Valsad. Meghalaya, Karnataka.

Elsewhere : Northwest Provinces, Myanmar, Pegu, Yoma, Southern Shan States, Sri Lanka.

Subfamily FORMICINAE Lepeletier

Tribe Camponotini Forel

Genus *Polyrhachis* Smith17. *Polyrhachis (Campomyrma) clypeata* Mayr

1862. *Polyrhachis (Campomyrma) clypeata* Mayr, *Veih zool.-bot. Ges. Wien* 2 : 683, worker.

1893. Forel, *J. Bombay nat. Hist. Soc.*, vii : 19 & 29 worker.

Material examined : Bharuch district : 2 exs., T.G.V. Coll., 01.02.1979; 1 ex., R.S. coll., 24.02.1986; 2 exs., R.S. coll., 24.02.1996. Valsad district : 8 exs., N.S.R. coll., 28.12.1980.

Diagnostic characters : Length worker : 6-7 mm.

Worker : Black, the mandibles, except the apex, and the legs red, the antennae dark fuscous red; the head; thorax and abdomen opaque. The whole insect covered with a very thin, fine, silky pile. Head short, very broad, almost as broad posteriorly as in front, clypeus with a well marked medial vertical carina and a distinct anteriorly produced rectangular lobe, the anterior margin of which is transverse and dentate, antennal carinae widely separate. Alitrunk broad anteriorly, gradually compressed and narrower towards the metanotum the sides vertical, the pronotum and mesonotum each broader than long, the former arched anteriorly; pro-meso and meso-metanotal sutures distinct and deeply impressed, basal portion of metanotum nearly square, the posterior lateral angles broadly turned upwards so as to form stout projection and making the upper surface of the metanotum concave the apical portion of metanotum nearly vertical, slightly concave. Node of petiole slightly biconvex armed with four short acute spines nearly equidistant from one another, the median spines nearly vertical pointing a little backwards and slightly longer than the lateral which point obliquely outwards and backwards, abdomen broadly oval.

Distribution : India : Gujarat - Bharuch, Valsad. Kerala, Bengal, Western India, Travancore.

Elsewhere : Sri Lanka.

Subfamily FORMICINAE Lepeletier

Tribe Prenolepidini Forel

Genus *Prenolepis* Mayr18. *Prenolepis aeta* Forel

1902. *Prenolepis aeta* Forel. *Ann. Soc. Ent. Belg.*, xivi : 202.

Material examined : Jamnagar district: 10 exs., N. S. R., 11.02.1990.

Diagnostic characters : Length worker : 2.5 mm.

Worker : Head and abdomen brownish yellow alitrunk, petiole and legs of dingy yellow, pilosity of pale yellow in colour. Head rectangular, the sides straight, posteriorly slightly emarginate. Mandibles finely sculptured, armed with 6 teeth. Clypeus polished and shining, convex, with the margin anteriorly slightly emarginate. Antennae long, 12-segmented, the scape passing beyond the top of the head by about one fourth of the length. Alitrunk the thoracic suture distinct but feeble the meso-metanotal suture slightly emarginate, metanotum slightly raised, the basal portion passing by a short and rounded curve to the apex. Petiole short, the node quadrangular, inclined forward. Abdomen round and gibbous in front with a shallow groove for reception of the node of petiole.

Distribution : India : Gujarat- Jamnagar. Sikkim, West Bengal (Darjeeling).

Subfamily FORMICINAE Lepeletier

Tribe Formicini Forel

Genus *Cataglyphis* Forster19. *Cataglyphis bicolor setipes* Emery

1894. *Myrmecocystus viaticus* race. *setipes* Forel, *A. Jour. Bombay nat. Hist. Soc.*, 8 : 401, male.

1925. *Cataglyphis bicolor setipes* Emery, *C. Genera Insect.*, Fasc. 183 : 266.

Material examined : Mahesana district : 3 exs., N.S.R. coll., 24.02.1992. Sabarkantha district: 4 exs., N.S.R. coll., 27.02.1992. Banaskantha district: 3 exs., N.S.R. coll., 26.02.1989; 5 exs., N.S.R. coll., 04.03.1989. Bhuj district: 1 ex.,

N.S.R. coll., 20.02.1992; 5 exs., N.S.R. coll., 04.03.1989. Dangs district: 1 ex., N.S.R. coll., 29.12.1980.

Diagnostic characters : Length worker : 10-12 mm.

Worker : Head, thorax, legs and node of petiole dark red, legs and abdomen black. Head quadrangular not emarginate posteriorly, mandibles comparatively large, strongly dentate, the apical tooth remarkably long, curved and acute. Three ocelli present. Alitrunk viewed from the side constricted in the middle, saddle shaped; pronotum convex, mesonotum long, narrow rounded above, metanotum short gibbous. Petiole one jointed, node rounded, not much raised. Abdomen oval.

Distribution : India : Gujarat Mahesana, Sabarkantha, Banaskantha, Bhuj, Dangs. Punjab, Central India, West Bengal, Delhi, Chandigarh, Rajasthan.

Elsewhere : Persia, North-eastern and Northern Africa, South Europe and Iran.

Subfamily FORMICINAE Lepeletier

Tribe **Oecophyllini** Forel

Genus **Oecophylla** Smith

20. **Oecophylla smaragdina** Fabricius

1775. *Oecophylla smaragdina* Fabr., *Syst. Ent.* : 828, female.

1894. Forel, *J. Bombay nat. Hist. Soc.*, 8 : 400.

Material examined : Junagadh district : Many exs., D.S.M. coll., 06.04.1969; 15 exs., N.S.R. coll., 29.01.1990; 4 exs., R.S. coll., 04.03.1986; 5 exs., N.S.R. coll., 02.02.1990; Many exs., R.S. coll., 04.09.1990; 20 exs., N.S.R. coll., 02.02.1990. Surat district: 3 exs., R.K.S. coll., 09.01.1989. Valsad district: 1 ex., R.S. coll., 09.03.1988; 4 exs., N.S.R. coll., 27.12.1980. Dangs district: 8 exs., R.K.S. coll., 16.03.1989. Banaskantha district: 5 exs., N.S.R. coll., 02.01.1978. Sabarkantha district: Many exs., N.S.R. coll., 07.03.1992.

Diagnostic characters : Length worker maj. : 9.5 - 11 mm. worker min. : 7 - 8 mm.

Worker : Rusty red. Head of maj. and min. relatively of the same size, roundly quadrangular, posteriorly not emarginate and slightly broader than in front. Mandibles long with masticatory margin very broad in proportion to length, dentate, the apical tooth acute and curved, clypeus strongly convex about two third as high as broad, its anterior margin strongly arched. Antennae 12-jointed originating from the anterior margin of the clypeus. Alitrunk elongate, pronotum convex, anteriorly narrowed into a collar, mesonotum constricted, narrow, saddle shaped. Metanotum rounded above, gibbous. Petiole elongate, incrassate in the middle scarcely nodiform. Abdomen short oval.

Distribution : India : Gujarat - Junagadh, Surat, Valsad, Dangs, Banskantha, Sabarkantha. Tamil Nadu, Karnataka, Kerala (Malabar), West Bengal, Andamans, Sikkim, Dehradun, N.W. Himalaya, Orissa, Calcutta, Assam, Chandigarh, Meghalaya, Maharashtra, Uttar Pradesh, Rajasthan.

Elsewhere : S. China, Malaya, New Guinea, Australia, Myanmar, Sri Lanka.

Subfamily FORMICINAE Lepeletier

Tribe **Plagiolepidini** Forel

Genus **Acantholepis** Mayr

21. **Acantholepis frauenfeldi** sub. sp. **bipartita** Forel (*bipartita* Indian Form)

1894. *Acantholepis frauenfeldi* subsp. *bipartita* Forel, *J. Bombay nat. Hist. Soc.*, 8 : 414, worker.

Material examined : Junagadh district: 25 exs., R.S. coll., 04.09.1990; 5 exs., R.S. coll., 01.09.1990; 1 ex., N.S.R. coll., 21.01.1990; 7 exs., R.S. coll., 03.09.1990; 15 exs., D.S.M. coll., 05.04.1969. Kachchh district: Many exs., N.S.R. coll., 11.03.1989. Ahmedabad district: 1 ex., N.S.R. coll., 14.02.1991; 2 exs., R.S. coll., 22.11.1986; 2 exs., R.S. coll., 28.02.1986. Jamnagar district: 2 exs., R.S. coll., 08.02.1990; 2 exs., V.C.A. coll., 06.03.1966; Many exs., R.S. coll., 27.08.1980; 5 exs., N.S.R. coll., 11.09.1990. Banaskantha district: 1 ex., N.S.R. coll., 20.02.1989. Sabarkantha district: 10 exs., N.S.R.

coll., 27.02.1992. Mahesana district: 10 exs., N.S.R. coll., 24.02.1992. Surendranagar district: 20 exs., R.S. coll., 02.03.1986. Rajkot district: 3 exs., R.S. coll., 08.09.1990; 20 exs., R.S. coll., 07.09.1990.

Diagnostic characters : Length worker : 3.5 mm.

Worker : Head brown, mandibles, antennae thorax, legs and node of petiole brownish yellow abdomen dark brown. Head distinctly longer than broad, rounded above, mandibles narrow, curved with the apical tooth long and acute, clypeus strongly convex, Scape of antennae remarkably long extending for more than half its length beyond the top of the head. Alitrunk - the pronotum in front above appears circular, the mesonotum strongly constricted in front forming a cylindrical neck, widening posteriorly, the metanotal teeth thick and broad at base, the meso-metanotal suture deep and distinct. Node of petiole pentagonal the upper border slightly emarginate. Abdomen oval.

Distribution : India : Gujarat - Junagadh, Kachchh, Ahmedabad, Jamnagar, Banaskantha, Sabarkantha, Mahesana; Surendranagar, Rajkot. Andhra Pradesh, West Bengal, Chandigarh, Karnataka, Meghalaya, Maharashtra, Punjab, Rajasthan.

Elsewhere : Southern Europe, North Africa.

Subfamily FORMICINAE Lepeletier

Tribe **Plagiopedini** Forel

Genus *Plagiolepis* Mayr

22. *Plagiolepis jerdoni* Forel

1894. *Plagiolepis jerdoni*, Forel, *J. Bombay nat. Hist. Soc.* 8 : 415 & 416, worker.

Material examined : Banaskantha district : 5 exs., N.S.R. coll., 17.02.1992.

Diagnostic characters : Length worker : 1.5 mm.

Worker : Brownish black, head smooth polished and shining. Head a little longer than broad, slightly emarginate posteriorly. Mandibles narrow, masticatory margin with five teeth, the apical tooth

long and acute. Antennae 11-jointed slender, scape extending slightly more beyond the top of the head. Alitrunk short and broad, pronotum large convex mesonotum from above circular, convex, meso-metanotal emargination well-marked, metanotum nearly as broad as the pronotum. Node of the petiole low transverse above, inclined to the front. Abdomen oval.

Distribution : India : Gujarat Banaskantha. Western India, Karnataka, Kerala, Rajasthan and Maharashtra.

Key to genera of the Subfamily Pseudomyrminae

1. Antennae 12 jointed. Posterior margin of clypeus not produced between bases of antennae *Tetraponera*

Key to species of the genus *Tetraponera*

- i. Ocelli present in worker *T. rufonigra*
- ii. Ocelli not present in worker *T. allaborans*

Subfamily PSEUDOMYRMECINAE Emery

Tribe **Pseudomyrmecini** Forel

Genus *Tetraponera* Smith

23. *Tetraponera (Tetraponera) rufonigra* Jerdon

1852. *Tetraponera (Tetraponera) rufonigra* Jerdon, (*Eciton*), *Madr. Jour. Lit. Sc.* 12 : 111.

1854. id. AM.N.H. (2) 13 : 33

1921. *Tetraponera (Tetraponera) rufonigra* Emery, *C. Gen. Insect. Fasc.*, 174 (A) : 23.

Material examined : Panchmahal district: 3 exs., T.G.V. coll., 23.01.1975. Junagadh district: Many R.S. coll., 30.03.1990. Surendranagar district: 2 exs., R.S. coll., 10.03.1986. Banaskantha district: 1 ex., R.N.B. coll., 29.12.1989; 2 exs., N.S.R. Coll., 22.02.1989; 2 exs., N.S.R. coll., 20.02.1992. Himmatnagar district: 2 exs., N.S.R. coll., 22.02.1989. Sabarkantha district: 3 exs., N.S.R. coll., 05.03.1992; 1 ex., N.S.R. coll., 23.02. 1992; 6 exs., N.S.R. coll., 24.02.1992. Mahesana district: 7 exs., R.S. coll., 17.03.1986. Gandhinagar district: 3 exs., N.S.R. coll., 23.02.1996.

Diagnostic characters : Length worker : 12 mm.

Worker : Head, 2nd joint of petiole black, the mandibles, antennae, thorax and 1st joint of the petiole more or less red. Head rectangular, a little longer than broad and slightly narrow in front than posteriorly. Mandibles with six teeth. Clypeus transverse, narrow raised in the middle which is slightly produced, giving the anterior margin a bisinuate appearance. Antennae short and stout, 12 segmented. Ocelli present. Alitrunk elongate, the pronotum broad its anterior lateral angles dentate, a medial, small longitudinal tubercle at its posterior margin, promesonotal suture arched to the front, mesonotum small flat, a deep emargination at the meso-metanotal suture. Metanotum longer than the pro and meso together. Petiole elongate, the 1st node oval with a long petiole, 2nd node conical with a short petiole.

Distribution : India : Gujarat Panchmahal, Junagadh, Surendranagar, Banaskantha, Mahesana, Gandhinagar, Sabarkantha. Tamil Nadu, Karnataka, Kerala, Tripura, Chandigarh, Punjab, Haryana, Uttar Pradesh, Himachal Pradesh, Meghalaya, Bengal.

Elsewhere : Sri Lanka, Myanmar, China, Singapore, Combdia, Indonesia (Java, Sumatra)

Subfamily PSEUDOMYRMECINAE Emery

Tribe Pseudomyrmecini Forel

Genus *Tetraponera* Smith

24. *Tetraponera (Tetraponera) allabarans* Walker

1854. *Tetraponera (Tetraponera) allabarans* Walker, *Ann. Mus. Nat. Hist.* 4 : 375, male, (*Pseudomyrma*).

Material examined : Junagadh district: 1 ex., R.S. coll., 01.03.1986. Sabarkantha district: 5 exs., N.S.R. coll., 05.03.1992. Bhuj district: Many exs., N.S.R. coll., 04.03.1989.

Diagnostic characters : Length worker : 5-6 mm.

Worker : Black, highly polished and shining, mandibles, antennae reddish yellow. Pilosity very sparse. Head rectangular, the posterior lateral

angles rounded. Mandibles broad, longitudinally striate with 5 or 6 teeth. Antennae short, stout with 12 segments. Alitrunk anteriorly flat, compressed, the pronotum, nearly square contracted anteriorly into a short neck, pro-mesonotal suture distinct but not emarginate, mesonotum longitudinally oval. Alitrunk in profile emarginate at the meso-metanotal suture, metanotum raised, convex, shortly compressed. Petiole with the nodes comparatively large, 1st node oval petiolate anteriorly, the 2nd node broader than the 1st node conical. Abdomen elongate, narrowly oval.

Distribution : India : Gujarat - Junagadh,, Bhuj, Sabarkantha. Karnataka, Tamil Nadu, Chandigarh, Meghalaya.

Elsewhere : Sri Lanka, Myanmar, Pegu, Yoma, Bhamo.

III Subfamily MYRMICINAE

Key to genera of Subfamily MYRMICINAE

A. Antennae with less than 12 joints.

- i. Antennae 11 jointed. Metanotum armed with two spines. Petiole attached to dorsal surface of abdomen *Crematogaster*
- ii. Antennae 9-jointed. Pronotum and metanotum armed with two teeth. Petiole attached to the middle of abdomen *Meranoplus*
- iii. Antennae 10-jointed. Metanotum unarmed. Petiole attached to the middle of abdomen. *Solenopsis*

B. Antennae 12-jointed

- i. Clypeus bicarinate *Monomarium*
- ii. Clypeus not bicarinate
 - a. Mandibles with or without teeth. Neuters or workers strongly dimorphous *Pheidole*
 - b. Mandibles with 5-7 teeth. Workers monomorphous *Tetramorium*
- C. Metanotum not swollen, metanotum bispinous. Head smooth shining with a few striae

anteriorly. Club of flagellum of antennae 3 jointed. Pronotum sculptured
..... *Crematogaster*

- i. Metanotal spines stout, acute, curved a little downwards and inwards *C. contemta*
ii. Metanotal spines slender, divergent straight not curved *C. subnuda*

Subfamily MYRMICINAE

Tribe *Crematogasterini* Emery

Genus *Crematogaster* Lund.

25. *Crematogaster contemta* Mayr

1878. *Crematogaster contemta* Mayr, Verh. zool.-bot. Ges. Wien, xxviii : 681 685, worker.

Material examined : Vadodara district : 2 exs., N.S.R. coll., 19.10.1982. Anand district: 4 exs., N.S.R. coll., 22.02.1991. Panchmahal district: 4 exs., N.S.R. coll., 22.01.1978. Sabarkantha district: 10 exs., N.S.R. coll., 06.02.1992; 5 exs., N.S.R. coll., 07.03.1992. Banaskantha district: 4 exs., N.S.R. coll., 22.01.1978.

Diagnostic characters : Length worker : 3.5 -4 mm.

Worker : Shining chestnut red, abdomen darkening posteriorly into dark brown, the base being chestnut red. Head very highly polished and shining, very globose and strongly convex in front, thick and narrow longitudinally striate at base, the masticatory margin with generally 4 teeth. Antennae 11 jointed the club formed of the apical three joints, Alitrunk the pronotum convex anteriorly with the lateral angles very prominent, mesonotum slightly oblique, longer than broad, meso-metanotal suture broad and very well marked, basal portion of metanotum slightly oblique steeply sloped, metanotal spines short acute, curved a little downwards and inwards and placed on the sides a little down the oblique sloping portion of the metanotum. Petiole-the 1st joint widened transversely concave and with a small rounded tubercle at apex above; 2nd joint short, longitudinally furrowed, the furrow widening posteriorly. Abdomen smooth, slightly shining.

Distribution : India : Gujarat Vadodara, Anand, Panchmahal, Sabarkantha, Banaskantha. Rajasthan; Bengal; Western India; Uttar Pradesh; Himachal Pradesh; Haryana; Chandigarh; Punjab.

Elsewhere : Myanmar.

Subfamily MYRMICINAE Lepeletier

Tribe *Crematogasterini* Emery

Genus *Crematogaster* Lund.

26. *Crematogaster subnuda* Mayr

1878. *Crematogaster subnuda* Mayr, Verh. zool.-bot. Ges. Wien., xxvii : 680 & 682, worker.

Material examined : Panchmahal district : 3 exs., T.G.V. COLL., 19.02.1975. Ahmedabad district: 4 exs., N.S.R. coll., 25.02.1991.

Diagnostic characters : Length worker : 3 -3.5 mm.

Worker : Dark chestnut red; the abdomen darkening posteriorly to fuscous black. Head smooth, square, angles rounded. Mandibles strong, thick and narrow, the masticatory margin with 4 teeth. Clypeus convex in the middle. Antennae long and slender, the scape reaching a little beyond the top of the head, the club of the flagellum formed of the last three joints, the apical two are much thick. Alitrunk the pronotum larger, rounded in front, subangular at the sides; pro-mesonotal suture distinct, the mesonotum small, slightly sloping posteriorly, mesometanotal suture well marked, the basal portion of metanotum rectangular sloping posteriorly, the metanotal spines short, and acute. Petiole 1st joint flat above not very wide, semicircular in front with the lateral angles obtuse, 2nd joint above longitudinally grooved forming two rounded tubercles with a transverse rounded tubercle at he apex., Abdomen broadly cordate.

Distribution : India : Gujarat Panchmahal, Ahmedabad. Chandigarh, Karnataka, Tamil Nadu, Assam, West Bengal, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Maharashtra.

Subfamily MYRMICINAE Lepeletier

Tribe **Meranoplini** Emery

Genus *Meranoplus* Fred, Smith

27. *Meranoplus bicolor* Guerin

1845. *Meranoplus bicolor* Guer. (*Cryptocerus*), *Cuv. Iconogr. Regne. Anim. Ins.* 7 : 425

1875. Smith, *Trans. Ent. Soc. Lond.* 1875 (34) : pl 1 figs. 1-3, worker, female, male.

1923. *Meranoplus bicolor* Emery. *Gen. Insect. Fasc.* 174 B : 228.

Material examined : Banaskantha district : 10 exs., V.C.A. coll., 14.10.1964.

Diagnostic characters : Length worker : 4-5 mm.

Worker : Head, alitrunk, legs and petiole of the abdomen bright ferruginous red abdomen black. Pilosity very long soft, abundant and of a grey colour. Head a little longer than broad, broader posteriorly than the front. Mandibles narrow armed with 4 teeth. Clypeus convex in the middle, inclined downwards. Alitrunk the pro-mesonotal shield about as broad as long with the anterior angles prominent and acute, the sides posteriorly with a small incision and beyond that produced, backwards into a long laminate spine on each side overhanging the metanotum, the latter, vertical, slightly convex with a carina on each side ending above in an acute spine. Petiole -the 1st node smooth, triangular 2nd node globose. Abdomen cordate.

Distribution : India : Gujarat Banaskantha. Rajasthan, Tamil Nadu, West Bengal, Punjab, Central India, Tripura, Chandigarh, Delhi, Karnataka.

Elsewhere : Nepal, Myanmar, Indonesia, Tenasserin.

Subfamily MYRMICINAE Lepeletier

Tribe **Solenopsidini** Forel

Genus *Solenopsis* Westwood

28. *Salenopsis geminata* Fabricius

1804. *Salenopsis geminata* Fabricius, *Syst. Piez.* 423, worker, (Atta).

Material examined : Valsad district: 2 exs., R.K.S. coll., 19.01.1989.

Diagnostic characters : Length worker : 3 -4.5 mm.

Worker : Reddish yellow, smooth and shining, the abdomen and borders of the mandibles marked with yellow. Head more or less square, posteriorly slightly emarginate. Mandibles 4-dentate apical tooth long and acute. Thorax pro-mesonotal suture obsolete, thorax seen in profile emarginate at meso- metanotal suture. Petiole 1st node squamiform, shortly petiolate, 2nd node seen from above oval, broader than long. Abdomen oval.

Distribution : India : Gujarat Valsad. Rajasthan, Karnataka, Tamil Nadu, Kerala, West Bengal, Punjab, Andamans.

Elsewhere : Sri Lanka; Philippines.

Key to genus of the Subfamily MYRMICINAE

Clypeus bicarinate. Club of flagellum formed of the apical three joints *Monomorium*

Key to species of Genus *Monomorium*

A. Head opaque

i. Seen from above 2nd node of petiole distinctly broader than 1st node.

a. Yellow, abdomen posteriorly black
..... *M. pharaonis*

b. Head, alitrunk and abdomen brown
..... *M. wroughtoni*

ii. Seen from above 2nd node of petiole not broader than 1st. Nodes subequal *M. indicum*

B. Head smooth and shining

a. Antennae 12-jointed, scape extending beyond top of the head *M. destructor*

b. Antennae 12-jointed, scape of antennae not extending beyond top of the head
..... *M. gracillimum*

C. Head striate

- i. Head entirely striate *M. scabriceps*
- ii. Anterior half or one-third of head striate.
 - a. Posterior half or two-third of head finely, closely, but not densely punctate
.....*M. criniceps*
 - b. Posterior half or two-thirds of head smooth, polished and shining*M. glabrum*

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr29. *Monomorium (Monomorium) pharaonis*
Linnaeus1758. *Monomorium (Monomorium) pharaonis* Linnaeus,
Syst. Nat. 1.*Material examined* : Banaskantha district: 15
exs., R.N.B. coll., 20.12.1989.*Diagnostic characters* : Length worker : 2.5
3 mm.

Worker : Reddish yellow, posterior two thirds of the abdomen black, shining. Head half as long again as broad, the sides slightly convex; the posterior margin transverse. Mandibles narrow, linear, slightly broadened at the masticatory margin with 3-4 teeth. Antennae long and thick, scape reaching nearly up to posterior margin of the head. Alitrunk - pro-mesonotum convex rounded in front and at the sides narrowing posteriorly, meso-metanotal suture very distinct, slightly emarginate metanotum seen from above rectangular, somewhat flat, the posterior lateral angles of the basal portion scarcely tuberculate. Petiole 1st node little thick and rounded at the top, anteriorly with a long petiole, 2nd node from above globose, slightly broader than long and broader than the 1st node. Abdomen oval, truncate anteriorly.

Distribution : India : Gujarat - Banaskantha. Karnataka, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Meghalaya.*Elsewhere* : New Britain, Oceania, Java, Sumatra, throughout our limits, spread over tropical region of both hemisphere.

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr30. *Monomorium (Monomorium) wroughtoni* Forel1902. *Monomorium (Monomorium) wroughtoni* Forel, *Rev. Suisse. Zool* 10 (1902) 209, worker.*Material examined* : Junagadh district: Many exs., N.S.R. coll., 02.02.1990. Banaskantha district: Many exs., R.N.B. coll., 20.12.1989.*Diagnostic characters* : Length worker : 2.0
mm.

Worker : Blackish brown with the abdomen dark brown. Abdomen opaque except at the base which is smooth and shining. Head longer than broad, narrow posteriorly, slightly emarginate. Mandibles narrow armed with 4 teeth. Antennae moderately long, the scape nearly reaching the top of the head. Alitrunk depressed sub-margined, the meso-metanotal suture distinct, basal portion of metanotum rectangular, apex truncate. Petiole 1st node conical, rounded above, anteriorly petiolate, the petiole thickening and sloping posteriorly, 2nd node globose broader than the 1st node. Abdomen broadly oval, truncate anteriorly, acute posteriorly.

Distribution : India : Gujarat Junagadh, Banaskantha. Rajasthan, Western India, Maharashtra.

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr31. *Monomorium (Xeromyrmex) indicum* Forel1902. *Monomorium salomonis* Linn. race *indicum* Forel, *Rev.Suisse Zool.* 10(1902) : 213.1922. *Monomorium (Xeromyrmex) salomonis*, sub sp. *indica*:
Emery, C., *Gen. Insect. Fasc.* 174 B (1922) : 178*Material examined* : Mahesana district: Many exs., R.S. coll., 16.03.1986. Ahmedabad district: 2 exs., R.S. coll., 22.02.1986; Many exs. R.S. coll., 20.02. 1986. Sabarkantha district: 6 exs., N.S.R. coll., 02.03.1992; 1 ex., N.S.R. coll., 29.02. 1992; 24 exs., N.S.R. coll., 06.03.1992. Rajkot

district: 3 exs., R.S. coll., 03.09.1990; 3 exs., N.S.R. coll., 13.02.1990. Bhuj district: Many exs., N.S.R. coll., 02.03. 1989. Banaskantha district: 2 exs., N.S.R. coll., 22.02.1989; 2 exs., N.S.R. coll., 20.02.1989. Kheda district: 3 exs., N.S.R. coll., 22.02.1991.

Diagnostic characters : Length worker : 3-3.5 mm.

Worker : Ferruginous red with abdomen dark brown. Head opaque almost as broad as long, broader anteriorly than posteriorly. Mandibles narrow with three to four teeth, when closed partially concealed under the projecting margin of the clypeus. Antennae moderately long, the scape not quite reaching the posterior margin of the clypeus. Alitrunk anteriorly rounded moderately broad, the meso-metanotal suture distinct, the basal portion of the metanotum broadening posteriorly. Petiole the nodes seen from above equal. The rounded 1st node higher than the 2nd node and petiolate anteriorly. Abdomen oval.

Distribution : India : Gujarat Mahesana, Ahmedabad, Sabarkantha, Rajkot, Bhuj, Banaskantha, Kheda. Rajasthan, Chandigarh, Karnataka, Andhra Pradesh, Tamil Nadu, Punjab, Maharashtra, Bengal.

Elsewhere : Myanmar.

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr

32. *Monomorium (Parholcomymex) destructor* Jerdon

1851. *Monomorium (Parholcomymex) destructor* Jerdon, *Madra. Jour. Lit. Sc.* 17 (1851) 105 worker, (Atta)

Material examined : Mahesana district: Many N.S.R. coll., 28.02.1992.

Diagnostic characters : Length worker : 1.8-2.3

Worker : Reddish yellow, apical three-fourth of abdomen from chestnut brown to dark brown. Head rectangular, slightly emarginate posteriorly. Mandibles narrow armed with 4 teeth; the apical

longest and acute. Antennae 12 jointed, the scape just reaching the top of the head. Alitrunk-elongate anteriorly as broad as the back of the head, the pro-metanotum convex, meso-metanotal suture deeply impressed, basal portion of metanotum narrow passing by the rounded curve into the apical portion. Petiole elongate the 1st node squami-form, anteriorly petiolate 2nd node globose, a little broader than long, not as high as the 1st node. Abdomen oval.

Distribution : India : Gujarat Mahesana. Karnataka, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Rajasthan.

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr

33. *Monomorium (Parholcomymex) gracillimum* Jerdon

1902. *Monomorium (Parholcomymex), var.-mayri* Forel, *Rev. Suisse. Zool.* 10 (1902) : 209, worker.

Material examined : Sabarkantha district: 24 exs., N.S.R. coll., 06.03.1992.

Diagnostic characters : Length worker : 2.5-3 mm.

Worker : Dark brown with the mandibles, antennae and legs pale yellow in colour. Abdomen with a patch of pale yellow at the base. Head convex, a little longer than broad, the posterior lateral angle rounded. Mandibles with the masticatory margin very oblique armed with four teeth. Antennae short slender the scape falling short of the top by one fourth of its length. Alitrunk narrower than the head, emarginate at the meso-metanotal suture, mesonotum convex, narrower anteriorly slightly convex apical portion obliquely truncate. Petiole 1st node conical rounded above, higher than the 2nd and anteriorly petiolate, 2nd node subglobose not broader than the 1st node. Abdomen oval.

Distribution : India : Gujarat Sabarkantha. Rajasthan, Tamil Nadu.

Elsewhere : Sri Lanka, North Africa, Arabia, Myanmar.

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr

34. *Monomorium (Holcomyrmex) scabriceps* Mayr

1878. *Monomorium (Holcomyrmex) scabriceps* Mayr, *Verh. zool.-bot. Ges. Wien*, 28 (1878) 627, (*Holcomyrmex*).

Material examined : Gandhinagar district: 2 exs., N.S.R. coll., 26.02.1991.

Diagnostic characters : Length worker : 3.5-7 mm.

Worker : Reddish ferruginous with the abdomen dark brown in colour. Head rectangular, sides straight, the posteriorly lateral angles rounded with a median impressed line. Mandibles very thick, much curved and masticatory margin indistinctly dentate. Antennae 12 jointed with the club formed of apical three joints. Pilosity very sparse. Alitrunk the pronotum narrower than the head, rounded anteriorly, the basal portion of the metanotum nearly as long as the pro-mesonotum, the posterior face of the metanotum obliquely truncate. Petiole the 1st node petiolate in front, higher than the 2nd node subtriangular, conical and rounded at the top; 2nd node subglobose, as broad as long. Abdomen broad, truncate anteriorly.

Distribution : India : Gujarat-Gandhinagar. Rajasthan, Karnataka, Tamil Nadu, Kerala, Punjab, Throughout India.

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr

35. *Monomorium (Holcomyrmex) criniceps* Mayr

1878. *Monomorium (Holcomyrmex) criniceps* Mayr, *Verh. zool.-bot. Ges. Wien*, 28 (1878) 672, (*Holcomyrmex*).

Material examined : Bhavnagar district: 8 exs., N.S.R. coll., 25.01.1990.

Diagnostic characters : Length worker : 3.5-5.5 mm.

Worker : Head and alitrunk chesnut brown, abdomen dark red. Head rectangular sides straight, posterior lateral angles rounded. Head striate anteriorly. Mandibles very thick, much curved,

the masticatory margin indistinctly dentate. Alitrunk-the promesonotum forming raised convexity, promesonotal suture obsolete, meso-metanotal suture distinct. The basal portion of the metanotum shorter than the promesonotum. Petiole the 1st node petiolate in front higher than the 2nd, sub-triangular, conical and rounded at the top, 2nd node sub-globose as broad as long, attached to the abdomen by the whole of its posterior face. Abdomen broad, truncate anteriorly.

Distribution : India : Gujarat Bhavnagar. Rajasthan, Western & Southern India, Chandigarh, Karnataka.

Elsewhere : Sri Lanka, Myanmar, Pegu, Yoma.

Subfamily MYRMICINAE Lepeletier

Tribe Solenopsidini Forel

Genus *Monomorium* Mayr

36. *Monomorium (Holcomyrmex) glabrum*

Ern. Andre

1883. *Monomorium (Holcomyrmex) glabrum* Ern. Andre, *Spec. Hym. Europe* 2 (1883) 345, (*Holcomyrmex*)

Material examined : Jamnagar district: 2 exs., R. S. coll., 23.08.1990. Junagadh district: 2 exs., R.S. coll., 01.09.1990; 3 exs., R.S. coll., 30.08.1990; 8 exs., R.S. coll., 30.08.1990.

Diagnostic characters : Length worker : 3.5-7.5 mm.

Worker : Brownish red to brownish black in colour. Pilosity more or less abundant. Head rectangular, sides straight, posterior lateral angles rounded and longitudinally striate. Mandibles very thick, much curved and masticatory margin indistinctly dentate. Alitrunk - the pro-mesonotum forming raised convexity, pro-mesonotal suture obsolete, mesometanotal suture distinct. Petiole 1st node petiolate in front higher than the 2nd node, sub triangular, conical and rounded at the top, 2nd node subglobose as broad as long, attached to the abdomen by the whole of its posterior face. Abdomen broad truncate anteriorly.

Distribution : India : Gujarat Junagadh, Jamnagar. Rajasthan, Western and Southern India, Tamil Nadu, Punjab.

Elsewhere : Sri Lanka, Myanmar.

Key to genus of the Subfamily *Myrmicinae*

1. Club of antennae formed of apical three joints which together are as long as the remainder of the flagellum. Antennae 12 jointed.....
.....*Pheidole*

Key to species of genus *Pheidole*

A. First joint of petiole with no projection beneath. Pro and mesonotum not forming a single convexity. Whole head sculptured.

- i. Frontal groove for reception of scape of antennae obsolete. Head including mandibles very large as long as or longer than alitrunk and petiole united*P. wroughtoni*
- ii. Frontal groove for reception of scape of antennae distinct. Abdomen finally striate at base*P. sulcaticeps*
- iii. Frontal groove for reception of scape of antennae distinct. Abdomen entirely smooth and shining*P. roberti*

Subfamily MYRMICINAE Lepeletier

Tribe **Pheidolini** Emery

Genus *Pheidole* Westwood

37. *Pheidole (Pheidole) wroughtoni* Forel

1902. *Pheidole (Pheidole) wroughtoni* Forel, *Rev. Suisse Zool* 19 (1902) : 176, 183, worker, female, male.

Material examined : Surendranagar district: 2 exs., N.S.R. coll., 18.08.1985. Banaskantha district: Many exs., R.N.B. coll., 20.12.1989. Bhavnagar district: 2 exs., R.S. coll., 11.09.1990. Jamnagar district: 3 exs., N.S.R. coll., 07.02.1990.

Diagnostic characters : Length worker : 5.5 - 6 mm.

Soldier : Head, alitrunk, petiole and the extreme base of the abdomen chestnut red, the rest of the abdomen, the mandibles and clypeus, dark brown or black. Body covered with soft erect hairs. Head proportionately very large rectangular, anteriorly longitudinally and coarsely, and

posteriorly on the lateral lobes transversely striate. Mandibles triangular, punctate. Clypeus medially slightly emarginate. No antennal groove. The scape of the antennae short not reaching quite half the distance between their insertion at the top of the head. Alitrunk transversely striate, anteriorly rounded and convex with no lateral tubercles, mesonotum with a transverse groove and posterior to it a transverse ridge, metanotum broad, base transversely striate posteriorly smooth, the metanotal spines short, stout, erect and acute. Petiole with the first node emarginated above with no appendix beneath, 2nd node transverse twice as long as broad, convex., Abdomen oval, opaque.

Distribution : India : Gujarat-Surendranagar, Banaskantha, Bhavnagar, Jamnagar. Western India, Karnataka.

Subfamily MYRMICINAE Lepeletier

Tribe **Pheidolini** Emery

Genus *Pheidole* Westwood

38. *Pheidole (Pheidole) sulcaticeps* Roger

1863. *Pheidole (Pheidole) sulcaticeps* Roger, *Berl. Ent. Zeitschr.* 7(1863) : 193, soldier, female, male.

Material examined : Bhavnagar district: 20 exs., N.S.R. coll., 25.01.1990. Jamnagar district: 4 exs., N.S.R. coll., 07.02.1990; 2 exs., R.N.B. coll., 11.02.1990; 2 exs., R.N.B. coll., 28.11.1990. Bhavnagar district: 2 exs., R.S. coll., 11.09.1990. Ahmedabad district: 10 exs., R.S. coll., 22.02.1986; 3 exs., N.S.R. coll., 16.02.1991; 2 exs., N.S.R. coll., 14.02.1991. Rajkot district: 1 ex., R.N.B. coll., 28.11.1990. Gandhinagar district: 2 exs., N.S.R. coll., 26.02.1991.

Diagnostic characters : Length soldier : 4.5 - 5 mm.

Soldier : Reddish brown, shining the head and abdomen darker than the alitrunk. Head rectangular as broad posteriorly as in front longitudinally striate, the striae curving laterally outwards and becoming transverse on the posterior lobes, a distinct transverse depression on the vertex, mandibles triangular smooth and shining, sparsely punctured. Clypeus smooth and slightly depressed in the middle, its anterior margin

incised. Antennal groove very well marked scape of the antennae not reaching quite half way from the insertion to the top of the head. Alitrunk transversely striate, anteriorly convex, the mesonotal transverse groove and ridge very distinct, the metanotum flat above, the metanotal spines short, erect, acute. Petiole the 1st node squamiform above, transverse not emarginate 2nd node transverse rounded above, opaque. Abdomen broadly oval.

Distribution : India : Gujarat : Bhavnagar, Jamnagar, Ahmedabad, Rajkot, Gandhinagar. Western India, Bengal, North-west Provinces.

Elsewhere : Sri Lanka.

Subfamily MYRMICINAE Lepeletier

Tribe *Pheidolini* Emery

Genus *Pheidole* Westwood

39. *Pheidole (Pheidole) roberti* Forel

1902. *Pheidole (Pheidole) roberti* Forel, *Rev. Suisse Zool.* 10 (1902) : 183, 198 female soldier.

Material examined : Rajkot district^{*} : 3 exs., N.S.R. coll., 28.11.1990. Surendranagar district : 3 exs., R.S. coll., 10.01.1986. Banaskantha district: 4 exs., V.C.A. coll., 16.10.1964

Diagnostic characters : Length soldier : 4.5 mm.

Soldier : Bright light red, the antennae legs, abdomen brownish yellow. Pilosity sparse and scattered. Head longitudinally striate, the striae breaking into reticulations posteriorly. Alitrunk transversely striate. Abdomen smooth and shining. Head longer than broad, the sides convex., Mandible triangular, smooth, polished and shining. Clypeus emarginate. Antennae short, the scape falling short of the top of the head by two third of its length. Alitrunk the pronotum without lateral tubercles, mesonotum slightly constricted, the transverse groove and ridge well marked. Metanotum narrow, the metanotal spines very long and acute. Petiole somewhat elongate the 1st node squamiform, 2nd node from above transversely oval. Abdomen oval.

Distribution : India : Gujarat : Rajkot, Surendranagar, Banaskantha. Meghalaya, Karnataka, Sikkim, Maharashtra, West Bengal.

Key to genus of Subfamily MYRMICINAE

1. Club of flagellum formed of the apical three joints which together are as long as the remainder of the flagellum. Antennae 11 or 12 jointed *Tetramorium*

Key to species of Genus *Tetramorium*

- i. Antennae 12 jointed. First node of petiole with an appendix beneath *T. rothneyi*
- ii. Antennae 12-jointed. First node of petiole without an appendix beneath *T. salvatum*

Subfamily MYRMICINAE Lepeletier

Tribe *Tetramoriini* Emery

Genus *Tetramorium* Mayr

40. *Tetramorium rothneyi* Forel

1902. *Rhoptromyrmex wroughtoni*, race *rothneyi*, Forel, *Rev Suisse. Zool. X* (1902), p. 232.

Material examined : Mahesana district: 6 exs., R.S. coll., 15.03.1986; 10 exs., N.S.R. coll., 23.02.1992.

Diagnostic characters : Length worker : 2-2.3 mm.

Worker : Brownish or darker yellow in colour. Head trapezoidal, very much broader posteriorly than in front, sub-opaque, densely longitudinally striate, reticulate between striae. Mandibles broad longitudinally striate at base, with 5-7 teeth. Abdomen 12 jointed, club formed of the apical three joints which together are as long as the remainder of the flagellum. Alitrunk-Pronotum broad anteriorly emarginate at the meso-metanotal suture, metanotum armed at the posterior lateral angles of its basal portion with two spines. Petiole the 1st node with a shorter appendix beneath, 2nd node a little broader than the 1st node. Abdomen oval.

Distribution : India : Gujarat -Mahesana. Karnataka, West Bengal, Western India, Maharashtra.

Elsewhere : Upper Myanmar.

SUMMARY

Subfamily MYRMICINAE Lepeletier

Tribe **Tetramoriini** Emery

Genus *Tetramorium* Mayr

41. *Tetramorium salvatum* Forel

1902. *Tetramorium salvatum* Forel, *Rev. Suisse. Zool.*, **10**
235, worker.

Material examined : Sabarkantha district: 8
exs., N.S.R. coll., 05.03.1992

Diagnostic characters : Length : 2.3-2.4 mm.

Worker : Reddish yellow in colour, abdomen
dark brown. Head rectangular a little broader
posteriorly than in front the sides convex.
Mandibles armed with 7 teeth. The eyes are large
and more convex., Antennae 11 jointed. Alitrunk

Pronotum broad anteriorly, not emarginate at
the meso-metanotal suture. Metanotal spines as
long as about two-thirds of the space between
them. First node of petiole as broad as long,
second node narrowed anteriorly, broadened
posteriorly. Abdomen convex.

Distribution : India : Gujarat Sabarkantha.
Rajasthan; North-west Himalayas, Western India.

The manuscript deals with 41 ant species
belonging to 20 genera of the family
Formicidae. The family Formicidae comprises
seven sub-families namely Ponerinae with two
genera and 4 species, Dorylinae with 1 genera
and 2 species, Aenictinae with 1 genera and 1
species, Dolichoderinae with 2 genera and 2
species, Formicinae with 7 genera and 13
species, Psuedomyrmecinae with 1 genera and
2 species and Myrmicinae with 6 genera and
17 species.

All the 41 species of ants are new records
from Gujarat.

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REFERENCE

- Ali T M. M. 1991. Ant Fauna of Karnataka -II *Newsl IUSSI* Indian Chapter, **5** : 1-3.
- Ali T. M. M. 1992. Ant Fauna of Karnataka II *Newsl. IUSSI* Indian Chapter, 1-9.
- Ali T. M. M. & Ganeshiah K. N. 1998. Mapping diversity on ants and root grubs *Current Science*,
75(3) : 201-204.
- Bharti, H. 2001. Checklist of Ants from North-West Indian I *Uttar Pradesh J. Zool*, **21**(2) : 183-187.
- Bingham C. T. 1903. *Fauna British India* (Hymenoptera) London, **2** : xix + 506, pl. 1.
- Bolton B. 1995. A taxonomical and zoogeographical census of the extant ant taxa (Hymenoptera :
Formicidae). *J. nat. Hist.* London, **29** : 1037-1056.
- Chapman, J. W. and Capco S. R. 1951. *Checklist of the Ants (Hymenoptera ; Formicidae) of Asia*.
Monograph of the Institute of Science and Technology, Manila, No. **I**, 327 pp.
- Chhotani, O. B. and Ray K. K. 1976. Fauna of Rajasthan, India, Hymenoptera. *Rec. zool. Surv. India*,
71 : 13-49.

- Chhotani O. B. and Maiti K. K. 1977. Contribution to the knowledge of Formicidae of the Andaman Island. *Newsl. Zool. Surv. India*, **3**(1) : 17-20.
- Gadagkar R., Nair P., Chandrasheker K & Bhat D. M. 1983. Ant species richness and diversity in some selected localities in Western Ghats, India. *Hexapoda* **5**(2) : 89-94.
- Mathew R. 1980. Description of a new species of Ant (Hymenoptera : Formicidae) from the Khasi Hills Meghalaya. *Oriental Insects* **14**(4) : 425 -427.
- Mathew R. 1983. Studies on the house hold pest (Hymenoptera : Formicidae) of Shillong. *Bull. Zool. Surv. India*, **5**(1) : 125-127.
- Mathew R. 1984. Some new records of Ants (Hymenoptera : Formicidae) from Tripura. *Bull. Zool. Surv. India*, **6**(1-3) : 307-308.
- Mathew R. & Tiwari R. N. 2002. Insecta : Hymenoptera : Formicidae. *State Fauna Series 4 : Fauna of Meghalaya*, Part 7 : 251-409. (Zool. Surv. India).
- Mathew R. 2000. Insecta : Hymenoptera : Formicidae. *State Fauna Series 7 : Fauna of Tripura*, Part 3 : 347-354 (Zool. Surv. India).
- Pajni H. R. and Suri R. K. 1978. First report on the Formicid Fauna (Hymenoptera) of Chandigarh. *Res. Bulletin (Science) Punjab University*, **29** : 5-12.
- Rastogi N., Nair P., Kolatkar M., William H & Gadagkar R. Ant Fauna of the Indian Institute of Science Campus Survey and some preliminary observations. *J. Indian Inst. Sci.* **77** : 133-140.
- Rastogi N., Nair P., Kolatkar M and Gadagkar R. 1997. Foraging strategies in the Ant *Myrmicaria brunnea* and *Diacamma ceylonensis*- Some preliminary observations. *Entomon.*, **22**(1) : 79-81.
- Roonwal M. L. 1972. Plant pest status of root eating ant *Dorylus orientalis* with notes on taxonomy, distribution and habits (Insecta : Hymenoptera). *J. Bombay nat. Hist. Soc.*, **72**(3) : 305-313.
- Rothney G. A. J. 1889. Notes on Indian ants. *Trans Ent. Soc. Lond.* **3** : 347-374.
- Sharma I. K. 1981. Notes on the Carpenter ant *Camponotus irritans* (Smith). *J. Bombay nat. Hist. Soc.*, **78**(3) : 616-617.
- Sunil Kumar M., Srihari K.T., Nair P, Varghese T. & Gadagkar R. 1987. Ant species richness of selected localities of Bangalore. *Insect Environment*, **3**(1) : 3-5.
- Tak N. 1995. Studies on Ants (Formicidae) of Rajasthan I. Jodhpur. *Hexapoda*, **7**(1) : 17-28.
- Tak N. 2000. Studies on Ants (Formicidae) of Rajasthan : II. Dungarpur. *Entomon*, **25**(1) : 47-54.
- Tak. N. 2000. Studies on Ants (Formicidae) of Rajasthan III. Banswara. *Entomon*, **25**(2) : 97-101.
- Tak N. & Rathore N. S. 1996. Ant (Formicidae) Fauna of Thar Desert : *Faunal Diversity in the Thar Desert : Gaps in Research* (Edited by Ghosh, Baqri and Prakash). Scientific publishers, pp. 271-279.
- Tak N. & Rathore N. S. 2001. Ant (Formicidae) Fauna of Desert National Park. In D.N.P. Project Report.
- Tak. N., Rathore N. S. & Kumar S. Insecta Hymenoptera. In Fauna of Pichola lake Wetland Ecosystem Series.
- Wroughton R. C. 1892. Our Ants. *J. Bombay nat. Hist. Soc.*, London, 13-60. b

ECHINODERMATA : CARINOIDEA, ASTEROIDEA, OPHIUROIDEA and ECHINOIDEA

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INTRODUCTION

Gujarat State has a long coast line of over 1,600 kilometres, the longest for any peninsular state of India, with varied habitats such as muddy, sandy, rocky, coral and mangrove habitats. In spite of a number of studies on these habitats, the echinoderm fauna of the state is poorly known because of lack of taxonomic approach to this very important group of marine organisms. The present report is based mainly on the extensive collections present in the Zoological Survey of India, Calcutta. To make the account as comprehensive as possible, it is supplemented by published reports and collections present in the Museum of the Gujarat Fisheries Aquatic Sciences Research Institute, Okha, formerly Marine

Biological Research Station of Gujarat State Fisheries and referred to as Okha Museum herein.

HISTORICAL REVIEW

The extensive cruises of R.I.M.S. *INVESTIGATOR* though covered the neighbouring Maharashtra and Pakistan coasts, made no collections from the coast of Gujarat. The first ever comprehensive account on the marine fauna of Gujarat coast by Hornell (1909, 1916) covering Okhamandal area, gives no taxonomic account of Echinodermata. Among the extensive collections of recent echinoidea in the British Museum (Natural History)

EARLIER REPORT		PROBABLE STATUS	
Gideon <i>et al.</i> (1957)			
	CRINOIDEA	<i>Troiometra</i> (sic;)	?
	ASTEROIDEA	<i>Palmipis</i> (sic;)	<i>Asterina</i> sp.
		<i>Astropecten</i>	<i>Astropecten</i> sp.
		<i>Asteria</i>	?
	ECHINOIDEA	<i>Temnopleura</i> (sic;)	<i>Temnopleurus toreumaticus</i> (Leske)
<i>Clypeaster</i>		<i>Peronella oblonga</i> Mortensen	
Gopalakrishnan (1971)			
	CRINOIDEA	<i>Antedon</i> sp.	<i>Euantedon</i> sp.
	ASTEROIDEA	<i>Pentaceros</i> sp.	?
		<i>Patiria</i> sp.	<i>Asterina</i> sp.
		<i>Anthenea</i> sp.	<i>Anthenea rudis</i> Koehler
		<i>Astropecten</i> sp.	<i>Astropecten vappa</i> (Mueller & Troschell)
	OPHIUROIDEA	<i>Ophiothrix</i> sp.	?
		<i>Macrophiothrix</i> sp.	<i>Macrophiothrix aspidota</i> (Mueller and Troschel)
		<i>Ophionereis</i> sp.	<i>Ophionereis dubia</i> (Mueller & Troschel)
	ECHINOIDEA	<i>Clypeaster</i> sp.	<i>Paronella oblonga</i> Mortensen

reported upon by Clark (1925), only one species, *Temnopleurus toreumaticus* (Leske) is represented by material from Gulf of Kutch (currently spelt as Kachchh). Later James (1969) listed three species from the area, namely the ophiuroid *Macrophothrix aspidota* (Mueller and Troschel) and the echionids *Salmacis bicolor* var. *rarispinus* L. Agassiz and *Temnopleurus toreumaticus* (Leske). The record of the ophiuroid *Ophioplocus imbricatus* (Mueller and Troschel) from 'West coast of India and Pakistan' in Clark and Rowe (1971) was based on material from 'Jamnagar Island, Bombay' (personal communication from A.M. Clark) evidently the current Gujarat State and erstwhile Bombay Province, most probably from Pirotan Island near Jamnagar. Subsequently, Soota and Sastry (1977, 1979) reported and commented upon two species of asteroids, *Echinaster luzonicus* (Gray) and *E. purpureus* (Gray) including material from Gulf of Kachchh. There are two more reports, Gideon *et al.*, (1957) and Gopalakrishnan, (1971) wherein some echinoderms of incomplete or doubtful identity were listed. Their probable status is mentioned in Table 1.

The holothurians reported include *Holothuria pardalis* by Gideon *et al.*, (1957), *H. paradalis* and *H. atra* by Gopaalkrishnan (1971). In addition, the report of Gopalakrishnan (1969) included exclusively five species of holothurians including the above two and James (1969) listed three species including one not reported by the former. Thus, the published accounts report with authenticity only two species each of Asteroidea, Ophiuroidea and Echinoidea and six species of Holothuroidea totalling to 12 species of Echinodermata from Gujarat coast. Supplementing with unpublished information available till then, the total number of echinoderm species from Gujarat was estimated at 15 in the review of Indian Echinodermata (Sastry, 1991). However, study of further material added many more species as given in the foregoing account.

LIST OF ECHINODERMATA (other than HOLOTHUROIDEA) of Gujarat

- Class CRINOIDEA
Order COMATULIDA
Family COMASTERIDAE
- *1. *Comanthus wahlbergii* (Mueller)
- Family MARIAMETRIDAE
- *2. *Lamprometra palmata* (Mueller)
*3. *Stephanometra indica* (Smith)
- Family ANTEDONIDAE
- **4. *Euantedon* sp.
- Class ASTEROIDEA
Order PAXILLOSIDA
Family LUIDIIDAE
- *5. *Luidia maculata* (Mueller and Troschel)
- Family ASTROPECTINIDAE
- *6. *Astropecten indicus* Doederlein
**7. *Astropecten vappa* (Mueller and Troschel)
- Order VALVATIDA
Family ASTERINIDAE
- *8. *Asterina burtoni* Gray
*9. *Asterina lorioli* Koehler
- Family GONIASTERIDAE*
- *10. *Anthenea rudis* Koehler
- Order SPINULOSIDA
Family ECHINASTERIDAE
11. *Echinaster luzonicus* (Gray)
12. *Echinaster purpureus* (Gray)
- Class OPHIUROIDEA
Order OPHIURIDA
Family AMPHIURIDAE
- * 13. *Amphiolus (Lymanella)* sp.
* 14. *Amphipholis squamata* (Delle Chiaje)

* Clark (1993. *Echinoderm Studies* Vol. 4 : 293-294) transferred the genus *Anthenea* from Goniasteridae to Oreastridae, while James (1997. *J. mar. biol. Ass. India*, 38(1996) : 133-138) synonymised *A. regalis* and *A. rudis* with *A. pentaginula* (Lamarck).

****15. *Amphiura ambigua* Koehler**

Family OPHIACTIDAE

****16. *Ophiactis brachyura* Doederlein*****17. *Ophiactis savignyi* (Mueller and Troschel)**

Family OPHIOTHRICIDAE

18. *Macrophiothrix aspidota* (Mueller and Troschel)***19. *Ophiothrix (O.) foveolata* Marktanner
Turneretscher**

Family OPHIONEREIDAE

***20. *Ophionereis dubia* (Mueller and Troschel)**

Family OPHIOCOMIDAE

***21. *Ophiocomella sexradia* (Duncan)**

Family OPHIODERMATIDAE

****22. *Ophiocormus compsus* (Clark)******23. *Ophiopeza fallax arabica* Clark**

Family OPHIURIDAE

24. *Ophioplocus imbricatus* (Mueller and Troschel)

Class ECHINOIDEA

Order TEMNOPLEUROIDA

Family TEMNOPLEURIDAE

25. *Salmacis bicolor* L. Agassiz**26. *Temnopleurus toreumaticus* (Leske)**

Order CLYPEASTEROIDA

Family CLYPEASTERIDAE

***27. *Clypeaster rarispinus* de Meijere**

Family LAGANIDAE

***28. *Peronella oblonga* Mortensen**

(* new to Gujarat; ** new to India)

2. Second brachial syzygy at 9+10
..... *Euantedon* sp.

Second brachial syzygy farther than 9+10 ... 3

3. P₂ stiff and erect with a pointed tip
..... *Stephanometra indica* (Smith)P₂ stiff only at the base, tapering to a flexible tip
..... *Lamprometra palmata* (Mueller)

Phylum ECHINODERMATA

Class CRINOIDEA

Order COMATULIDA

Family COMASTERIDAE

1. *Comanthus wahlbergii* (Mueller)1843. *Alecto wahlbergii* Mueller, *Arch. Naturges.*, 9 : 131.1986. *Comanthus wahlbergii* : Rowe *et al.*, *Zool. J. Linn. Soc.* 86 : 228.

Material examined : Okha Adatra Beach, ten specimens, Dr. H.C. Ray, 22.i.1953; two specimens, K.V. Surya Rao, 10.vii.1972; three specimens, K.N. Reddy, 5 & 6.iv.1977; Mandvi Rocks near Port area, one specimen, Dr. N.V. Subba Rao, 25.i.1992; Western side of Wharf wall, one specimen, Dr. N.V. Subba Rao, 27.i.1992.

Description : Centrodorsal large, overlying the radials, only corners of the radials visible. I Br of two ossicles, no syzygy; II Br of two or four ossicles with syzygy at 3+4; III Br of four ossicles with syzygy at 3+4. Arms 17 to more than 30. Pinnule combs extending to distal pinnules. Cirri XV, distal border of segments as large as the proximal, distal border swollen.

Distribution : India Gujarat, Andaman Is.*Elsewhere* : Indo-West Pacific shallow waters.

Family MARIAMETRIDAE

2. *Lamprometra palmata* (Mueller)1841. *Alecto palmata* Mueller, *J. Arch. Naturgesch.* 7 : 144.1971. *Lamprometra palmata* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 8 (distribution), 24 (key)**SYSTEMATIC ACCOUNT****Key to CRINOIDEA of Gujarat coast**

1. Pinnules soft and curving, with combs
..... *Comanthus wahlbergii* (Mueller)
At least the basal pinnules stiff and erect, no
combs 2

Material examined : Umbergaon (15 kilometres south of Daman) one specimen, B.P. Haldar, 12.ii.1978; Daman Nani Daman, 51 specimens, B.P. Haldar, 9.ii.1978; Devka, one specimen, B.P.Haldar, 10.ii.1978, Jampore, two specimens, B.P.Haldar, 11.ii.1978.

Description : Arms about 20. I Br and II Br of two ossicles each, no syzygy. First brachial syzygy at 3+4 and the second far beyond 10. Proximal pinnules stiff; P_2 largest, stout, stiff at base, tapering to a flexible tip. Cirri XX.

Remarks : A large number of specimens were found in small shallow puddles at low tide mark, crawling on the sandy bottom at Nani Daman beach of Daman on 9.ii.1978.

Distribution : India : Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Andamans.

Elsewhere : Arabian Sea to Hawaiian Islands.

3. *Stephanometra indica* (Smith)

1876. *Comatula indica* Smith, *Ann. Mag. nat. Hist.*, (4) 17 : 406.

1971. *Stephanometra indica* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 8 (distribution), 24 (key).

Material : Ajad Reef (Gulf of Kachchh) two specimens, R. Pravez, 13.iii.1985.

Description : Arms 25-30. I Br and subsequent Br Series of two ossicles, no syzygy. First brachial syzygy at 3+4, the second beyond 10. Proximal pinnules stiff and erect; P_1 slender with flexible tip, P_2 longest, stiff, spike like, following pinnules shorter with flexible tip. Cirri XX, 20.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : East Coast of Africa to South Pacific Islands.

Family ANTEDONIDAE

4. *Euantedon* sp.

Material : DIU : Fort area, three specimens, B.P. Haldar, 2.i.1990.

Description : Centrodorsal small, about 1.5 mm in diameter, hemispherical with irregularly alternating cirri. Cirri XXV, 13-18, longest about 8 mm. in length; proximal 2-3 segments as long as wide gradually becoming twice as long as broad; terminal claw as long as the penultimate segment, opposing spine short. Distal border of radials visible beyond the rim of the centrodorsal. Only I Br series present, two ossicles, no syzygy. Arms 10, about 25-30 mm long, brachial syzygies regularly at 3+4 and 9+10.

Pinnules appear to have lost the tips, P_3 is shorter and similar to succeeding pinnules; P_1 and P_2 appear to be not having more than 10-15 segments and the distal only about twice as long as broad.

Remarks : By elimination of disagreeing alternate characters and comparison with the diagnostic characters of other genera, the specimens are led to *Euantedon* in the key of Clark and Clark (1967) and to *E. tahitiensis* in the key of Clark and Rowe (1971). But in the two type specimens known of *E. tahitiensis*, the arms are 100 mm long and cirri XV, 22- 25 unlike in the present specimens. They appear to be closer to *E. paucicirra* with arms 40 mm long and cirri XXV, 17-26, but the P_1 is only slightly shorter than the cirri, while the P_1 as also P_2 appear to be much smaller than the cirri, about half the length.

Distribution : The genus is distributed from China, Philippines and Moluccas to South Australia and Society Islands. The genus has not so far been reported from India.

Key to ATEROIDEA of Gujarat Coast

1. Tube feet bluntly pointed, without a sucking disc; abactinal plates paxilliform 2
- Tube feet terminating in a sucking disc; abactinal plates not paxilliform 4
2. Superomarginal plates paxilliform, similar to abactinal plates; arms seven to nine
..... *Luidia maculata* (Mueller and Troschel)
- Superomarginal plates distinct from the paxilliform abactinal plates 3

3. Superomarginal plates relatively broader even at the interradius and are bare or at the most with granule like spinelets in a discontinuous series; arms tapering to a rounded tip
..... *Astropecten indicus* Doederlein

Superomarginal plates high and vertical at the interradius, gradually becoming broader than long on arms, with a stout spine on the inner margin at the interradius and shifting to outer margin from 3-5 plates; arms pointed or blunt, not rounded at tip
..... *Astropecten vappa* Mueller and Troschel

4. Marginal plates large forming a distinct border; actinal and abactinal plates covered by granulation *Anthenea rudis* Koehler

- Marginal plates not distinct; arms either cylindrical or with flat margins; at least the abactinal plates with spinelets 5

5. Arms short, triangular in shape with flat margins; abactinal plates closely imbricating; papular pores in regular series on arms 6

Arms long, cylindrical; abactinal plates in an open reticulum; papular pores not in regular series 7

6. Disc and arms thick, distinctly raised abactinally; R/r greater than 2/1; madrepoites two or more; arms usually more than five and unequal *Asterina burtoni* Gray

Disc and arms flat; R/r is 1.7/1 or less; madreporite single; arms five, equal
..... *Asterina lorioli* Koehler

7. Madreporites two or more; usually more than five unequal arms
..... *Echinaster luzonicus* (Gray)

Madreporite single; usually five subequal arms
..... *Echinaster purpureus* (Gray)

Class ASTEROIDEA
Order PAXILLOSIDA
Family LUIDIIDAE

5. *Luidia maculata* Mueller and Troschel

1842. *Luidia maculata* Mueller and Troschel, *System der Asteriden*, 77

1919. *Luidia maculata* : Fisher, *Bull. U.S. natn. Mus.* **100** (3) : 168.

1971. *Luidia maculata* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 30 (distribution) 43 (key)

Material : Poshitra Bay (Gulf of Kachchh) one specimen, Okha Museum.

Remarks : The species is characterised by paxilliform superomarginal plates similar to the abactinal plates; spiniform pedicellariae with 2-3 jaws in the superomarginal and adambulacral armature; 7-9 arms and tube feet without a sucking disc, terminating in a blunt tip.

The species was reported by Hoque (1970) from the adjoining Pakistan coast.

Distribution : India : Gujarat, Karnataka, Tamilnadu, Orissa, Andaman Islands.

Elsewhere : Persian Gulf to Philippines and Australia.

Family ASTROPECTINIDAE

6. *Astropecten indicus* Doederlein

1888. *Astropecten indicus* Doederlein, *Zool. Jb.*, **3** : 828.

1917. *Astropecten indicus* : Doederlein, *Siboga Exped. Monog.* **46 a** : 146 and 180

1971. *Astropecten indicus* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, **30** (distribution), 45 (key)

Material : Navi Bandar (three kilometres SE of Porbandar)- 29 specimens, Dr. G.C. Rao, 2.ix.1971.

Description : Arms five, equal, tips rounded. Abactinal paxillae small, closely packed, paxillar area 60-70 per cent of the width of the arm. Superomarginal plates broader than long, a little narrower at the interradius; no conspicuous superomarginal spines, sometimes with tubercle like spinelets of discontinuous series. Inferomarginal plates with a strong spine at the margin, a smaller spine and a pair of subequal spines adradially; actinal surface with short spinelets. Adamublacral plates with 3 spines in the furrow and 5-6 spines in the subambulacral

area. Madreporite single, small, nearer to interradial margin.

Distribution : INDIA Gujarat, Kerala, Tamilnadu, Andhra Pradesh, Orissa, West Bengal.

Elsewhere : Persian Gulf to East Indies.

7. *Astropecten vappa* Mueller and Troschel

1843. *Astropecten vappa* Mueller and Troschel, *Arch. f. Naturgesch.*, 9 (1) : 119.

1917. *Astropecten vappa* : Doederlein, *Siboga Exped. Monog.*, 46 a : 124

1971. *Astropecten vappa* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 30 (distribution) 45 (key)

Material. : Okha : Adatra Beach, two specimens, T.D. Soota, 25.xii.1954; one specimen, K.N. Reddy, 6.iv.1977; Beytislant Balapur Bay, 13 specimens, K.V. Surya Rao, 15.vii.1972; 15 specimens, K.N. Reddy, 7.iv.1977.

Description : Arms five, equal, tapering to a pointed or blunt tip; R = 25-129 mm, R/r = 3.2 to 5.8, R/br = 3.8 to 5.4, paxillar area 43 to 82 percent of arm breadth. Superomarginal plates narrow and high in the interradius, becoming broader than long on arms; a strong superomarginal spine on the inner edge of the plates in the interradius, shifting to outer margin from 4th or 5th plate and the series continuing up to the tip of the arm, some times absent on the 2nd or 2nd and 3rd plates, additional series of smaller spinelets may be present on the distal plates below the main series. Inferomarginal plates with a strong pointed spine at the outer margin and two unequal spines adradial to the marginal spine; actinal surface with smaller spinelets. Actinal plates two each on either side of the interradius. Adambulacral plates with three spines in the furrow and two unequal spines - the distal flat and larger, and two or three slender spines outer to these on the subambulacral area. Madreporite single.

Remarks : The species differs from *A. indicus* in having pointed arms and strong superomarginal series of spines, extending to the tip of the arms. In *A. indicus* the arms taper to a rounded tip and the superomarginal plates are bare or with only

ganule - like spinelets, and the series is discontinuous and not extending to the tip of the arms. In *A. polyacanthus* all the superomarginal plates are high and vertically alligned throughout the length of the arm.

In view of the variations encountered in the present series of specimens, Fisher's (1919) subspecies *inequalis* based on slender arms (R = 3.9 br), narrower paxillar area (0.4 - 0.50 br) and unequal subambulacral spines, is not satisfactorily distinguishable from the nominate subspecies.

The specimens were found burried in fine sand with a thin layer of overlying silt in small puddles at mid tide level. The stomach contents of a few specimens consisted of brachyuran crabs of the family Leucosiidae, the gastropods *Pyrene blanda* and *Nassarius pulla* and the bivalves *Laternula subrostrata*, *Paphia cor*, *Dosinia insularum* and *Tellina iridescens* inhabiting higher levels.

Distribution : India : Gujarat. The present report is the first from the Indian coast extending the distribution westwards into the Arabian Sea. It was earlier reported from Sri Lanka, East Indies, South China Sea, Philippines and Australia.

Order VALVATIDA

Family ASTERINIDAE

8. *Asterina burtoni* Gray

1840. *Asterina burtoni* Gray, *Ann. Mag. nat. Hist.*, 6 : 289.

1971. *Asterina burtoni* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 38 (distribution) 68 (key)

1991. *Asterina burtoni* : Sastry, *State Fauna Series. 2 : Fauna of Lakshadweep*, 370.

Material : VERAVAL Port area, four specimens, B.P. Haldar, 24.i.1978; SHIVRAJPUR (10 Kilometres North of Dwaraka) Rocky shore near Kachchigadh Light Housh, one specimen, Dr. N.V. Subba Rao, 8.ii.1992.

Description : R = 8-20 mm, R/r more than 2/1. Arms often six, flat on actinal side, thick abactinally. Abactinal plates imbricating with 6-12 short blunt tubercle like spinelets covering almost the entire plate, a few small intermediate plates

scattered. Papular pores single, in about 10 series, the middle ones extending farthest on the arm. Superomarginal plates with 6-8 longer spines. Actinal plates with 3-5 spines. Oral plates with 6-8 longer marginal spines and 2-4 shorter spines on the actinal surface. Adambulacral plates with 5-6 webbed spines in the furrow and 3-4 subambulacral spines. Madreporites two or more in the interradial adjoining the anal ring.

Remarks : The specimen from Shivrajpur (R = 20 mm) is sandy brown and five armed with two madreporites, while those from Veraval are six unequal armed with 3-5 madreporites.

Distribution : India : Gujarat, Lakshadweep, Tamilnadu, Andaman and Nicobar Islands.

Elsewhere : Persian Gulf to Hawaiian Islands.

9. *Asterina lorioli* Koehler

1910. *Asterina lorioli* Koehler, *Echinoderma of the Indian Museum*, Part VI : 129.

1971. *Asterina lorioli* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 38 (distribution), 67 (key)

Material : Veraval - Port area, one specimen, B.P. Haldar, 24.i.1978; Shivrajpur Rocky shore near Kachchigadh Light House, five specimens, Dr. N.V. Subba Rao, 8.ii.1992; Okha - Adatra Beach, one specimen, Dr. A. Daniel, 11.xi.1968; three specimens, K.N. Reddy, 5.iv.1977; Sikka Dead coral rubble east of Jetty, one specimen, B.P. Haldar, 23.i.1990; seven specimens, Dr. N.V. Subba Rao, 30.i.1992; Pirotan Island One specimen, B.P. Haldar, 25.i.1990.

Description : R = 10- 18 mm; R/r = 1.5 - 1.7. Arms five, equal, short, flat on actinal side, slightly raised abactinally. Abactinal plates imbricating, with 4-5 short blunt spinelets on each plate, associated with each papular pore, rest of the plate quite bare. Anal area marked by a circlet of elongated plates with spines. Madreporite single, close to the anal ring of plates. Papular pores single, 8-10 regular longitudinal series, the middle ones extending farthest on the arms. Superomarginal plates with 6-8 spines. Actinal plates with 3-5 spines. Oral plates with 6 spines on the margin and 4 on the actinal surface on

each side. Adambulacral plates with 5-6 webbed spines in the furrow and 3-4 spines on the subambulacral area.

Remarks : The specimens are generally dirty green when collected while a few are brownish red with dirty green patches at the tips of the arms.

Distribution : India : Gujarat, Maharashtra, Tamil Nadu, Andhra Pradesh.

Elsewhere : Arabian Sea and Bay of Bengal.

Family GONIASTERIDAE

10. *Anthenea rudis* Koehler

1910. *Anthenea rudis*, Koehler, *Echinoderma of the Indian Museum*, Part VI : 86.

1971. *Anthenea rudis* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 32 (distribution), 51 (key).

Material : Okha - Adatra Beach, one specimen, K.N. Reddy, 8.iv.1977.

Description : Arms five, equal, tapering to a blunt tip. Abactinal plates each with a single round tubercle, prominent on the five primary plates, continuing on the carinal series though smaller in size. Marginal plates conspicuous, forming a border along the arms and interradial areas. Actinal plates with elongate bivalved pedicellariae, prominent on the plates adjoining the adambulacrals. Adambulacrals with furrow spines and subambulacral spines in two series of inner and outer. Madreporite single. Tube feet terminating in a well developed sucking disc.

Distribution : India : Gujarat.

Elsewhere : Persian Gulf, Pakistan and Bay of Bengal.

Order SPINULOSIDA

Family ECHINASTERIDAE

11. *Echinaster luzonicus* (Gray)

1840. *Othilia luzonica* Gray, *Ann. Mag. nat. Hist.*, 6 : 282.

1979. *Echinaster luzonicus* : Soota and Sastry, *Rec. zool Surv. India*, 75 : 345.

Material : BEYT ISLAND Balapur Bay, one specimen, T.D. Soota, 31.xii.1954.

Description : R = 120 mm, r = 14 mm, br 14 mm. Arms six, subequal, cylindrical, Abactinal plates in an open reticulum with small blunt spines. Papular pores 2-3 in each area, no papular pores on the actinal side. Marginal plates not conspicuous. Adambul acral plates with long furrow spines and subam bulacral spines continuous only in the proximal part of the arm. Madreporites two. Tube feet in two series, terminating in a sucking disc.

Distribution : INDIA Gujarat, Tamilnadu, Andaman and Nicobar Islands.

Elsewhere : Arabian Sea to South Pacific Islands.

12. *Echinaster purpureus* (Gray)

1840. *Othilia purpurea* Gray, *Ann. Mag. nat. Hist.* 6 : 282.

1979. *Echinaster purpureus* : Soota and Sastry, *Rec. zool. Surv. India*, 75 : 343.

Material : Okha - one specimen, V.C. Agarwal, 12.iii.1966; Three miles South-East of Okha Port, one specimen, 22.i.1952; Beyt Island Balapur Bay, one specimen, T.D. Soota, 31.xii.1954.

Description : R = 140 mm in the specimen from Beyt Island and 95 mm in the other two specimens from Okha. Arms five, equal, cylindrical. Abactinal plates in an open reticulum with groups of small blunt spines. Papular pores in groups of 2-3 in each papular area, no papular pores on actinal side. Marginal plates not conspicuous. Adambulacral plates with furrow spines united with skin and subambulacral spines small and almost continuous. Madreporite single. Tube feet in two series, terminating in a sucking disc.

Remarks : Variations in the subambulacral spines and other characters in the above two species of *Echinaster* were dealt with in detail by Soota and Sastry (1979).

Distribution : India : Gujarat, Orissa.

Elsewhere : East coast of Africa to Bay of Bengal.

Key to OPHIUROIDEA of Gujarat Coast

1. A pair of prominent infradental papillae present 2
A single infradental papilla or a cluster or none 4
2. A wide space between the infradental papillae and the single distally located lateral papilla on each side *Amphiura ambigua* Koehler
Infradental papillae and lateral papillae forming a continuous series 3
3. Only two lateral papillae
..... *Amphipholis squamata* (Delle Chiaje)
Three lateral papillae
..... *Amphioplus (Lymanella)* sp.
4. Teeth square tipped; no infradental papillae, only distally placed lateral papillae 5
Teeth rounded or pointed, infradental papillae present, single or in a cluster; lateral papillae present or absent 6
5. Two lateral papillae on each side of the jaw; six or more rugose arm spines
..... *Ophiactis savignyi* (Mueller & Troschel)
A single lateral papilla on each side of the jaw; four or five smooth arm spines
..... *Ophiactis brachyura* Doederlien
6. Infradental papillae in a cluster 7
A single infradental papilla 9
7. Lateral papillae present, usually six armed ..
..... *Ophiocomella sexradia* (Duncan)
No lateral papillae, only five arms 8
8. Dorsal arm plates not more than twice as wide as long; a dark transverse band on the dorsal and ventral arm plates
..... *Ophiothrix (Ophiothrix) foveolata* -Marktanner Turneretscher
Dorsal arm plates more than twice as broad as long; no dark transverse bands on the arm plates
..... *Macrophiothrix aspidota* (Mueller and Troschel)
9. Arms inserted below the disc; arm spines distinctly projecting sideways; a pair of supplementary arm plates present
..... *Ophionereis dubia* (Mueller and Troschel)

- Arms fused to the disc; arm spines short and appressed to the arm; dorsal arm plates complete or much fragmented 10
10. Disc scales naked, no granulation; dorsal arm plates extensively fragmented, a single tentacle scale *Ophioplocus imbricatus* (Mueller and Troschel)
- Disc scales covered by fine granulation; dorsal arm plates entire, not fragmented, two tentacles scales 11
11. Disc granulation extending on arms
..... *Ophiocormus compsus* (Clark)
- Granulation restricted to disc plates, no granulation on arm plates
..... *Ophiopeza fallax arabica* Clark

Class OPHIUROIDEA

Order OPHIURIDA

Family AMPHIURIDAE

13. *Amphioplus (Lymanella)* sp.

Material : Beyt Island Balapur Bay, three specimens, K.N. Reddy, 13.iv.1977.

Description : Disc scales lost, arms long, dorsal arm plates with distal margin appearing trilobed. Oral papillae continuous, third larger than the fourth. Three arm spines. Two large tentacle scales.

Remarks : The key of Clark and Rowe (1971) leads the specimens to the couplet - 90 wherein two species *Aphioplus (L.) andrea* and *Amphioplus (L.) laevis* are separated by the nature of radial shields broad in the former and narrow in the latter. Unfortunately the disc in all the three specimens was lost during sieving of the large quantity of shell and gravel laden mud from the Balapur Bay. However the long arms suggest their probable identity with *A. (L.) laevis* (Lyman). One specimen in a similar condition was collected from the Sandheads, off Hughli River Mouth (Sastry, 1995, 1998).

14. *Amphipholis squamata* (Delle Chiaje)

1828. *Asterias squamata* Delle Chiaje, *Mem. anim. vert. Napoli*, 3 : 77.

1978. *Amphipholis squamata* : Cherbonnier and Guille, *Fauna de Madagascar*, 48 : 105.

1991. *Amphipholis squamata* : Sastry, *State Fauna Series 2 : Fauna of Lakshadweep*, 376.

Material : DIU Fort area, 20 specimens, B.P.Haldar, 26.i.1978; four specimens, B.P. Haldar, 2.i.1990; Nagoa, four specimens, B.P. Haldar, 29.i.1978; Fudam, one specimen, B.P. Haldar, 1.i.1990; VERAVAL Port area, two specimens, B.P. Haldar, 24.i.1978; Jaleswar, two specimens, B.P. Haldar, 8.i.1990; seven specimens, Dr. N.V.S. Rao, 13.ii.1992; HOLIDAY CAMP (4 kilometres from Chorwad) six specimens, B.P. Haldar, 7.i.1990; DWARAKA Rocky shore near Light House, two specimens, B.P. Haldar, 12.i.1990; six specimens, B.P. Haldar, 16.i.1990; OKHA Adatra Beach, one specimen, B.P. Haldar, 11.i.1990; Rocky shore near Arab Guest House, two specimens, Dr. N.V. Subba Rao, 4.ii.1992; NARARA BEYT (10 Kilometres from Vadinar) six specimens, Dr. N.V. Subba Rao, 31.i.1992.

Description : Disc diametre 0.5 to 2.8 mm. Disc covered with imbricating plates, larger and rounded at the centre, but the primary rosette not distinct. Radial shields D-shaped, slightly longer than broad, contiguous throughout. Arms five, about four times the disc diametre in length; dorsal arm plates broader and convex at the distal margin and narrow and rounded proximally. Ventral arm plates longer than broad, convex or straight distally. Lateral arm plates with three arm spines, slightly longer than the segment, uppermost the longest. Tentacles pores small, each with two tentacles scales.

Oral shields broader than long, pointed proximally; adoral shields meeting in front of the oral shields and separated radially by the ventral arm plates; oral plates with two prominent, rounded infradental papillae; lateral papillae two on each side, contiguous with the infradental papillae, distal papilla twice as broad as the proximal papilla.

Remarks : The species is very common in the bushy algal tufts, particularly coralline red algae. In one specimen of about one mm disc diametre, the centrodorsal plate is distinct, while in another of 2 mm disc diametre the centrodorsal as well as the primary rosette are distinct with intervening plates at the corners of the centrodorsal plate.

Distribution : India : Gujarat, Maharashtra, Lakshadweep, Tamilnadu.

Elsewhere : Nearly cosmopolitan in cold, temperate and tropical oceans from intertidal region to 500 m.

15. *Amphiura ambigua* Koehler

1905. *Amphiura ambigua* Koehler, *Siboga Exped. Monog.* 45 b : 39

1980. *Amphiura ambigua* : Clark, *Rec. Zool. afr.* 94 : 535.

Material : Dwaraka Rocky shore near light House, one specimen, Dr. N.V. Subba Rao, 6.ii.1992; Beyt Island Balapur Bay, one specimen, K.N. Reddy, 13.iv.1977; Hanuman Dandi, one specimen, B.P. Haldar, 18.i.1990.

Description : Disc diameter from 3 mm to 5 mm. Disc scales small, imbricating, relatively larger at the centre, much smaller on the ventral interradial disc. Radial shields long, narrow, at least three times as long as wide, converging distally, proximally separated by three rows of narrow elongate scales.

Arms about five times the disc diameter in length. Dorsal arm plates as broad as long, distal margin convex. Ventral arm plates with rounded distal margin, gradually becoming longer than broad. Lateral arm plates with six spines proximally, fewer distally, uppermost and lowermost longer, middle arm spines shorter and with distally pointed spinelet.

Oral shields longer than broad; adoral shields separate radially as well as interradially; oral plates with two prominent infradental papillae and one lateral papilla on each side located distally and separated widely from the infradental papilla. Tentacle pores with two tentacles scales.

Distribution : India : Gujarat.

Elsewhere : Seychelles Islands to Philippines and western Australia.

Family OPHIACTIDAE

16. *Ophiactis brachyura* Doederlein

1896. *Ophiactis brachyura* Doederlein, *Dansk. Ges. Jena*, 8:

1971. *Ophiactis brachyura* : Clark and Rowe, *Monograph*

of shallow water Indo-West pacific echinoderms, 82 (distribution), 104 (key).

Material : Veraval Jaleswar, 24 specimens, B.P. Haldar, 8.i.1990; Holiday Camp (4 kilometres from Chorwad) one specimen, B.P. Haldar, 7.i.1990.

Description : Disc diameter upto 2 mm. Disc scales large, naked, rarely upto three spines at each interradial margin. Radial shields distinct, as large as the disc plates. Arms mostly six, three times the disc diameter in length. Dorsal arm plates narrow proximally, convex and broader at distal margin. Lateral arm plates approximating on dorsal side and sometimes separating the dorsal arm plates, arm spines four proximally, fewer distally. Oral plates with square tipped teeth; no infradental papillae; a single distally placed lateral papilla.

Remarks : The specimens are greenish variegated with rusty brown patched on the disc and arms in the preserved state. Only one specimen from Veraval and the one from Holiday Camp are five armed while the rest are six armed. In the specimen from Holiday Camp, some proximal dorsal arm plates are elliptical, the rest being fan shaped as in the specimens from Veraval.

Distribution : India : Gujarat. The species is known till date only by the types from the Type Locality East Indies.

17. *Ophiactis savignyi* (Mueller and Troschel)

1842. *Ophiactis savignyi* Mueller and Troschel, *System der Asteriden*, 95.

1975. *Ophiactis savignyi* : Cherbonnier and Guille, *Fauna de Madagascar*, 48 : 125.

1991. *Ophiactis savignyi* : Sastry, *Fauna of States Series 2 : Fauna of Lakshadweep*, 376.

Material : Veraval - Rocky shore between Port and Light House, one specimen, K.V. Surya Rao, 24.ii.1979; two specimens, B.P. Haldar, 5.i.1990; Dwaraka - Rocky shore near Light House, six specimens, B.P. Haldar, 16.i.1990; Okha - Rocky shore near Arab Guest House, seven specimens, Dr. N.V. Subba Rao, 4.ii.1992; Pirotan Island - one specimen, Dr. A. Daniel, 16.xi.1968; Mandvi - Western side of Wharf wall, three specimens, Dr. N.V. Subba Rao, 27.i.1992.

Description : Disc diametre from 1.75 to 3.5 mm. Disc scales distinct, slightly imbricating spinelets on disc scattered, few centrally and more at the interradial disc margin. Radial shields large, contiguous only distally. Arms six, half discs with only three arms, up to seven times the disc diametre in length. Dorsal arm plates elliptical with a central lobe at the distal margin marked by two dark spots, one on either side. Arm spines six, uppermost longest and pointed, others shorter, stumpy and rogoe, lowermost shortest.

Oral shields longer than broad, bluntly pointed proximally. Adoral shields meeting radially between the ventral arm plates and also interradially in front of the oral shields. Oral plates with broad square tipped teeth. Lateral papillae two, scale like distally located.

Remarks : The specimens are of variegated green colouration. Complete specimens are six armed, some with three shorter arms. Half discs are three armed and some with three regenerating arms. They are rarely five armed.

Distribution : India : Gujarat, Maharashtra, Lakshadweep, Tamil Nadu, Orissa, Andhra Pradesh, Andaman Islands.

Elsewhere : Tropical Atlantic, Indian and Western Pacific Oceans.

Family OPHIOTHRICIDAE

18. *Macrophiothrix aspidota* (Mueller and Troschel)

1842. *Ophiiothrix aspidota* Mueller and Troschel, *System der Asteriden*, 115

1971. *Macrophiothrix aspidota* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 82 (distribution), 114 (key)

Material : Okha - Adatra Beach, six specimens, K.V. Surya Rao, 10.viii.1972.

Description : Disc scales covered by granular stumps; radial shields large, naked. Arms about 6-8 times the disc diametre in length. Dorsal arm plates more than twice as broad as long, lateral portions of distal margin bent backwards so that the broadest region of the plate is at about 2/3 the plate length, distal

margin convex. Ventral arm plates broader than long, distal margin straight. Arm spines long, four times as long as the length of the segment, lowest spines on distal arm segments with a well developed hook like tooth at the tip and 2-4 smaller ones proximal to it. Oral plates with a cluster of only infradental papillae, no lateral papillae.

Distribution : India : Gujarat, Maharashtra, Kerala, Tamilnadu.

Elsewhere : Arabian Sea to East Indies.

19. *Ophiiothrix (Ophiiothrix) foveolata* Marktanner-Turneretscher

1887. *Ophiiothrix foveolata* Marktanner-Turneretscher, *Ann. Naturh. Mus. Wien.*, 2 : 313

1971. *Ophiiothrix (Ophiiothrix) foveolata* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 84 (distribution), 110 (key)

Material : Pirotan Island two specimens, Dr. A. Daniel, 16.ix.1968.

Description : Disc scales distinct, with scattered spiny stumps; radial shields almost naked with only a few stumps at the proximal end. Dorsal arm plates fan shaped, proximal margin narrow and straight, distal margin broader and convex, a transverse dark band across the middle of the plate. Arm spines about three times as long as the segment. Oral plates with a cluster of infradental papillae, no lateral papillae.

Distribution : India : Gujarat, Andaman Islands.

Elsewhere : East coast of Africa to Philippine Islands.

Family OPHIONEREIDAE

20. *Ophionereis dubia* (Mueller and Troschel)

1842. *Ophiolepis dubia* Mueller and Troschel, *System der Asteriden*, 94.

1953. *Ophionereis dubia* : Clark, *Proc. zool. Soc. Lond.* 123 : 83:

1971. *Ophionereis dubia* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 88

(distribution), 122 (key).

Material : SIKKA Dead coral bed east of Jetty, one specimen, B.P. Haldar, 22.i.1990; PIROTAN ISLAND two specimens, Dr. A. Daniel, 16.xi.1968; two specimens, K.N. Reddy, 20.iv.1977.

Description : Disc diameter is 5 mm. Disc scales fine, imbricating, radial shields narrow, 3-4 times as long as broad, widely separated. Arms five, about 7 times as long as the disc diameter. Dorsal arm plates broader than long, narrow and convex distally, two supplementary arm plates one on either side in the distal corners. Ventral arm plates longer than broad, distal margin rounded. Lateral arm plates with three spines, longer than the segment.

Oral shield slightly broader than long, rounded proximally, distally and laterally. Adoral shields narrow, approximating closely in front of the oral shields, separated radially by the ventral arm plates. A single median infradental papilla and five lateral papillae. Tentacle scale single, slightly elongate.

Remarks : The specimens have dark reticulate lines on the disc, transverse bands on arms and a dark spot on the oral shields.

Distribution : India : Gujarat, Maharashtra, Tamilnadu, Andaman Islands.

Elsewhere : East Africa to Philippines and north Australia.

Family OPHIOCOMIDAE

21. *Ophiocomella sexradia* (Duncan)

1887. *Ophiocnida sexradia* Duncan, *J. Linn. Soc. Lond. (Zool.)*, 21 : 92.

1978. *Ophiocomella sexradia* : Cherbonnier and Guille, *Faune de Madagascar*, 48 : 178.

1991. *Ophiocomella sexradia* : Sastry, *Fauna of States Series 2 : Lakshadweep*, 382.

Material : Dwaraka Rocky shore near Light House, one specimen, B.P. Haldar, 12.i.1990; three specimens, B.P. Haldar, 16.i.1990; five specimens, Dr. N.V. Subba Rao, 6.ii.1992; Okha - Rocky shore

near Arab Guest House, three specimens, Dr. N.V. Subba Rao, 4.ii.1992.

Description : Disc diameter 3-5 mm. Disc scales imbricating, covered by granules rounded at the centre of the disc, and longer than wide at the periphery, extending to ventral interradial disc area. Arms six, about 3-4 times as long as the disc diameter. Dorsal arm plates narrow proximally, rounded laterally and wider distally. Ventral arm plates with distal margin concave and rounded at corners. Lateral arm plates with four arm spines proximally, uppermost or the next longer, distally three subequal spines. Oral plates with about five infradental papillae. Lateral papillae four on each side of the jaw. Tentacle scale single.

Remarks : Among the specimens from Dwaraka, three are half discs with three arms each and another is five armed of which two are short regenerating arms. Some of the first tentacle pores have two tentacle scales.

Distribution : India : Gujarat, Lakshadweep, Tamilnadu, Andaman Islands.

Elsewhere : East coast of Africa to Hawaiian Islands.

Family OPHIODERMATIDAE

22. *Ophiocormus compsus* (Clark)

1968. *Ophiostegastis compsus* Clark, *Bull. Br. Mus. nat. Hist. (Zool.)*, 16 : 317.

1971. *Ophiostegastis compsus* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echienedermis*, 90 (distribution), 127 (key).

Material : Sikka Dead coral bed east of Jetty, one specimen, Dr. N.V. Subba Rao, 30.i.1992.

Description : Disc diameter 11 mm. Disc scales covered by fine granulation continuing on ventral interradial up to the distal border and around the oral shields; interradial marginal plates slightly convex. Arms five, tips broken beyond 35 mm. Dorsal arm plates broader than long with a notch at the centre of the distal margin; proximal plates covered by the continuing disc granulation, only around the plates from 3rd or 4th plate; distal

plates becoming triangular. Ventral arm plates with concave lateral margins. Lateral arm plates with about 10 short appressed spines.

Oral shields without granule covering, triangular with a deep depression at the centre, separated from adoral shields by granulation. Adoral shields small, covered by granulation. Oral plates granule covered. Lateral papillae 9-10, conical proximally and rectangular distally. Tentacle pores with two tentacle scales.

Remarks : The arms have dark bands of 3-4 segment width separated by 10 paler segments. The specimens were collected from the dead coral habitat in a muddy beach similar to the type locality.

Based on Clark's (1915) description, Matsumoto (1917) considered *Ophiocormus* Clark, 1915 to be synonymous with *Ophioconis* Luetken having a single tentacle scale. Subsequently, Murakami (1944) described *Ophiostegastus* with two tentacle scales. Fell (1960) finding the holotype of the type species *Ophiocormus notabilis* Clark, 1915 to be having two tentacle scales, revived *Ophiocormus* Clark, 1915 from the synonymy of *Ophioconis* Luetken and relegated *Ophiostegastus* Murakami, 1944 to the synonymy of *Ophiocormus* Clark, 1915. While assigning her new species to *Ophiostegastus*, Clark (1968) probably overlooked these changes. Hence the species is here referred to *Ophiocormus* revived by Fell (1960).

Distribution : India : Gujarat. The species is known so far only by the type specimens from Qudhaibiya Bay, Bahrein, Persian Gulf.

23. *Ophiopeza fallax arabica* Clark

1968. *Ophiopeza fallax arabica* Clark, *Bull. Br. Mus. nat. Hist. (Zool.)*, 16 : 313.

1970. *Ophiopeza fallax* : Hoque, *Rec. zool. Surv. Pakistan*, 1 (2) : 29 and 35 [non : Peters, 1851].

Material : Pirotan Island one specimen, Dr. A. Daniel, 16.xi.1968.

Description : Disc diameter 10 mm. Disc scales and radial shields covered by fine granulation excepting one marginal plate in each interradius

and three plates at the base of each arm which are naked. Arms five, longest intact arm broken at 7 mm from the disc margin and longest broken arm bit is 20 mm long. Dorsal arm plates broader than long, narrowed proximally with distal margin broader and convex, proximal margin becoming much narrower towards distal part of the arm. Ventral arm plates longer than wide, narrowed proximally and concave laterally. Lateral arm plates with 10 appressed spines.

Oral shields somewhat triangular, naked, no supplementary plate. Adoral shields naked, close to the oral shield, long and triangular. Oral plates covered by granulation. Lateral papillae 9-10, proximally small and conical, becoming larger and rectangular distally. Tentacle pores with two tentacle scales.

Remarks : In the present specimen the radial shields are granule covered as in the specimens of the nominate subspecies of *O. fallax* Peters from Madagascar (Cherbonnier and Guille, 1978). However, the disc plates at the interradial margin and at the base of the arms are naked and there is no supplementary oral shield resembling the subspecies *O. fallax arabica* Clark. In spite of the variations in these characters, Clark (1968) referred the northern specimens from Persian Gulf and the nearby Pakistan coast to the subspecies *arabica*. In view of the naked disc scales and the prominent marginal plates, the present specimen is referred to *arabica*.

The Pakistan specimens from Bulejee Village, Karachi, reported as *Ophiopeza fallax* by Hoque (1970) were referred already by Clark (1968) to subspecies *arabica*.

Distribution : India : Gujarat.

Elsewhere : Earlier known only from Persian Gulf (Type Locality) and Pakistan.

Family OPHIURIDAE

24. *Ophioplocus imbricatus* (Mueller and Troschel)

1842. *Ophioplocus imbricatus* Mueller and Troschel, *System der Asteriden*, 93

1971. *Ophioplocus imbricatus* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 90

(lí str but on), 128 (key)

1978. *Ophioplocus imbricatus* : Cherbonn er aní Gu lle, .Faune de Madagascar, 48 : 239.

Material : Okha Adatra Beach, two specimens, K.V. Surya Rao, 10.viii.1972; two specimens, K.N. Reddy, 5.iv.1977; beyt Island Hanuman Dandi, one specimen, K.N. Reddy, 8.iv.1977; SIKKA- four specimens, V.C. Agarwal, 4.iii.1966.

Description : Disc scales small, imbricating; radial shields slightly larger than disc scales, well separated. Arms five; dorsal arm plates fragmented into numerous pieces. Arm spines erect. Oral Papillae five on each side. Tentacle pores with a single tentacle scale.

Distribution : India Gujarat, Tamilnadu, Andaman and Nicobar Islands.

Elsewhere : East coast of Africa to Hawaiian Islands.

Key to Echinoidea of Gujarat Coast

1. Form globular on aboral side and flat on oral side; periproct within the apical system at the aboral pole; ambulacral pore pairs in arcs of three 2
Form flat on both aboral and oral sides; periproct in the posterior interambulacrum on the oral side; ambulacral pore pairs forming expanded petaloids on the aboral side, not in arcs 3
2. Test plates with only sutural pores at the angles; primary tubercles faintly crenulate; spines short, banded with bright red
..... *Salmacis bicolor* L. Agassiz.
Test plates with deep transverse pits; primary tubercles strongly crenulate; spines banded with olive green and rusty red
..... *Temnopleurus toreumaticus* (Leske)
3. Ambulacral petaloids with alternating primary and demi plates; test rounded pentagonal, as long as broad; five genital pores; periproct close to and abutting the posterior margin of the test
..... *Clypeaster rarispinus* de Meijere

Ambulacral petaloids with only primaries; test oblong, longer than broad; four genital pores; periproct well separated from the posterior margin of test by its own length or more
..... *Peronella oblonga* Mortensen

Class ECHINOIDEA

Order TEMNOPLEUROIDA

Family TEMNOPLEURIDAE

25. *Salmacis bicolor* L. Agassiz

1841. *Salmacis bicolor* L. Agassiz *Mon. Ech. Anat. Echinus*, 8

1925. *Salmacis bicolor* : H.L. Clark, *A. catalogue of recent sea-urchins (Echinoidea) in the collection of the British Museum (Natural History)*, 84

1971. *Salmacis bicolor* : Clark aní Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 140 (lí str but on), 156 (key)

Material : Gulf of Kachchh one specimen in the Okha Museum.

Remarks : The species is characterised by shallow gill slits, primary spines banded with red, a primary tubercles on each ambulacral plate, pore pairs in arcs of three, primary tubercles faintly crenulate and angular pores at the corners of test plates.

Distribution : India : Gujarat, Karnataka, Tamilnadu, Andhra Pradesh, Orissa, Andaman Islands.

Elsewhere : East coast of Africa to Philippine Islands.

26. *Temnopleurus toreumaticus* (Leske)

1778. *Cidaris toreumatica* Leske, *Add. ad Klein*, 155

1925. *Temnopleurus toreumaticus* : H.L. Clark, *A catalogue of recent sea urchins in the collection of the British Museum (Natural History)*, 82

1971. *Temnopleurus toreumaticus* : Clark aní Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 142 (lí str but on), 154 (key).

Material : Some broken pieces of dead tests from Balapur Bay of Beyt Island and Jampore Beach of Dama.

Remarks : The broken pieces of dead tests appear to be definitely of *Temnopleurus toreumaticus* as can be inferred by the strongly crenulate primary tubercles and deep transverse pits at the corners of the test plates. There is a specimens in the Okha Museum which can be identified with this species and said to have been collected from Gulf of Kachchh. It was earlier reported from Gulf of Kachchh by Clark (1925) and James (1969).

Distribution : India : Gujarat, Maharashtra, Tamilnadu, Andhra Pradesh, Orissa, West Bengal, Andaman and Nicobar Islands.

Elsewhere : East coast of Africa to South Pacific Islands.

Order CLYPEASTEROIDA

Family CLYPEASTERIDAE

27. *Clypeaster rarispinus* de Meijere

1903. *Clypeaster rarispinus* de Meijere, *Tijdschr. ned. dierk. Vereen.*, (2) 8 : 7

1971. *Clypeaster rarispinus* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 144 (distribution), 160 (key)

Material : Off Porbandar, 23-22 m. eight specimens, K.N. Reddy, 2.iv.1977.

Description : Test pentagonal, as long as wide, corners rounded; apical system slightly raised, margin thick. Petaloid area 0.56 of test length, petaloids with alternating primaries and demiplates. Peristome central, deeply sunk, oral furrows prominent upto the test margin. Anus on the oral side in the posterior interambulacrum, close to the posterior margin. Spines few, well spaced, often rubbed off in the preserved specimens. Genital pores five. Naked tests show a dark reticulation and spots.

Distribution : India : Gujarat, Karnataka, Lakshadweep Sea, Kerala, Tamilnadu, Andhra Pradesh, Orissa, West Bengal.

Elsewhere : Persian Gulf and East coast of Africa to East Indies.

Family LAGANIDAE

28. *Peronella oblonga* Mortensen

1948. *Peronella oblonga* Mortensen, *Vidensk. Meddel. dansk naturh. Foren.* 111 : 71.

1948. *Peronella oblonga* : Mortensen, *A monograph of the Echinoidea*, IV (2) : 299.

1971. *Pronella oblonga* : Clark and Rowe, *Monograph of shallow water Indo-West Pacific echinoderms*, 144 (distribution), 162 (key).

Material : Beyt Island Balapur Bay, one specimen, Dr. A. Daniel, 12.xi.1968; six specimens, K.V. Surya Rao, 15.viii.1972; one specimen, K.N. Reddy, 7.iv.1977; three specimens, K.N. Reddy, 8.iv.1977; 31 specimens, K.N. Reddy, 13.iv.1977; Sikka one specimen, Dr. B.H.Patel; Jamnagar Bedi Bandar, six specimens, K.V. Surya Rao, 20.viii.1972; Pirotan Island five specimens, K.N. Reddy, 20.iv.1977.

Description : Test length upto 53 mm; breadth is 0.87 of length. Test oblong, longer than wide; margin thick, separated from the slightly raised apical system by a shallow depression. Ambulacra petaloid on aboral side, pore pairs conjugate, petaloid plates all primaries.

Peristome central or slightly anterior; oral furrows shallow. Periproct on oral side in the posterior interambulacrum, separated from the posterior margin of the test by up to twice its length, periproctal membrane with a few spines.

Primary tubercles prominent; glossy tubercles present on the oral and aboral sides of the margin.

Remarks : The type specimens from Tuticorin (Gulf of Mannar, Tamilnadu) are dead tests in which the periproct is lost and hence presence or otherwise of spines on the periproct is not known. The present lot also contains only tests in which the periproct is lost excepting the one from Sikka donated by Dr. B.H. Patel. The periproct of this specimen has a few spines at the periphery.

Distribution : India : Gujarat, Tamil Nadu.

GENERAL OBSERVATIONS

The coast of Gujarat is varied with muddy, sandy, rocky, coral and mangrove habitats. The

Gulf of Kachchh, particularly the eastern part criss-crossed by several creeks, abounds with muddy habitats and mangrove vegetation. The open coast is mainly sandy with rocky outcrops. However, the Gulf of Kambhat and further south is silty even on the rocky patches with oyster settlements. The coral habitats of several islets scattered in the Gulf of Kachchh along the southern coast support a rich biodiversity. However there is a discernible decline in the abundance and diversity of fauna in general and echinoderms in particular of the coast. Particularly the stretch from Okha to Jamnagar revealed several species of echinoderms during the earlier years upto late seventies of the present century. Subsequent visits to the same areas were however not as promising.

The depletion of the fauna during the present time, is apparently due to the change in the habitat over the years. The once clean beaches with rocks and dead coral conglomerates have been covered by silt and putrifying organic debris. Indiscriminate collection of dead and live corals as well as shells from the Gulf of Kachchh for industrial purposes has considerably changed the habitat resulting in siltation. Providing berthing facilities for fishing vessels at the mouth of the Gulf at Adatra Beach of Okha, has increased organic load due to trash from the fishing vessels, fouling the environment with high Biological Oxygen Demand, as can be inferred from the black substratum as well as gases (most probably Hydrogen Sulphide and Methane) bubbling out from the intertidal area. As a result, many crinoids, asteroids and ophiuroids of a healthy environment which were once abundant, are absent or have become rare. Indiscriminate collection of fauna and damage to the habitat by unguided student parties added to further deterioration of habitat and depletion of fauna. However certain inaccessible and infrequently visited areas still have a rich diversity and abundance, and need immediate protection.

Declaration of a Marine Sanctuary in the Gulf of Kachchh with a core area as Marine National Park, has not shown any effect because of difficulties in controlling illegal exploitation of fauna and unintelligent damage to the habitats.

The distribution of 28 species of Crinoidea, Asteroidea, Ophiuroidea and Echinoidea known

from Gujarat is compared with that along the adjacent coasts of Maharashtra (India) and Pakistan in Table 2.

It can be seen from the above distribution table that seven species of Maharashtra and 13 species of Pakistan coasts occur along the Gujarat coast. The ophiuroid *Ophiothela danae* of Maharashtra and *Amphiura (Ophiopeltis) tenuis* (Ophiuroidea), *Stomopneustes variolaris*, *Echinometra mathaei*, *Echinostrephus molaris* and *Arachnoides placenta* (Echinoidea) of Pakistan, reported respectively by Sane and Chhapgar (1962) and Hoque (1970) have not been encountered on the Gujarat coast. However 13 species not reported from either Maharashtra or Pakistan are known from the Gujarat coast. It can also be seen that the Gulf of Kachchh is richer with 22 species, compared to the open coast inhabited by only 12 species including six occurring in the Gulf of Kachchh. However current availability of some of the species collected only during the earlier years from the Gulf of Kachchh is doubtful in view of the deteriorated environmental conditions.

In addition to the above 28 species, the holothurian component of Gujarat coast comprises the following eight species.

1. *Holothuria (Lessonothuria) pardalis* Selenka (Okha and Jamnagar)
2. *Holothuria (Metriatyla) ocellata* Jaeger (Jamnagar)
3. *Holothuria (Metriatyla) scabra* Jaeger (Jamnagar)
4. *Stolus buccalis* (Stimpson) (Gulf of Kachchh)
5. *Stolus conjungens* (Semper) (Veraval)
6. *Actinocucumis typicus* Ludwig (Okha and Pirotan Island)
7. *Ohshimella ehrenbergi* (Selenka) (Pirotan Island)
8. *Acaudina molpadioides* (Selenka) (Pirotan Island)

Of these, only *Stolus conjungens* is from Veraval on the open coast while the other seven species are from the Gulf of Kachchh. Thus a total of 36 species of echinoderms with as many as 29 from the Gulf of Kachchh, occur along the Gujarat coast.

Table 2. Distribution of echinoderm species of Gujarat coast along the adjacent coasts of Maharashtra (India) and Pakistan. ? Hoque's (1970) records of *C. parvicirrus* and *C. samoamus* need confirmation in the light of the revisionary changes made by Rowe *et al.*, (1986). (+) Hoque's (1970) material reported as *Ophiopeza fallax* has already been referred to subspecies *arabica* by Clark (1968).

Sl. No.	Species	Gujarat		Maharashtra (Bombay)	Pakistan
		Gulf of Kachchh	Open Coast		
CRINOIDEA					
1.	<i>Comanthus walbergi</i>	+	-	-	?
2.	<i>Lampromerta palmata</i>	-	+	+	-
3.	<i>Stephanomerta indica</i>	+	-	-	-
4.	<i>Euantedon</i> sp.	-	+	-	-
ASTEROIDEA					
5.	<i>Luidia maculata</i>	+	-	-	+
6.	<i>Asteropecten indicus</i>	-	+	-	+
7.	<i>Asteropecten vappa</i>	+	-	-	-
8.	<i>Asyterina burtoni</i>	-	+	-	+
9.	<i>Asterina lorioli</i>	+	+	+	+
10.	<i>Anthenea rudis</i>	+	-	-	+
11.	<i>Echinaster luzonicus</i>	+	-	-	-
12.	<i>Echinaster purpureus</i>	+	-	-	-
OPHIUROIDEA					
13.	<i>Amphioplus (Lymanella)</i> sp.	+	-	-	-
14.	<i>Amphipholis squamata</i>	+	+	+	-
15.	<i>Amphiura ambigua</i>	+	+	-	-
16.	<i>Ophiactis brachyura</i>	-	+	-	-
17.	<i>Ophiactis savignyi</i>	+	+	+	+
18.	<i>Macrophiothrix aspidota</i>	+	-	+	+
19.	<i>Ophiothrix (O.) foveolata</i>	+	-	-	-
20.	<i>Ophionereis dubia</i>	+	-	+	+
21.	<i>Ophiocomella sexradia</i>	+	+	-	-
22.	<i>Ophiocormus compsus</i>	+	-	-	-
23.	<i>Ophiopeza fallax arabica</i>	+	-	-	(+)
24.	<i>Ophioplocus imbricatus</i>	+	-	-	+
ECHINOIDEA					
25.	<i>Salmacis bicolor</i>	+	-	-	-
26.	<i>Temnopleurus toreumaticus</i>	+	+	+	+
27.	<i>Clypeaster rarispinus</i>	-	+	-	+
28.	<i>Peronella oblonga</i>	+	-	-	-
Total		22	12	7	13

Along the southern coast of the Gulf of Kachchh under the Jamnagar District, an area of 458 sq. km has been designated Marine Sancturay, with a core area of 163 sq. km. comprising the intertidal region and nearby islands as Marine National Park. It is noteworthy that out of the 36 species of echinoderms occurring along the Gujarat coast, a total of 29 species are from the Marine National Park area revealing its rich biodiversity and necessity for its effective protection. The Marine National Park shares only six of the species with open coast and another seven species inhabit the open coast. The distribution of all the 36 species of echinoderms along the Gujarat coast is as follows.

Marine National Park

CRINOIDEA

1. *Stephanometra indica*

ASTEROIDEA

2. *Luidia maculata*
3. *Astropecten vappa*
4. *Anthenea rudis*
5. *Echinaster luzonicus*
6. *Echinaster purpureus*

OPHIUROIDEA

7. *Amphioplus (Lymanella) sp.*
8. *Macrophiothrix aspidota*
9. *Ophiothrix (O.) foveolata*
10. *Ophionereis dubia*
11. *Ophiocormus compsus*
12. *Ophiopeza fallax arabica*
13. *Ophioplocus imbricatus*

ECHINOIDEA

14. *Salmacis bicolor*
15. *Peronella oblonga*

HOLOTHUROIDEA

16. *Holothuria (L.) pardalis*
17. *Holothuria (M.) ocellata*
18. *Holothuria (M.) scabra*

19. *Stolus buccalis*
20. *Actinocucumis typicus*
21. *Ohshimella ehrenbergi*
22. *Acaudina molpadioides*

Marine National Park and Mandvi

CARINOIDEA

23. *Comanthus wahlbergii*

Marine National Park and Mandvi and open coast

OPHIUROIDEA

24. *Ophiactis savignyi*

Marine National Park and open coast

ASTEROIDEA

25. *Asterina lorioli*

OPHIUROIDEA

26. *Amphipholis squamata*
27. *Ampiura ambigua*
28. *Ophiocomella sexradia*

ECHINOIDEA

29. *Temnopleurus toreumaticus*

Open Coast

CRINOIDEA

30. *Lamprometra palmata*
31. *Euantedon sp.*

ASTEROIDEA

32. *Astropecten indicus*
33. *Asterina burtoni*

OPHIUROIDEA

34. *Ophiactis brachyura*

ECHINOIDEA

35. *Clypeaster rarispinus*

HOLOTHUROIDEA

36. *Stolus conjungens*

SUMMARY

The echinoderm fauna (excluding holothurians) of the Gujarat coast (India, Arabian Sea) comprising four species of Crinoidea, eight species of Asteroidea, 12 species of Ophiuroidea and four species of Echinoidea, totalling to 28, is dealt with in detail along with keys for their identification. Of these, the crinoid *Euantedon* sp., the asteroid, *Astropecten vappa*, and the ophiuroids, *Amphiura ambigua*, *Ophiactis brachyura*, *Ophiocormus compsus* and *Ophiopeza fallax arabica* are new to Indian Fauna and 16 others are new to the fauna of Gujarat coast. Distribution of all the 28 species along the Gulf of Kachchh and open coast of Gujarat and the adjoining Maharashtra (India) and Pakistan coasts has been compared. The total echinoderm fauna of Gujarat coast including eight species of

Holothurioidea and the 28 species reported herein, are grouped as per their distribution in the Marine National Park (Gulf of Kachchh), Mandvi (Gulf of Kuchchh outside Marine National Park) and the open coast (Outside Gulf of Kachchh). In addition, some observations on the environmental aspect are also included.

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REFERENCES

- Cherbonnier, C. and Guille, A. 1978. Echinodermes : Ophiurides. *Faune de Madagascar*, **48** : 1 -272.
- Clark, A.H. and Clark, A.M. 1967. A monograph of the existing Crinoids 1 (5) : Suborders Oligophreata (concluded) and Macrophreata. *Bull. U.S. natn. Mus.* **82** (5) : xiv + 1 - 860.
- Clark, A.M. 1968. Notes on some tropical Indo-Pacific ophiotrichids and ophiodermatids (Ophiuroidea). *Bull. Br. Mus. nat. Hist. (Zool.)*, **16** : 275 - 322.
- Clark, A.M. and Rowe, F.W.E. 1971. *Monograph of shallow water Indo-West Pacific echinoderms*. 238 pp. Brit. Mus. (N.H.), London.
- Clark, H.L. 1915. Catalogue of recent ophiurans. *Mem. Mus. comp. Zool. Harv.* **25** : 165 - 376 (in Fell, 1960)
- Clark, H.L. 1925. *A catalogue of recent sea urchins (Echinoidea) in the collection of the British Museum (Natural History)*, xxviii + 250 pp. Brit. Mus. (N.H.), London.
- Fell, H.B. 1960. Synoptic keys to the genera of Ophiuroidea. *Zool. Publ. Victoria Univ. Wellington*, No. **26** : 1 - 44.
- Fisher, W.K. 1919. Starfishes of the Philippine Seas and adjacent waters. *Bull. U.S. natn. Mus.* **100** (3) : 1 - 712.
- Gideon, P.W., Menon, P.K.B., Rao, S.R.V. and Jose, K.V. 1957. On the marine fauna of Gulf of Kutch A preliminary survey. *J. Bombay nat. Hist. Soc.*, **54** : 690 - 706.
- Gopalakrishnan, P. 1969. On the Holothuroidea (Echinodermata) of the Gulf of Kutch. *J. Bombay nat. Hist. Soc.* **66** : 399 - 400.
- Gopalakrishnan, P. 1971. Some observations on the shore ecology of the Okha coast. *J. mar. biol. Ass. India*, **12** : 15-34 (1970).

- Hoque, Md. M. 1970. Echinoderms of Pakistan coasts. *Rec. zool. Surv. Pakistan*, **1** (2) : 27 - 38 (1969).
- Hornell, J.J. 1909. *Report to the Government of Baroda on the marine zoology of Okhamandal in Kathiawar, Part I*, 148 pp. Williams and Norgate, London.
- Hornell, J.J. 1916. *Report to the Government of Baroda on the marine zoology of Okhamandal in Kathiawar, Part II*. Williams and Norgate, London.
- James, D.B. 1969. Catalogue of echinoderms in the reference collection of the Central Marine Fisheries Research Institute. *Bull. cent. mar. Fish. Res. Inst.*, **7** : 51 - 62.
- Matsumoto, H. 1917. A monograph of Japanese Ophiuroidea arranged according to a new classification. *J. Coll. Sc. imp. Univ. Tokyo*, **38** : 1 - 408.
- Murakami, S. 1944. Note on the ophiurans of Amakusa, Kyushu. *J. Dep. Agric. Kyushu imp. Univ.* **7** (8) : 259 - 280. (in Fell. 1960).
- Sane, S.R. and Chhapgar, B.F. 1962. Intertidal Echinodermata of Bombay. *J. Bombay nat. Hist. Soc.* **59** : 672 - 676.
- Sastry, D. R. K. 1991. Echinodermata. p. 559-569. *Animal Resources of India : Protozoa to Mammalia State of Art*. Zoological Survey of India, Calcutta. 694 pp.
- Sastry, D. R. K. 1995. Asteroidea, Ophiuroidea and Echinoidea (Echinodermata). *Estuarine Ecosystem Series, Part 2 : Hughli Matla Estuary* : 327-338.
- Sastry, D. R. K. 1998. Echinodermata. *State Fauna Series 3 : Fauna of West Bengal, Part 10* : 463-489.
- Soota, T. D. and Sastry, D. R. K. 1977. A notes on two species of *Echinaster* Mueller and Troschel (Echinodermata : Asteroidea) from the Indian Ocean. *newls. zool. Surv. India*, **3** : 168-169.
- Soota, T. D. and Sastry, D. R. K. 1979. Notes on two species of *Echinaster* Mueller and Troschel (Echinodermata : Asteroidea) from the Indian Ocean. *Rec. zool. Surv. India*, **75** : 343-352.

ADDENDUM

- Recently the author came across some works on the echinoderm fauna of the adjacent Pakistan coast which the echinoderm fauna of Gujarat coast was compared in Table 1. Additional information and clarifications regarding these are given below.
- The report of Tahera (1996. A checklist of echinoderm fauna of Pakistan. *Scientific Khyber*, 9: 103-106) includes the ophiuroid, *Ohiactis savignyi* and the holothurians, *Holothuria pardalis*, *Stolus buccalis* and *Stolus conjungens* which are common on Gujarat coast. Of these the ophiuroid was recorded by Tahera and Naushaba (1995. In: M.F. Thompson and N.M. Tirmuz (eds) *Proc. Arabian Sea Living Marine Resources and the Environment*, 123-133) while the three holothurians and another holothurian *Holothuria leucospilota* were based on the distribution for West coast of India and Pakistan' given by Clark and Rowe (1971). Since the holothurian records are not from actual material, these need confirmation with the material in the British Museum. The above checklist further includes the following :
 - i) The asterioid, *Astropecten euryacanthus* reported by Hoque (1969) from Bangladesh, the erstwhile East Pakistan and not from the present Pakistan.
 - ii) The ophiuroid *Ophiopeza fallax* as separate from the subspecies *Ophiopeza fallax arabica* with which Clark (1968) identified the Pakistan specimens.
 - iii) The echinoid *Arachnoides placenta* whose known distribution does not extend west of Bay of Bengal and which was reported by Hoque (1969) only from the erstwhile East Pakistan and
 - iv) The holothurian *Synapta recta* probably only from unpublished information.
- The ophiuroids, *Ophiothela danae* and *Ophiothela venusta* and the holothurian *Synaptula hydriformis* reported by Tahera and Naushaba (1995) and the holothurians *Holothuria difficilis* reported by Tahera and Kazmi (1995. *Pakistan Journal of Marine Science*, 4 : 71-73) and *Holothuria arenicola* reported by Tahera and Tirmuz (1995. *The Raffles Bulletin of Zoology*, 43 : 217-220) are not so far known from the coast of Gujarat.

CRUSTACEA : DECAPODA : GRAPSIDAE

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INTRODUCTION

Earlier records on Grapsid crabs are known from the contribution of Alcock (1900) on the collections of Indian Marine Survey Ship; Pillai (1951) on the crabs of Travancore; Chhappgar (1957) on the Marine crabs of Bombay; Sankarankutty (1961) on the crabs of Andaman and Nicobar Islands; Chakraborty; Choudhury and Deb (1986) on the crabs of Sundarbans; Ghosh (1995) on the crabs of Hugli Matla Estuary.

Besides this, Tesch (1917-18) made reports on the Indo-pacific species; Tweedie (1936) on the species of Mangrove swamps around Singapore Is. and a few other malayan localities ; Sakai (1939 & 1976) reported on the crabs of Japan.

The present report is based on the material collected during different surveys and also on the material present in the collections of zoological Survey of India. About 49 species of Grapsid crabs under 15 genera were recorded from India and Out of these 6 species belonging to 4 genera have been reported, of which *Sesarma jousseaumei* has been reported as first known record from Gujarat.

The paper provides keys, diagnostic characters and geographical distribution.

SYSTEMATIC ACCOUNT

Class CRUSTACEA
Order DECAPODA
Family GRAPSIDAE Dana, 1852

Diagnosis : Sides of body either straight or very slightly arched. Shape squarish, front broad and much exceeding length of short and thick eye-stalks, external maxillipeds widely gaping;

chelae very often provided with a tuft of hairs on palm or in cleft of fingers.

A LIST OF SPECIES

Genus 1. *Grapsus* Lamarck

(1) *Grapsus grapsus* (Linnaeus)

(2) *Grapsus strigosus* (Herbst)

Genus 2. *Metopograpsus* H.M. Edwards

(3) *Metopograpsus messor* (Forsk.)

Genus 3. *Ptychognathus* Stimpson

(4) *Ptychognathus barbatus* (A.M. Edwards)

Genus 4. *Sesarma* Say

(5) *Sesarma jousseaumei* (Nobili)

(6) *Sesarma quadrata* (Fabricius)

Key to genera of GRAPSIDAE

1. Exposed surface of external maxillipeds without oblique hairy ridge..... 2
- Exposed surface of external maxillipeds with an oblique hairy ridge *Sesarma*
2. Front more than half the extreme breadth of carapace; merus of external maxillipeds broader than long..... 3
- Front less than half the extreme breadth of carapace; merus of external maxillipeds longer than broad..... *Grapsus*
3. Antennae completely excluded from orbit
..... *Metopograpsus*
- Antennae stand in orbital hiatus
..... *Ptychognathus*

Genus 1. *Grapsus* Lamarck, 1801.

Diagnosis : Fingers short, stout, broad with spoon-shaped tips; orbit moderate size, deep, distinctly divided into two fossae; exognath of external maxillipeds well developed. The genus can be distinguished into two species by the key.

Key to species of *Grapsus*

- Tooth at inner angle of orbit blunt and at inner angle of wrist of chelipeds produced to form a talon-shaped spine *Grapsus grapsus*
- Tooth at inner angle of orbit subacute and at inner angle of wrist of chelipeds nearly straight *Grapsus strigosus*

1. *Grapsus grapsus* (Linnaeus)

1758. *Cancer grapsus* Linnaeus, *Syst. Nat. (ed. xii)* p. 1048.

1918. *Grapsus grapsus* Tesch. *Siboga Exped.*, 39c : 71.

Material examined : 1 ex., Lamba, 35 miles from Porbandar, 23.1.53, H.C. Roy; 2 exs., Hanuman Dandi, Gulf of Kutch, 23.1.53, H.C. Roy; 1 ex., Port Okha, 24.1.53, H.C. Roy; 1 ex., Dwaraka, 24.1.53, H.C. Roy.

Diagnosis : Transverse and oblique ridge of carapace prominent and surface between the oblique ridges coarsely reticulate. Front deep and vertically deflexed, its free edge crenulate. Chelipeds longer than carapace in male and shorter in female. Fingers with broad rounded tips; length of dactylus nearly twice the length of upper border of palm.

Distribution : India : Gujarat, Andhra Pradesh, Andaman Islands and Lakshadweep.

Elsewhere : Sri Lanka.

Remarks : Larger than other species of the genus, found in rocks and reefs of all the tropical and subtropical seas. Appears to be rare in Gujarat.

2. *Grapsus strigosus* (Herbst)

1799. *Cancer strigosus* Herbst, *Krabben*, III. i, p. -55.

1957. *Grapsus strigosus* Chhapgar, *J. Bombay nat. Hist. Soc.*, 54 (3) : 515.

Material examined : 1 ex., Holiday Camp, 4 km. from Chorwad, 7.1.90, B.P. Haldar; 4 exs., Port Okha, 30.11.92, H.C. Ghosh.

Diagnosis : Transverse and oblique ridges of carapace low and smooth, surface between the oblique ridges quite smooth. Front not so deep, obliquely deflexed, its free edge not so distinctly crenulate. Length of upper border of palm of chelipeds nearly two-thirds the length of dactylus, tips of fingers not so broad and blunt.

Distribution : India : Gujarat, Andhra Pradesh, Andaman & Nicobar Islands.

Elsewhere : Afganistan, Pakistan, Srilanka, Japan, Australia East coast of Africa and Red Sea.

Remarks : This species is found in abundance throughout the tropical coasts of Indo-pacific.

Genus 2. *Metopograpsus* H.M. Edwards, 1853.

Diagnosis : Carapace quadrate, antero-lateral border entire, chelipeds either subequal or unequal with spooned tip. The genus is represented in the present study by a single species.

3. *Metopograpsus messor* (Forsk.)

1818. *Cancer messor* Forskal, *Descrip. Anim. in itin Orient* : 88.

1995. *Metopograpsus messor* Ghosh, *Zool. Surv. India, Estuarine Ecosystem series*, (2) : Hugli Matla Estuary : 239.

Material examined : 2 exs., Okha Arambhada beach, 13.1.90, B.P. Haldar; 21 exs., Jamnagar, Sikka, 27.11.92, H.C. Ghosh; 22 exs., Diu Port, 15-16.12.92, H.C. Ghosh.

Diagnosis : Carapace four fifths as long as broad, some fine transverse markings on post-frontal region. Front about three-fifths the greatest breadth of carapace, orbits little oblique and their inner angle of lower border denticulate. Chelipeds unequal, presence of wrinkles markings on upper surface of arm and wrist, tips of fingers blunt. Legs of first pair smallest whereas the third pair longest. Terminal segment of male abdomen simply triangular.

Distribution : India : Gujarat, Maharashtra, West Bengal, Orissa, Andamans.

Elsewhere : From Red sea to Australia.

Remarks : The species is widely ranges in the Islands of Indo-pacific.

Genus 3. *Ptychognathus* Stimpson, 1858.

Diagnosis : Region of carapace not always so well-defined; dactyli of legs not so broad but compressed. The genus is represented by a single species from the study area.

4. *Ptychognathus barbatus* (A.M. Edwards)

1873. *Gnathograpsus barbatus* A.M. Edwards *Nouv. Archiv. Mus. Paris*, ix : 316.

1976. *Ptychognathus barbatus* Sakai, *Crabs of Japan & the adjacent seas*, Japan : 396.

Material examined : 2 exs., DIU Port, 15-16.12.92, H.C. Ghosh.

Diagnosis : Carapace decidedly broader than long, dorsal surface flat and smooth, front decidedly sinuous and not prominent. Antero-lateral borders divided into three teeth including external orbital angle. Chelipeds equal, arm very short, wrist without armed, palm swollen and high, chela with a tuft of hair in finger-cleft and running some little distance along outer surface of both fingers. No subterminal spine on the anterior border of meropodites of legs. Terminal segment of male abdomen extremely oblong and terminally fringed with longish hairs.

Distribution : India : Gujarat, Tamil Nadu, Andaman & Nicobar Islands.

Elsewhere : Myanmar, Samoa, Penang, Pegu Coast, Akyab.

Remarks : Indo-pacific species, entering freshwater above any tidal influence, appears to be rare in this region.

Genus 4. *Sesarma* Say, 1817

Diagnosis : Carapace squarish, flattened, often covered with numerous tufts of hairs, front nearly always sharply deflexed. Only two species are

reported from the study area may be distinguished by key given below.

Key to species of *Sesarma*

- Upper surface of palm of cheliped with two characteristic comb like ridges
..... *Sesarma quadrata*
- Upper surface of palm of cheliped without comb like ridges *Sesarma jousseaumei*

5. *Sesarma jousseaumei* (Nobili)

1906. *Sesarma jousseaumei* Nobili, *Bull. Scient France et Belgique*, t. 40 p. 411.

1917. *Sesarma jousseaumei* Tesch, *Zool. Meded Leiden*, III : 164.

Material examined : 3 exs., Pirotan Is., 20 miles from Sika Port, 18.1.53, H.C. Roy; 1 ex., Dwaraka, 24.1.53, H.C. Roy; 1 ex., Lamba, 35 miles from Lumber Port, H.C. Roy.

Diagnosis : Length of external orbital angles more than or equal to length of carapace in the median line. Carapace of legs covered with short hairs and tufts of longer hairs. Sides of carapace nearly parallel, without any tooth, somewhat convergent posteriorly. Outer surface of palm of cheliped with a brush of longer hair. Posterior margin of meropodites of walking legs always without any tooth.

Distribution : India : Gujarat.

Elsewhere : Red Sea.

Remarks : Small species recorded for first time from west coast of India. It appears to be rare in the study area.

6. *Sesarma quadrata* (Fabricius)

1798. *Cancer quadratus* Fabricius, *Ent. Syst. Suppl.* : 341.

1995. *Sesarma quadrata* Ghosh, *Zool. Surv. India, Estuarine Ecosystem series, (2)* : Hugli Matla Estuary 245.

Material examined : 1 ex., DIU Port, 15-16.xii.92, H.C. Ghosh.

Diagnosis : Carapace broader than long, nearly parallel, somewhat divergent anteriorly, without

any tooth on the lateral borders behind orbital angle. Inner border of arm bears a large tooth at its distal end, dorsal surface of male dactylus is milled with 11-19 blunt, transverse lamellae.

Distribution : India : Gujarat, Maharashtra, West Bengal, Orissa, Andhra Pradesh, Kerala, Andaman & Nicobar Islands.

Elsewhere : Pakistan, Sri Lanka, Myanmar.

Remarks : The species is found in tropical and subtropical seas, not in the mediterranean. Appears to be rare in the study area.

SUMMARY

Out of four subfamilies, three are known from the coastal water of Gujarat State, of the three,

Grapsinae is represented by three species under the genera *Grapsus* and *Metopograpsus*; Varuninae is represented by one species under the genus *Ptychognathus*; Sesarminae is represented by two species belonging to genus *Sesarma*. Out of six species, one is recorded for the first time from this area.

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REFERENCES

- Alcock, A. 1900. Material for a carcinological fauna of India, no. 6, The Brachyura catometopa or Grapsoidea. *J. Asia. Soc. Bengal*, **69** (2) : 279-456.
- Chakraborty, S.K. Choudhury, A. and Deb. M. (1986). Decapod Brachyura from Sunderbans mangrove estuarine complex, India. *J. Bengal Nat. Hist. Soc.* (New series) **5** (1) : 55-68.
- Ghosh, S.K. 1998. Fauna of West Bengal Crustacea : Decapoda : Grapsidae.
- Pillai, N.K. 1951. Decapoda (Brachyura) from Travancore. *Bull. Central Research Institute, Univ. Travancore*, **2** (1) Ser-C : 1-46.
- Sakai, T. (1939). Studies on the crabs of Japan-iv, Brachygnatha, Brachyrhyncha, Yokendo, Tokyo : 365-741.
- Sankarankutty, C. (1961). On Decapoda : Brachyura from the Andaman & Nicobar Islands. 1. Families Portunidae, Ocypodidae, Grapsidae and Mictyridae, *J. Mar. Biol. Assoc. India*, **3** : 101-119.
- Tweedie, M.W.F. (1936). On the crabs of the family Grapsidae in the Collection of the Raffles Museum. *Bull. Raffles Mus.*, (12) : 44-70.
- Tesch, J.J. (1918). The Grapsoid genus *Pyxidognathus* A.M. Edwards, with description of a new species. *Zool. Meded., Leiden*, **iv** : 167-177.

PRAWNS OF GUJARAT COAST

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INTRODUCTION

Inspite of so much attention, our knowledge on penaeid prawns of Gujarat Coastal region is still inadequate. The limits of Gujarat region included for the present studies the coastal belt of about 99,373 sq. km. The penaeid prawns dealt with in the present work comprising 14 species belonging to 4 genera and 1 subfamily under 1 family. To breakwise the entire species of Prawn of Gujarat coastal region, the following details of the groupwise strength of the species & genus are as follows : Eight species under genus *Metapenaeus* : two species under genus *Parapenaeopsis* : three species under genus *Penaeus* and one species under genus *Trachypenaeus*.

It is indeed true that fauna of any group is a flexible work tool capable of periodical updating through additions and revisions. However, Penaeid prawns of Gujarat region is rich and diverse in nature and therefore, this group has been studied and reported by George & Rao (1963 & 1966). Since Alcock's (1906) monograph on Indian Penaeid Prawns, mention was not made about their occurrence in particular locality of Gujarat coastal region. In all such cases, they have been cited as authority of occurrence of Penaeid prawns of Gujarat Coastal region. However, in several occasions, two new species were described by George & Rao (1963 & 1966) but a comprehensive revision of the Penaeid prawns of the Gujarat Coastal region has not so far been carried out by the said workers. Hence, this study was undertaken and designed to facilitate identification of Penaeid prawns of the Gujarat Coast and their general information. It is hoped that the use of this work will definitely contribute to the improvement to

the fishery resources, survey work, sampling schemes and fishery activities in general.

MATERIAL AND METHODS

The material was collected with the help of a fine meshed hand net from the rocks and tide pools of Gujarat Coast. For collecting the shallow and deep water benthic forms trawls and dredges were used.

After collection the specimens were narcotised by spraying 5% buffered formaldehyde solution. The specimens were kept for 3-4 days in this solution for fixation. After fixation the specimens were washed thoroughly in water. Then the material was preserved in 70-90% ethyl alcohol. Proper labelling were made on a good quality of Cartridge paper with a soft pencil (for temporary) or with indelible ink (for permanent). Each label beared essential informations such as exact locality (place name, district, state), date of collection, station number and name of the collector.

The preparation of the list of Penaeid prawns based on examination of specimens, present in the National Collections of the Zoological Survey of India, Calcutta and also various available literature of Penaeid prawns of the Gujarat Coast.

The present paper deals with the diagnostic characters of a particular species given by those authors, omission and commission of the characters also made where necessary for accuracy. Besides information on diagnostic characters, the range of distribution, size, present catchment areas in the state are also given. Regarding size, the maximum length between the tip of rostrum and telson were recorded in centimeter.

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The general classification adopted in the paper is based on Burukovskii (1982). In order to assist the identification of species and genera, the keys are artificial and not strictly phylogenetical.

SYSTEMATIC ACCOUNTS

Family PENAEIDAE
Sub family PENAEINAE

A key to the identification of genera of the family PENAEIDAE

1. Mastigobranchiae present on 3rd pereopod 2
— Mastigobranchiae absent on 3rd pereopod.
..... *Parapenaeopsis* (Alcock), 1901
2. Pleurobranch absent on 7th thoracic somite; exopod on 5th pereopod
..... *Trachypenaeus* Alcock, 1901
— Pleurobranch present on 7th thoracic somite; no exopod on 5th pereopod 3
3. Rostrum toothed dorsally
Metapenaeus Wood-Mason and Alcock, 1891
— Rostrum both dorsally and ventrally toothed
..... *Penaeus* Fabricius, 1798

A. Genus *Parapenaeopsis* (Alcock), 1901

Type Species : *Parapenaeopsis stylifera* Edw., 1885

A key to identification of species of the genus *Parapenaeopsis*

- Rostrum shorter and not extending to tip of antennular peduncle; postrostral carina distinctly canaliculate; thelycum consists of a large hexagonal or leaf-shaped plate, lying between 4th pair of legs
..... *P. sculptilis* (Heller), 1862
- Rostrum longer and extending beyond tip of antennular peduncle; postrostral carina not canaliculate; thelycum consists of three squarish cut lobes lying between 4th pair of legs *P. stylifera* (M.Edw.), 1837

1. *Parapenaeopsis sculptilis* (Heller), 1862

1862. *Penaeus sculptilis* Heller, *Verh. Zool. bot. Ges. Wien*, **12** : 519-528.

1957 *Parapenaeopsis sculptilis* Dall, *Aust. J. mar. & Freshw Res.* **8** (2) : 217-220.

1969 *Parapenaeopsis sculptilis* George, *Bull. Cent. mar. Fish Res. Inst.*, **14** : 35.

Material examined : 1 ♂, Bhabanagar, Ghogha Bandar, H.C. Ghosh & party, 19.12.1992.

Size : It attains 12 cm in length.

Diagnosis : 1/3rd or less free portion of rostrum unarmed, curving downwards & extending to 2nd segment of antennular peduncle. Adrostral carina terminates just midway between first and 2nd teeth longitudinal suture extending more than half length of carapace from post orbital margin. Mastigobranchiae on 1st & 2nd pereopods; 1st & 2nd pereopods possessing each with basal spines. Telson without fixed subapical spines also lateral movable spines may or may not be present. Petasma with a pair of distolateral projections directed laterally or distolaterally usually short and spout like.

Distribution : India : Gujarat Coast, Northern area of east & west coast, Matla river, Gangetic delta, Mumbai.

Elsewhere : Gulf of Carpentaria, Queensland, Indonesia, Singapore, Hongkong, Gulf of Martaban, Australia, New Guinea & Bangladesh.

Remarks : This species is not only common to Gujarat Coast but also to the other coastal belts of India.

2. *Parapenaeopsis stylifera* (M. Edw.), 1837

1837 *Penaeus styliferus* M. Edw, *Hist. Nat. Crust.* **II** : 418

1903. *Parapenaeopsis stylifera* Nobili, *Boll. Mus. Torino*, **17** No. 452, P. 4, F. 4

Material examined : 3 ♂♂, Gulf of Kutch, H.C. Ghosh & Party, 30.11.1992; 1 ♂, Porbandar, H.C. Ghosh & party, 10.12.1992; 3 ♂♂, Dwarka Fishing Port, H.C. Ghosh & party, 4.12.1992.

Size : It attains 9-13 cm in length.

Diagnosis : A strong double curved rostrum present, it's proximal part bearing a crest of 7-9 teeth while it's distal part styliform. Post rostral carina extends nearly to posterior margin of carapace; post occular tooth present. Mastigobranchiae on 1st & 2nd pereopods. 1st & 2nd pereopods with basal spine. All thoracic legs have petaloid exopodites. Thelycum consists of a three lobes.

Distribution : India : All along coast lines through West Coast to N.E. Coast.

Elsewhere : Sri Lanka through Malayasia to Indonesia and Borneo and also in New Guinea Bangladesh.

Remarks : This is a very common species in West coast having immense commercial importance.

B. Genus *Trachypenaeus* Alcock, 1901

Type species : *Trachypenaeus curvirostris* (Stimpson), 1860 (= *Trachypenaeus anchoralis* Spence Bate, 1888)

3. *Trachypenaeus curvirostris* (Stimpson), 1860

1860. *Penaeus curvirostris* Stimpson, *Proc. Acad. Nat. Soc. Thailand* : 22 47.

1957. *Trachypenaeus curvirostris* Dall, *Aust. J. mar. & freshw. Res.* 8 : 203 206.

Material examined : 2 ♂♂, Veraval seacoast, H.C. Ghosh & Party, 16.12.1992, 3 ♂♂, 1 ♀, Kerebal Port, H.C. Ghosh & party, 7.12.1992.

Size : It attains 5-7 cm in length.

Diagnosis : Teeth 7-10 and rostrum extending tip of 2nd segment of antennular peduncle. Anterior carina extending to or just beyond 1st tooth; postrostral carina extending to middle of carapace; antennular carina extending to mid way between antennal and hepatic spine. Hepatic sulcus and supra-orbital spine present. Prosartema extending almost eye region. Fifth pereopod not extending beyond 2nd segment of antennular peduncle. Epipod (Mastigobranchiae) on 1st & 2nd pereopod; ischium of 1st leg with a small spine; carapace with longitudinal suture not

extending beyond hepatic spine. Telson with 3 pairs distinct spines; subapical pair not on prominent shoulders.

Distribution : India : East & West coast including Gujarat region.

Elsewhere : Eastern Africa through Sri Lanka and Malaysian waters to Japan; Australia, Queensland; Formosa & Indonesia.

Remarks : It is very common forms found in shallow water.

C. Genus *Metapenaeus* Wood-Mason & Alcock, 1891

Type species : *Metapenaeus affinis* Edw., 1885

A key to the identification of species of the genus *Metapenaeus*

1. Telson possess three pairs of articulating marginal spines on its distal ends..... 2
 - Telson having without marginal spines on its distal end 3
2. Rostrum extending upto or beyond tip of antennular peduncle
 - *M. ensis* (de Hann), 1850
 - Rostrum rarely extending middle of antennular peduncle..... 4
3. Last pair of thoracic legs usually surpass the tip of antennular scale
 - *M. affinis* (H.M. Edw.), 1837
 - Last pair of thoracic legs seldom reach to tip of antennular scale 5
4. Outer antennular flagellum equal in length of peduncle.....
 - *M. brevicornis* (H.M. Edw.), 1837
 - Outer antennular flagellum half in length of peduncle.....
 - *M. kutchensis* George & Rao, 1963
5. Distomedian petasmas projections hook-like.
 - *M. monoceros* (Fab.), 1798
 - Distomedian petasmas projections spout-like 6

6. Anterior plate of thelycum with 5 tubercle
..... *M. mastersii* (Haswell), 1879

— Anterior plate of thelycum with small, flat and
leaf like 7

7. 1/3rd portion of distal part of rostrum naked &
curved little upward
..... *M. eborensis* Dall, 1957

— No naked portion on rostrum but distal half
slightly curved upward
..... *M. alcocki* George & Rao, 1966

4. *Metapenaeus ensis* (de Hann), 1850

1850. *Penaeus monoceros* de Haan, *Faun. Japan. Crust.* :
192

1971. *Metapenaeus ensis* Raek & Yaldwyn, *Proc. Linn.
Soc. N. S.W.*, 95 : 209-214.

Material examined : 1 ♂, Dwarka Fishing Port,
H.C. Ghosh & party, 4.12.1992.

Size : It attains 9 cm in length.

Diagnosis : All characters similar to *M. monoceros* except telson which possesses three pairs of articulating marginal spines on its distal end and distomedian petasmas directed anteriorly; lateral thelycal plates with raised lateral ridges, each with a posterior inwardly curved triangular plate.

Distribution : India : Gujarat coast, Port Blair and Andamans.

Remarks : This species is commonly found in this region

5. *Metapenaeus affinis* (H.M. Edw.), 1837

1837. *Penaeus affinis* H.M. Edw., *Hist. nat. Crust. Paris*, 2 : 416

1969. *Metapenaeus affinis* George, *Bull. Cent. mar. Fish. Resh. Inst.*, 14 : 31

Material examined : 1 ♂, Dwarka Fishing Port, H.C. Ghosh and party, 4.12.1992

Size : It attains 10 cm in length.

Diagnosis : Rostrum deeply curved, little uplifted and longer bearing 9 teeth. Postrostral crest less prominent and gradually becomes fading

away a little portion in front of posterior border of Carapace. Outer antennular flagellum longer and also more or less 3/4th in length of peduncle. Fifth abdominal somite 2/3rd in length of sixth somite. Telson without marginal spine. Petasma symmetrical. Thelycum concave and setose. Lateral lobes fairly flat and transversely cut into unequal segments. Median plate originates between two lobes of sternum which exists between 4th pair of legs. Median groove present anterior half of this plate.

Distribution : India : Gujarat Coast, Malabar Coast, Ratnagiri Coast, Mumbai, Travancore, Chilka Lake.

Elsewhere : Malayasia, Indonesia, New Guinea, Sri Lanka, Pakistan, Hong Kong, Japan, Australia.

Remarks : *Metapenaeus affinis* is most commercially important very common species in India.

6. *Metapenaeus brevicornis* (H.M. Edw.), 1837

1837. *Penaeus brevicornis* H.M. Edw., *Hist. Nat. Crust. II.*

1969. *Metapenaeus brevicornis* George, *Bull. Cent. Mar. Res. Inst. No. 14* : 5 48.

Material examined : 3 ♂, Dwarka Fishing Port, H.C. Ghosh and party, 4.12.1992.

Size : It attains 5-11 cm. in length.

Diagnosis : Rostrum curved and extend to middle of second joint of antennular peduncle, dorsal of it bears several teeth forming a decided crest. Postrostral crest not prominent. Post antennular spine weak and not continued and hereby postantennular groove shallow. Hepatic spine very small. Subhepatic groove shallow and does not meet hepatic spine. Outer antennular flagellum equal in length of peduncle. Last pair of thoracic legs extending beyond tip of antennal scale. Telson not distinctly armed. Andrium ends in a pair of simple spouts carrying each a longish filament on its middle. Thelycum concaved and its median lobe looks like eight. Anterior portion of it being embraced between processes of anepennultimate throacic sternum and posterior portion by flat crescent shaped lateral lobes.

Distribution : India : Gujarat Coast, Matla river in the Gangetic delta and Andamans.

Elsewhere : Borneo.

Remarks : *Metapeneus brevicornis* is compared with *Metapeneus lysianassa*, *M. dobsoni* and *M. monoceros* by the configuration of Petasma thelycum, rostrum, rostral teeth. This species is common and widely distributed in this region. This species is cultivated in India.

7. *Metapeneus kutchensis* George & Rao, 1963

1963. *Metapeneus kutchensis* George & Rao, *J. Mar. biol. Ass. India*, 5 (2) : 284-288.

Diagnosis : Rostrum straight with a small crest, extending little beyond tip of antennular peduncle; teeth 8-9. Adrostral carina ending near epigastric sulcus extending to middle of carapace; postrostral carina ending in a glabrous expansion 1/6th length of carapace from its posterior margin. Hepatic sulcus descending vertically and then curving towards pterygostominal angle. Cervical sulcus straight. Branchiocardiac sulcus distinct. Scaphocerite extending nearly to tip of antennular peduncle overpassing eye by double in length. Antennular flagella nearly equal and half in length of peduncle. First pereopod extending to base of carapocerite, second to tip of carapocerite; third to tip of antennular segment; fourth to tip of basicerite and fifth to middle of scaphocerite. Ischium of first pereopod with a spine smaller than basal. Telson grooved on dorsal side and with very minute dorsolateral spinules. Posterior plate of thelycum concave without ear like lobes divided transversely into two unequal segments without having clusters of setae between them.

Distribution : India : Gulf of Kutch (Gujarat).

Remarks : Details of this species are based on literature and therefore, 'material examined' & 'size' are not included.

8. *Metapeneus monoceros* (Fab.), 1798

1798. *Penaeus monoceros* Fab., "Supplementum Entomologiae Systematicae" (Hafniae).

1957. *Metapeneus monoceros* Dall, *Aust. J. mar. & Freshw. Res.*, 8 : 184 187.

Material examined : 2 ♂♂, 1 ♀, Gulf of Kutch, H.C. Ghosh & party, 30.11.1992; 1 ♂, 1 ♀, Porbandar : subhasport, H.C. Ghosh & party, 10.12.1992; 1 ♂, Dwarka Fishing Port, H.C. Ghosh & party, 4.12.1992; 3 ♂♂, 2 ♀♀, Bhabanagar : Ghoga Bandar, H.C. Ghosh & party, 19.12.1992.

Size : It attains 12-15 cm in length.

Diagnosis : Rostrum nearly straight, armed with 9-11 teeth dorsally; extending upto or a little beyond tip of antennular peduncle. Branchiocardiac ridge sinuous reaching posterior extension of hepatic spine. Flagella subequal and half in length of peduncle. Second pereopod extending to tip of first segment and third pereopod upto or beyond tip of second segment of antennular peduncle. First to third somite incomplete. Fifth abdominal somite nearly 2/3rd in length of sixth somite. First somite carinated dorsally sometimes and becoming more prominent to sixth somite. Eyes very large and slightly covered by antennular scale. Telson little longer than sixth somite and having without marginal spines. Distomedian petasmas projections hood-like. Lateral thelycal plates with salient and parallel ear shaped lateral ridge.

Distribution : India : Gujarat coast, Mumbai, Palk strait, Coromondal coast, Chilka Lake, Ganjam, Vizagapatnam, Matla river in Gangetic delta.

Elsewhere : New South Wales of Exmouth Gulf, West Asia through Indonesia and Philippine Island, Red Sea, Mediterranean, Africa, Hong Kong. Akyale.

Remarks : Very common Indian Prawn having commercial importance for its giant size.

9. *Metapeneus mastersii* (Haswell), 1879

1879. *Penaeus mastersii* Haswell, *Proc. Linn. Soc. N.S.W.*, 4 : 38 44.

1957. *Metapeneus mastersii* Dall, *Aust. J. mar. & freshw. Res.*, 8 : 190 193.

Material examined : 1 ♂, Bhabanagar : Ghogha bandar, H.C. Ghosh & party, 19.12.1992.

Size : It attains 7 cm in length.

Diagnosis : Rostrum slender and little curved upward bearing 8-9 teeth on its dorsal side and extends upto tip of second segment of antennular peduncle. Adrostral carina terminates between epigastric and first tooth. Post rostral carina distinct and may or may not prominent. Gastrofrontal sulcus very wide and shallow having without carina. Orbito-antennal sulcus narrow posteriorly and terminates to anterior part of hepatic spine. Hepatic sulcus descending vertically, branchiocardiac sulcus feeble, carina absent. Flagella equal in length and nearly half in length of peduncle. Telson fringed with numerous minute spines. Distomedian projection spout like, tapering and inner edge convex. Anterior plate of thelycum with five tubercle, lateral plate hooked and curved inward.

Distribution : India : Gujarat

Elsewhere : Australia, Indonesia

Remarks : This commercially important species considered as a first record from this region. This usually spawn in coastal waters.

10. *Metapenaeus eboracensis* Dall, 1957

1957. *Metapenaeus eboracensis* Dall, *Aust. J. mar. & freshw. Res.*, 8 : 193-196.

Material examined : 1 ♂, Bhabanagar : Ghogha Bandar, H.C. Ghosh & party, 19.12.1992.

Size : It attains 8 cm in length.

Diagnosis : 1/3rd portion of distal part of rostrum naked and curved little upward and proximal 2/3rd portion denticulated with 7-8 teeth and curving downwards. It extends to or slightly exceeding tip to antennular peduncle. Carapace very wide & shallow and bounded posteriorly by post ocular sulcus. Hepatic sulcus descending vertically, branchiocardiac sulcus present. Flagellum of antennular is twice in length of body. Ischium of first pereopod angled but without spine. Dorsally corinated from anterior of fourth somite. Single row of minute spinules present on either side of telson. Median projections flaps closing distal opening of petasone. Anterior plate of thelycum small, flat, leaf-shaped as long as wide bounded and level with coxal projection of 4th pereopod.

Distribution : India : Gujarat coast

Elsewhere : Australia

Remarks : This species turns to first record from the coast of Gujarat, India.

11. *Metapenaeus alcocki* George & Rao, 1966

1966. *Metapenaeus alcocki* George & Rao, *J. Mar. biol. Ass. India*, 8 (1) : 146-151.

Diagnosis : Half of distal end of rostrum little curved. Number of teeth is 10. Postrostral carina terminating to a transverse glabrous strip at 1/10th smaller in length of carapace from posterior margin. Adrostral carina terminating between tooth of epigastric and penultimate and adrostral sulcus behind epigastric tooth. Scaphocarite extending beyond tip of antennular peduncle by length of its third segment. Branchiocardiac sulcus distinct in at least posterior 1/3rd carapace. Third maxilliped terminating beyond tip of carpocerite. First pereopod extending beyond middle of carpocerite; second beyond tip of carpocerite, third nearly tip of antennular segment; fourth beyond base of carpocerite & fifth beyond middle of scaphocerite. Ischium of first pereopod possessing a strong spine. Distolateral projections of petasma spout like with distal openings. Anterior plate midially grooved & tongue like in shape and tapering posteriorly to a narrow plate, margined laterally by a pair of oval bases.

Distribution : India : Gulf of Kutch, Gujarat.

Elsewhere : Nil.

Remarks : Details of this species are based on literature and therefore, "Material examined" & "Size" are not included.

D. Genus *Penaeus* Fabricius, 1798

Type species : *Penaeus caramote* (Risso), 1885

A key to identification of species of the genus *Penaeus* Fab. 1798

1. Hepatic carina present 2
- Hepatic carina absent
..... *P. penicillatus* Alcock, 1905

2. Adrostral carina reaching nearly middle of carapace; gastrofrontal carina absent; telson without spinules

..... *P. semisulcatus* de Haan, 1844

— Adrostral carina reaching nearly posterior border of carapace; Gastrofrontal carina present; telson with 3 pairs of spinules

..... *P. latisulcatus* Kishinouye, 1896

12. *Penaeus penicillatus* Alcock, 1905

1905. *Penaeus indicus* var. *penicillatus* Alcock, *Ann. Mag. N.H.* (7) 16 : 525.

1969. *Penaeus penicillatus* George, *Bull. Cent. mar. Fish. Res. Inst.* 14 : 24.

Material examined : 2 ♂♂, 2 ♀♀, Porbandar : Subhasport, H.C. Ghosh & party, 10.12.1992.

Size : It attains 5-12 cm in length.

Diagnosis : Rostral crest courex and not triangular. Adrostral carina extending upto middle of carapace and just beyond epigastric tooth; gastrofrontal carina and hepatic carina absent. Third pereopod extending scaphocerite by at least dactyl; maxillary palp two segmented. Dactyl of 3rd maxilliped of adult male specimen much longer than propodus.

Distribution : India : Gujarat coast, Mumbai, Orissa coast, Hooghly delta.

Elsewhere : Pakistan, Karachi, Bangladesh; Mergui.

Remarks : This species is very common to Indian coasts.

13. *Penaeus semisulcatus* de Haan, 1844

1950. *Penaeus semisulcatus* de Haan, *Crustacea*. In P.E. de Siebold, "Fauna Japonica".

1957. *Penaeus semisulcatus* Dall, *Aust. J. mar. & freshw. Res.* 8 : 154-157.

Material examined : 2 ♂♂, 1 ♀, Dwarka Fishing Port, H.C. Ghosh & party, 4.12.1992.

Size : It attains 10-12 cm in length.

Diagnosis : Adrostral carina and sulcus extending nearly to middle of carapace; Post

rostral carina distinctly sulcate and extending nearly to posterior margin of carapace; gastrofrontal carina absent; hepatic carina present; gastroorbital carina occupying posterior half of area between cervical sulcus and anterior margin of carapace. Outer antennular flagellum longer than peduncle. Fifth pereopods with small but distinct exopod; third maxilliped extending nearly or little exceeding tip of first segment of antennular peduncle. Lateral lobe of petasma thickened distally; thelycum with seminal receptacle closed by two flaps.

Distribution : India : Gujarat coast, Malabar coast, Mumbai, Pondichery, Tamil Nadu, Pulicat, Andman, Ganjam, Hooghly delta.

Elsewhere : Karachi, Colombo, Nagasaki, Fiji, Red Sea & E. Africa to Australia, Tahiti, Margui and Akyab.

Remarks : This species is of great commercial importance and distributed through the entire coasts of India.

14. *Penaeus latisulcatus* Kishinouye, 1900

1900. *Penaeus latisulcatus* Kishinouye, *J. Fish. Bur. Tokyo*, 8 : 1-29.

1957. *Penaeus latisulcatus* Dall, *Aust. J. mar. & freshw. Res.* 8 : 149-151.

Material examined : 1 ♂, Gulf of Kutch : Okha : off Dalda Port, H.C. Ghosh & party, 30.11.1992.

Size : It attains 12 cm in length.

Diagnosis : Rostrum without accessory pair of carinae, not more than 1 ventral rostral tooth. Adrostral carina reaching almost posterior border of carapace, gastrofrontal carina present, gastrofrontal sulcus with bifurcate posterior end, adrostral sulcus as wide as postrostral carina. Ischial spine on 1st pereopod absent. Telson with 3 pairs of spinules. Thelycum with apex of anterior plate befid, seminal receptacle flat, closed by 2 flaps.

Distribution : India : Gujarat coast, South-west coast & Andaman sea.

Elsewhere : Australia, Tokyo Bay, Kagoshni, Japan, Batjan, Red Sea, Penang, Korea

Remarks : This species is largely found in the West coast of India and it deserves the maximum importance on the view of economic importance.

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REFERENCES

- Alcock, A. 1905. A revision of the genus *Penaeus* with diagnoses of some new species and varieties *Ann. Mag. Nat. Hist.* **16** (7) : 508-32.
- Alcock, A. 1906. Prawns of the *Penaeus* group. *In* : Catalogue of the Indian Decapod Crustacea in the collections of the Indian Museum, Part 3, Macrura, Fasc 1. Calcutta, 55 p.
- Bate, C.S. 1881. On the Penaeidae *Ann. Mag. Nat. Hist.*, **8** (5) : 169-196.
- Dall, W. 1957. A revision of the Australian species of Penaeinae (Crustacea : Decapoda : Penaeidae) *Ann. J. Mar. Freshw. Res.* **8** (2) : 136-231.
- De Man, J.G. 1931. The Decapoda of the Siboga Expedition part I. Family Penaeidae. Siboga-Exped., **39a** : 1-131.
- Fabricius, J.C. 1798. "Supplementum Entomologiae Systematicae" (Hafniae).
- George, M.J. 1969. Prawn fisheries of India, II. Systematics taxonomic considerations and general distribution. *Bull. Centr. Mar. Fish. Res. Inst.*, **14** : 5-48.
- George, M.J. 1979. Taxonomy of Indian Prawn (Penaeidae : Crustacea : Decapoda). In contributions to Marine sciences", dedicated to Dr. C.V. Kurien, 21-59.

ANNELIDA : POLYCHAETA

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INTRODUCTION

Polychaetes, commonly known as bristle worms, are recognised as a very important and significant group among the marine organisms. Availability of polychaetes in diverse ecological niches is due to their high degree of adaptability to a wide range of environmental factors. Majority of these worms are benthic. Benthic polychaetes mostly prefer sandy or muddy substrata, some are found to be comfortable in the crevices of rocks and coral reefs.

The most important works on the taxonomy of polychaetes pertaining to Indian waters are those of Fauvel (1932, 1953). However, our knowledge of the polychaete fauna of Gujarat coast is based on the works of Fauvel (1953), Rao and Soota (1981) and Soota *et al.* (1981). Some additional records are also available from Dalal and Dubale (1975 and 1976), Dalal, Dubale and Shah (1978), Dalal (1982), and Misra and Chakraborty (1983).

The present paper deals with 90 species of polychaetes, so far recorded from the coastal areas of Gujarat, of which the present authors have collected 51 species from the area. The present study includes new locality records of 13 species from Gujarat coast including two species recorded for the first time from the Indian waters. Only the original reference, diagnostic features and distribution are included under each species. Key to different taxa below family level are also provided. A classified list of the species of polychaetes so far known from the Gujarat coast has also been given.

CLASSIFIED LIST OF POLYCHAETES SPECIES HITHERTO KNOWN FROM THE GUJARAT COAST

Family APHRODITIDAE

- * *Aphrodita aculeata* Linnaeus, 1761
- Harmonia hystrix* (Savigny, 1820)

Family POLYNOIDAE

- * *Eunoe pallida* (Ehlers, 1908)
- ** *Harmothoe dictyophora* (Grube, 1878)
- ** *Iphione muricata* (Savigny, 1818)
- * *Lepidonotus carinulatus* (Grube, 1870)
- * *Lepidonotus cristatus* (Grube, 1876)
- Lepidonotus tenuisetosus* (Gravier, 1901)
- * *Paralepidonotus ampulliferus* (Grube, 1878)
- * *Scalisetosus fragilis* (Claparede, 1886)
- Thormora jukesi* (Baird, 1865)

Family SIGALIONIDAE

- ** *Sthenelais boa* (Jonston, 1839)
- ** *Sthenolepsis japonica* (McIntosh, 1885)

Family AMPHINOMIDAE

- * *Amphinome rostrata* (Pallas, 1766)
- Eurythoe complanata* (Pallas, 1766)

Family PHYLLODOCIDAE

- ** *Anaitides madeirensis* Langerhans, 1880
- Eulalia viridis* (Muller, 1767)

Family HESIONIDAE

- * *Hesione splendida* (Savigny, 1818)
- Leocrates claparedii* (Coasta, 1868)

Family SYLLIDAE

- * *Syllis gracilis* Grube, 1940
- * *Typosyllis variegata* Grube, 1860

Family NEREIDIDAE

- * *Ceratonereis burmensis* (Monro, 1937)
- * *Ceratonereis costae* (Grube, 1840)
- ** *Ceratonereis mirabilis* Kinberg, 1866
- * *Dendronereides heteropoda* Souther, 1921
- * *Namalycastis indica* (Southern, 1921)
- Nereis coutierei* Gravier, 1899
- * *Nereis persica* (Fauvel, 1911)
- * *Neanthes indica* Kinberg, 1866
- ** *Neanthes unifasciata* Willey, 1905
- * *Neanthes willey* Day, 1934
- Perinereis aibuhitensis* Grube, 1878
- Perinereis nigropunctata* (Horst, 1889)
- Perinereis nuntia* (Savigny, 1818)
- Perinereis cavifrons* Ehlers, 1920
- Perinereis cultrifera* (Grube, 1840)
- Perinereis vancaurica* (Ehlers, 1868)
- Pseudonereis anomala* Gravier, 1901
- Pseudonereis rotnestiana* Augener, 1913
- Pseudonereis variegata* (Grube, 1857)
- * *Platynereis abnormis* (Horst, 1924)
- * *Tylonereis bogoyawlenskyi* Fauvel, 1911

Family NEPTYIIDAE

- * *Nephtys polybranchia* Southern, 1921

Family GLYCERIDAE

- * *Glycera convoluta* Keferstein, 1862
- * *Glycera tessellata* Grube, 1863

Family GONIADIDAE

- Goniada emerita* Audouin and Milne-Edwards, 1833.
- *** *Goniadopsis incerta* Fauvel, 1932

Family EUNICIDAE

- Eunice antennata* (Savigny, 1820)
- Eunice australis* Quatrafages, 1865
- ** *Eunice cincta* (Kinberg, 1865)
- Eunice gracilis* (Crossland, 1904)
- Eunice tentaculata* Quatrafages, 1865
- Eunice siciliensis* Grube, 1840
- Eunice afra paupera* Grube, 1878
- Lysidice collaris* Grube, 1870
- Lysidice natalensis* Kinberg, 1865
- Marphysa sanguinea* (Montagu, 1815)
- ** *Marphysa mossambica* (Peters, 1854)

Family ONUPHIDAE

- Diopatra neapolitana* Delle-chiaje, 1841

Family LUMBRINEREIDAE

- Lumbrinereis heteropoda* (Marenzeller, 1879)
- * *Lumbrinereis polydesma* Southern, 1921
- * *Lumbrinereis pseudobifilaris* (Fauvel, 1932)
- * *Lumbrinereis simplex* Southern, 1921
- Lumbrinereis notocirrata* (Fauvel, 1932)

Family ARABELLIDAE

- * *Arabella iricolor* (Montagu, 1804)

Family LYSARETIDAE

- ** *Oenone fulgida* (Savigny, 1818)

Family ORBINIIDAE

- * *Naineris laevigata* (Grube, 1855)

Family CIRRATULIDAE

- Cirriiformia filigera* (Delle-chiaje, 1825)
- * *Cirriiformia punctata* (Grube, 1859)
- * *Cirriiformia tentaculata* (Montagu, 1808)
- Cirratulus chrysoderma* Claparede, 1868

Family FLABELLIGERIDAE

- Pherusa parmata* (Grube, 1878)

Family OPHELIIDAE

- * *Ophelina acuminata* Oersted, 1843
- Armandia leptocirris* Grube, 1878

Family CAPITELLIDAE

- * *Notomastus latericeus* Sars, 1851

Family SABELLARIIDAE

- * *Sabellaria cementarium* Moore, 1906

Family TRICHOBRANCHIDAE

- * *Terebellides stroemi* Sars, 1835

Family TERESELLIDAE

- * *Streblosoma persica* (Fauvel, 1908)
- * *Lanice socialis* (Willey, 1905)
- Loimia medusa* (Savigny, 1820)
- * *Nicolea gracilibranchis* (Grube, 1878)
- Terebella ehrenbergi* Grube, 1870
- Eupolymnia nebulosa* (Montagu, 1818)

Family SABELLIDAE

- * *Branchiomma serratibranchis* (Grube, 1878)
- * *Laonome indica* Southern, 1921

Sabella fusca Grube, 1870

*** *Sabella penicillus* Linnaeus, 1767

Hypsicomus phaeotaenia (Schmarda, 1861)

* *Sabellastarte sanctijosephi* (Gravier, 1906)

Family SERPULIDAE

** *Serpula vermicularis* Linnaeus, 1767

* Not available during present investigation.

** New record from the Gujarat Coast.

*** New record from the Indian waters.

Species without starmarkes are recorded by the present authors.

Material : 1 ex., Sikka, Gulf of Kutch; 22.1.90, B.P. Haldar.

Diagnosis : Prostomium rounded with a slender median antenna. Elytra 15 pairs, Notosetae of elytrigerous feet have long harpoon setae, sabre-setae and some capillaries, Neurosetae bifurcate and having one to four accessory teeth.

Distribution : India : Gujarat, Nicobar Island.

Elsewhere : Red Sea, South Africa, Sri Lanka, Malay Archipelago, Philippine Island.

SYSTEMATIC ACCOUNT

Family I APHRODITIDAE

Key to genera

- Harpoon-shaped dorsal spines present; neurosetae bifurcate, often with one or more accessory teeth, not fringed with hairs.....
..... *Hermonia*
- Harpoon-shaped dorsal spines absent; neurosetae acicular, with a bent pilose tip.
..... *Aphrodita*

Genus 1. *Aphrodita* Linnaeus, 1758

1. *Aphrodita aculeata* Linnaeus, 1761

1761. *Aphrodita aculeata* Linnaeus, *Fauna Suecia Sistem Animalia Suecia Regni, Mammalia, Aves, Amphibia, pisces, Insecta, Vermes* Stockholm, 4 : 509.

Diagnosis : Prostomium rounded with one antenna. Elytra 15 pairs. Notosetae of two types; short erect, and lateral slender iridescent; neurosetae smooth without hook.

Distribution : India : Madras, Gujarat.

Elsewhere : Japan, Indian Ocean, Mediterranean Sea, Atlantic Ocean, North Sea, English Channel.

Genus 2. *Hermonia* Hartman, 1959

2. *Hermonia hystrix* (Savigny, 1820)

1820. *Halithea hystrix* Savigny, *Systema des annelides, principalement de celles des iotes de Egypte et de la Syrie*, etc.

Family II POLYNOIDAE

Key to genera

1. Three antennae, median antenna very small, lateral antennae inserted anteriorly .. *Iphione*
— Three antennae, median antenna distinct, laterals either terminal or ventral in origin
..... 2
2. Lateral antennae attached subdistally or ventrally (Ceratophore below the anterior points of the prostomium) 3
— Lateral antennae attached distally (Ceratophore continuation of the prostomium) 5
3. Both noto - and neurosetae with basal serrations, enlarged to form spinous pockets
..... *Scalisetosus*
— Serrations on setae not enlarged, often smaller than subsequent ones 4
4. Notosetae much stouter than neurosetae, neurosetae mainly unidentate *Eunoe*
— Notosetae not stouter than neurosetae, neurosetae mainly bidentate *Harmothoe*
5. Notosetae of two types, short and lancet shaped, and long, serrated and tapering... *Thormora*
— Notosetae of one type, slender and serrated
..... 6
6. 12 pairs of elytra, 26 segments, notosetae finer than neurosetae *Lepidonotus*
— 15 pairs of elytra, 38 segments, notosetae thicker than neurosetae *Paralepidonotus*

Genus 3. *Eunoe* Malmgren, 18663. *Eunoe pallida* (Ehlers, 1908)

1908. *Gattyana pallida* Ehlers, *Wiss-Ergetn. d. D. Tiefsee Exped.*, 16 : 49.

Diagnosis : Prostomium bilobed with three antennae, lateral ones inserted ventrally. Elytra 15 pairs, smooth, unfringed. Notosetae serrated on one side, stouter than neurosetae those with spinulose blades and unidentate tips.

Distribution : India : Gujarat, Kerala Coast, Andamans.

Elsewhere : Persian Gulf; Malay Archipelago.

Genus 4. *Harmothoe* Kinberg, 18554. *Harmothoe dictyophora* (Grube, 1878)

1878. *Polynoe dictyophora* Grube, *Mem. Acad. Sci. St. Peterb.*, 25 : 44.

Material : 1 ex., Mandvi, 27.1.1992, N.V.S. Rao.

Diagnosis : Prostomium bilobed with three antennae, median antenna twice as long as laterals. Antennae and cirri densely papillated, elytra 15 pairs, divided into polygonal areas and covered with conical chitinous tubercles of varying size, margin densely fringed with long papillae. Notosetae strongly serrated with pointed tips, neurosetae strongly bidentate.

Distribution : India : Gujarat, Kerala, Tamil Nadu, Orissa, Andamans.

Elsewhere : Red Sea, Tropical Indo-Pacific.

Genus 5. *Iphione* Kinberg, 18555. *Iphione muricata* (Savigny, 1818)

1818. *Polynoe muricata* Savigny, *Systeme annel.* : 308.

Material : 1 ex., Rozi Bandar, 14.1.1977, K.N. Reddy, 1 ex., Nagoa, 29.1.1978, B.P. Haldar, 1 ex., Diu-fort, 2.1.1990, B.P. Haldar, 6 ex., Jaleswar, 8.1.1990, B.P. Haldar.

Diagnosis : Prostomium bilobed with three antennae, median one represented by a small papilla, elytra 13 pairs, with marginal papillae.

Notosetae very fine bi-serrated capillaries, neurosetae stout with unidentate tips.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : South Africa, Zangibar, Mozambique, Madagascar, Maldives, Sri Lanka, Mergui, Philippines, Japan, Solomon Island.

Genus 6. *Lepidonotus* Leach, 1816

Key to species

1. Elytra with smooth margin
..... *Lepidonotus cristatus*
- Elytra with fringed margin..... 2
2. Antennae and dorsal cirri with subterminal dark swelling; elytra covered with innumerable small conical tubercles *L. tenuisetosus*
- Antennae and dorsal cirri without subterminal swelling or dark bands; elytra covered with spherical tubercles varying in size.....
..... *L. carinulatus*

6. *Lepidonotus carinulatus* (Grube, 1870)

1870. *Polynoe (L.) carinulatus* Grube, *Mber. Akad. Wiss. Berlin.* : 488.

Diagnosis : Prostomium with three terminal antennae. Elytra, 2 pairs, with marginal papillae, and surface with spherical tubercles. Notosetae small, slender and serrated, neurosetae weakly bidentate.

Distribution : India : Gujarat, Kerala, Tamil Nadu.

Elsewhere : Red Sea, Persian Gulf, Madagascar, Philippines, Japan.

7. *Lepidonotus cristatus* (Grube, 1876)

1876. *Polynoe cristatus* Grube, *Jber. Schles. Ges Vaterl. Kult.*, 53 : 62.

Diagnosis : Prostomium longer than broad, partly covered by occipital fold. Elytra without fringes, covered with small conical tubercles and with a large bilobed crest. Notosetae stout, carinated. Neurosetae stout with several rows of spines and with a short smooth apex.

Distribution : India : Gujarat, Tamil Nadu, Andamans.

Elsewhere : Red Sea, Zanzibar, Mozambique, Madagascar, Mauritius, Sri Lanka, Australia.

8. *Lepidonotus tenuisetosus* (Gravier, 1901)

1901. *Euphione tenuisetosa* Gravier, *Neuv. Archs. Mus. Hist. nat. Paris* 3 : 222.

Material : 7 ex., Mioni Beach, 27.8.1972, K.V. Surya Rao, 1 ex., Nagoa, West Diu, 31.12.89, B.P. Haldar, 2 ex., Veraval port, 5.1.90, A. Misra; 3 ex., Holiday camp, 7.1.1990, B.P. Haldar, 1 ex., Pirotan Island, 25.1.1990, B.P. Haldar.

Diagnosis : Prostomium longer than broad, antennae and dorsal cirri with sub-terminal swelling and dark band. Elytra fringed, surface conical with innumerable small conical tubercles, notosetae numerous, slender and spinulose, neurosetae stout mainly bidentate, sometimes unidentate.

Distribution : India : Gujarat, Maharashtra, Goa, Kerala, Tamil Nadu, Orissa, West Bengal, Andamans.

Elsewhere : Red Sea, South Africa, Madagascar, Persian Gulf, Mergu Archipelago, Japan, Tropical West Africa.

Genus 7. *Paralepidonotus* Horst, 1915

9. *Paralepidonotus ampulliferus* (Grube, 1878)

1878. *Polynoe ampullifera* Grube, *Mem. Acad. Sci. S. Peterb.* 25 : 35.

Diagnosis : Prostomium globular, with slender median antenna and sort laterals. Elytra oval with small marginal papillae, surface with numerous tubercles and a series of large pear-shaped vesicles near the posterior margin. Notosetae numerous and coarsely serrated, neurosetae slender and with bidentate tips.

Distribution : India : Gujarat, Tamil Nadu, Andaman.

Elsewhere : Red Sea, Persian Gulf, Mozambique, Philippine Islands.

Genus 8. *Scalisetosus* McIntosh, 1885.

10. *Scalisetosus fragilis* (Claparede, 1868)

1868. *Hermadion fragilis* Claparede, *Mem. Soc. Phys. Hist. nat.*, Geneva, 19 (2) : 383.

Diagnosis : Prostomium bilobed, dorsal cirri and antennae with soft papillae. Elytra oval, surface with very minute pedunculate tubercles, margin fringed. Notosetae stout, very coarsely serrated, neurosetae long, coarsely serrated and with one large spinous pockets at the base, bidentate tips.

Distribution : India : Gujarat, Tamil Nadu, Andamans.

Elsewhere : South Africa, Madagascar, Maldives, Malay Archipelago, Atlantic Ocean, Mediterranean Sea.

Genus 9. *Thormora* Bair, 1865.

11. *Thormora jukesii* (Baird, 1865)

1865. *Thormora jukesii* Baird, *J. Linn. Soc. Zool.*, 8 : 199.

Material : 2 ex., Jalendar (Diu), 30.12.89, B.P. Haldar, 1 ex., Dwaraka, 12.1.90, B.P. Haldar, 3 ex., Balapur, 17.1.90, B.P. Haldar.

Diagnosis : Antennae, tentacular cirri, dorsal cirri and anterior part of prostomium with dark pigments. Elytra slightly reniform with smooth margin. Notosetae of two kinds - short, spinulose and long, smooth capillaries. Neurosetae with 8-10 rows of spine, having unidentate tips.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : Red Sea, Madagascar, Mozambique, Malay Archipelago, New Calendonia, Australia, New Zealand, Philippine, Japan.

Family III SIGALIONIDAE

Key to genera

- Compound neurosetae with falcigerous blades *Sthenelais*
- Compound neurosetae with spinigerous laddered blades *Sthenolepis*

Genus 10. *Sthenelais* Kinberg, 1858

12. *Sthenelais boa* (Johnston, 1839)

1839. *Sigalion boa* Johnston, *Ann. Mag. nat. Hist.*, 2 : 439.

Material : 2 ex., Armbhada, Okha, 13.1.90, B.P. Haldar.

Diagnosis : Prostomium rounded with a large smooth median antenna. Elytra reniform, with a simple external fringe of papillae. Notosetae long, fine and spinulose; neurosetae of several kinds.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : Persian Gulf, Mozambique, Madagascar, Sri Lanka, Atlantic Ocean, North Carolina, Mediterranean Sea.

Genus 11. *Sthenolepis* Willey, 1905

13. *Sthenolepis japonica* (McIntosh, 1885)

1885. *Leanira japonica* McIntosh, *Rep. Scient. Results challenger*. (Zool), 12 : 154.

Material : 1 ex., Balapur Bay, (Beyt Is.), 17.1.90, B.P. Haldar.

Diagnosis : Prostomium rounded with a long tapered median antenna, lateral antennae fused to the base of the tentacular segments. Elytra smooth, reniform with very minute marginal papillae. Notosetae numerous fine capillaries with serrated margin, neurosetae mostly composite spiniger with ladder-shaped blades.

Distribution : India : Gujarat, Vellar estuary (Tamil Nadu), Andamans.

Elsewhere : Tropical Indo-West Pacific from Japan, Indian Ocean to Gulf of Oman and Mozambique.

Family IV AMPHINOMIDAE

Key to genera

— Branchiae present on most of the body segments; Caruncle short, heart-shaped
..... *Amphinome*

— Branchiae limited to the anterior part of the body segments; Caruncle long and trilobed ..
..... *Eurythoe*

Genus 12. *Amphinome* Bruguières, 1789

14. *Amphinome rostrata* (Pallas, 1766)

1766. *Aphrodita rostrata* Pallas, *Miscellanea Zoologica* : 106.

Diagnosis : Prostomium rounded, caruncle small smooth and heart-shaped. Branchiae starting from setiger 2, reaching 2 to 3 segments. Notosetae simple capillaries and harpoonsetae, neurosetae stout, curved and avicular.

Distribution : India : Gujarat, Orissa, Andamans.

Elsewhere : Widely recorded from Worm and tropical Seas.

Genus 13. *Eurythoe* Suvigny, 1818

15. *Eurythoe complanata* (Pallas, 1766)

1766. *Aphrodita complanata* Pallas, *Miscellanea Zoologica* : 109.

Material : 2 ex., Gogla, Diu, 27.11.71, Dr. G.C. Rao, 1 ex., Subhasnagar, 31.12.89, A. Misra; 1 ex., Fudam, Diu, 1.1.90, B.P. Haldar, 1 ex., Dwaraka, 16.1.90, B.P. Haldar.

Diagnosis : Caruncle extending up to setiger 4, Branchiae from setiger 2 onwards. Notosetae of three types—smooth pointed setae, harpoon setae and fine setae with a small basal spur. Neurosetae of two types—short forked setae with unequal prongs and slender setae with a small basal spur.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : Mozambique, Pakistan, Sri Lanka, Maldives, Australia, Florida, West Indies.

Family V PHYLLODOCIDAE

Key to genera

— Antennae four; prostomium heart-shaped with nuchal papillae; pharynx eversible basally papillated in rows *Anaitides*

— Antennae five; prostomium pentagonal without nuchal papilla; pharynx eversible diffusely papillated *Eulalia*

Genus 14. *Anaitides* Czerniavsky, 1882

16. *Anaitides madeirensis* Langerhans, 1880

1880. *Phyllodoce (Anaitides) madeirensis* Langerhans *Z. Wiss. Zool.* 33 : 307

Material : 1 ex., New Kandla port, 2.8.72, K.V. Surya Rao.

Diagnosis : Prostomium heart-shaped, proboscis with six lateral rows of papillae at the base of antennae, and tentacular cirri subulate, dorsal cirri lanceolate, ventral cirri oval, short and bluntly pointed. Setae composite.

Distribution : India : Gujarat, Lakshadweep, Orissa, West Bengal, Andamans.

Elsewhere : Red Sea, Mozambique, Maldives, Persian Gulf, Philippines, Sri Lanka, Solomon Island, New Caledonia.

Genus 15. *Eulalia* Savigny, 1817

17. *Eulalia viridis* (Linnaeus, 1767).

1767. *Nereis viridis* Linnaeus, *Systema Naturae etc. Edition* 12 : 3.

Material : 1 ex., Mioni beach, 27.8.72, K.V. Surya Rao; 1 ex., Veraval, 3.1.90, A. Misra; 2 ex., Fudam, Diu, 7.1.90, B.P. Haldar; 1 ex., Sikka, 23.1.90, B.P. Haldar.

Diagnosis : Prostomium rounded, with five antennae and four pairs of tentacular cirri. Proboscis long with numerous soft papillae. Dorsal cirri lanceolate, setae composite with short terminal piece.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : Cosmopolitan.

Family VI HESIONIDAE

Key to Genera

Two antennae; palps absent; parapodia uniramous *Hesione*

— Three antennae; palps present; parapodia biramous *Leocrates*

Genus 16. *Hesione* Savigny, 1818

18. *Hesione splendida* (Savigny, 1818)

1818. *Hesione splendida* Savigny, *Histoire naturelle des animaux sans Vertebres.* : 316.

Diagnosis : Prostomium deeply notched posteriorly. Two minute antero-lateral antennae. Dorsal cirri long, ventral cirri short and indistinct. Setae falcigerous with blades of varying length, tip with two distinct teeth and a fine one.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : Red Sea, Mozambique, Madagascar, tropical Indo-West Pacific.

Genus 17. *Leocrates* Kinberg, 1866

19. *Leocrates claparedii* (Coasta, 1868)

1868. *Costalia claparedii* Coasta, *Soc. phys. Geneva. Mus.* 19 : 539.

Material : 2 ex., Sikka, 22.1.90, B.P. Haldar.

Diagnosis : Prostomium with one median and two lateral antennae. Proboscis with one piece of stout teeth dorsally and one finer one ventrally. Notosetae with fine capillaries, neurosetae heterogomph falcigers with bidentate tips.

Distribution : India : Gujarat, Andamans.

Elsewhere : Red Sea, Persian Gulf, Japan, Indo-China, Mediterranean Sea.

Family VII SYLLIDAE

Key to genera

— Parapodia with pseudocomposite, simple setae in addition to composite ones *Syllis*

— Parapodia maximally with two simple setae in addition to composite ones *Typosyllis*

Genus 18. *Syllis* Savigny, 1818

20. *Syllis gracilis* Grube, 1840

1840. *Syllis gracilis* Grube, *Actinien Echinodermen und Wirmen des Adriatischen und Mittelmeeres.* : 77.

Diagnosis : Pharynx long with a simple anterior tooth. Anterior and posterior setae finely serrated, composite blades, replaced by 2-3 stout V-shaped simple setae in middle of the segments.

Distribution : India : Gujarat, Maharashtra, Goa, Lakshadweep.

Elsewhere : Mozambique, South Africa, Persian Gulf, Maldives, Sri Lanka, Atlantic Ocean.

Genus 19. *Typosyllis* Langerhans, 1879.

21. *Typosyllis variegata* Grube, 1860

1860. *Syllis variegata* Grube, *Beitrag, Zaireiche, Gattungen*, 26 : 85.

Diagnosis : Prostomium with four eyes, pharynx long with a simple anterior tooth. Setae all composite with strongly bidentate blades.

Distribution : India : Gujarat, Gulf of Mannar.

Elsewhere : Pacific and Atlantic Ocean, Mediterranean Sea.

Family VIII NEREIDIDAE

Key to genera

1. Parapodia sub-biramous throughout; without ligules *Namalycastis*
— Parapodia biramous from 3rd setiger onwards; with well developed ligules 2
2. Pharynx eversible with soft papillae 3
— Pharynx eversible with paragnaths (chitinous denticles) 4
3. Pharynx with soft papillae on both rings; some notopodia with branchiae *Dendronereis*
— Pharynx with soft papillae on maxillary ring only; notopodia without branchiae
..... *Tylonereis*
4. Pharynx with paragnath on maxillary ring only *Ceratonereis*
— Pharynx with paragnath on both rings 5
5. Paragnaths conical and in addition transverse or pectinate or both 6

— All paragnaths conical 8

6. Paragnaths include pectinate bars and usually small patches of cones; transverse smooth bars absent *Platynereis*

— Paragnaths include transverse smooth bars; patches of cones and sometimes pectinate bars 7

7. Superior notopodial lobes greatly expanded in posterior setigers; pectinate bars usually present *Pseudonereis*

— Superior notopodial lobes not expanded in any setiger; pectinate bars absent *Perinereis*

8. Notopodial homogomph falcigers present in posterior setigers *Nereis*

— Notopodial homogomph falcigers absent
..... *Neanthes*

Genus 20. *Ceratonereis* Kinberg, 1866

Key to species

1. Prostomium cleft; notopodial falcigers present in posterior feet *Ceratonereis mirabilis*

— Prostomium not cleft; notopodial falcigers absent 2

2. Neuropodial falcigers present throughout
..... *Ceratonereis costae*

— Neuropodial falcigers confined to a short middle region only. *Ceratonereis burmensis*

22. *Ceratonereis burmensis* (Monro, 1937)

1937. *Ceratonereis burmensis* Monro, *Ann. Mag. nat. Hist.*, 19 : 532.

Diagnosis : Prostomium deeply cleft, palps elongate. Eversible pharynx with chitinous paragnaths on maxillary ring, arranged as follows. Gr I = a patch of very small 3-4 paragnaths, Gr II = 6-8 in a cluster, Gr III = three rows of minute paragnaths, Gr IV = 8-12 in a cluster. Paragnaths on oral ring absent. Anterior feet with 3 dorsal and 4 ventral ligules. Setae homogomph and heterogomph spinigers. Ventral falcigers with long slender end piece.

Distribution : India : Gujarat, Goa.

Elsewhere : Burma.

23. *Ceratonereis costae* (Grube, 1840)

1840. *Nereis costae* Grube, *Actinien Echinoderman und Wirrmen des Adriatischen und Mittelmeere* : 74.

Diagnosis : Prostomium broader than long. Eversible pharynx with paragnaths arranged as : Gr I = 0, Gr II = Crescentic rows, Gr III = 4-8 in triangle, Gr IV = a wedge-shaped cluster. Anterior feet with 3 notopodial lobes, median one shorter and 3 neuropodial lobes. Posterior feet with all the lobes longer and pointed. Notopodial falcigers absent.

Distribution : India : Gujarat.

Elsewhere : Red Sea, North Atlantic, Mediterranean Sea.

24. *Ceratonereis mirabilis* Kinberg, 1866

1866. *Ceratonereis mirabilis* Kinberg, *ofver. K. Vetensk. Akad. Forh, D 22* : 170.

Material : 6 ex., Dwaraka, 12.1.90, B.P. Haldar.

Diagnosis : Prostomium cleft, pharynx with chitinous paragnaths as Gr I = 0, Gr II and IV = Wedge-shaped cluster, Gr III = a transverse cluster of several rows. Tentacular cirri and ventral cirri very long. Notopodial falcigers present in posterior feet.

Distribution : India : Gujarat, Lakshadweep, Tamil Nadu, Andamans.

Elsewhere : Red Sea, Persian Gulf, Pacific Ocean, Atlantic Ocean.

Genus 21. *Dendronereides* Southern, 1921

25. *Dendronereides heteropoda* Southern, 1921

1921. *Dendronereides heteropoda* Southern, *Mem. India, Mus, 5* : 603.

Diagnosis : Prostomium broad, pharynx with a number of papillae on both basal and maxillary rings. Superior lobes of notopodium divided to form a simple series of branchial filaments.

Notosetae all homogomph spinigers and neurosetae include both spinigers and falcigers.

Distribution : India : Gujarat, Bombay, Kerala, Orissa, Gangetic delta.

Elsewhere : Mozambique, Madagascar, Shat-el-Arab, Burma.

Genus 22. *Namalycastis* Hartman, 1959

26. *Namalycastis indica* (Southern, 1921)

1921. *Namalycastis indica* Southern, *Mem. Indian. Mus., 5* : 578.

Diagnosis : Prostomium wider than long, with a short antero-median groove. Pharynx without paragnaths, parapodia sub-biramous throughout. Dorsal cirri short in anterior segments, increasing in size in middle and posterior segments. Notosetae sometimes present and all hemigomph spinigers. Neurosetae of three kinds, hemi and heterogomph spinigers and heterogomph falcigers.

Distribution : India : Gujarat, Kerala, Tamil Nadu, Orissa, West Bengal, Andamans.

Elsewhere : Mozambique, South Africa, Burma, Mahassar, Sulawesi (Indonesia), Salomon Island.

Genus 23. *Nereis* Linnaeus, 1758

27. *Nereis coutierei* Gravier, 1899

1899. *Nereis coutierei* Gravier, *Bull. Mus. Hist. nat. Paris, 5* : 237.

Material : 6 ex, Okha, 14.1.90, B.P. Haldar.

Diagnosis : Paragnaths on proboscis arranged as : Gr I = 1; Gr II to IV = small cluster, Gr V = 0, Gr VI = on each side a small rounded cluster of 6-9, Gr VII and VIII = a single row of 8 to 10 denticles. Anterior feet with two equal ligules. Posterior feet with enlarged rounded ligules. Ventral heterogomph falcigers with short sickle-shaped blades in posterior feet.

Distribution : India : Gujarat, Andamans.

Elsewhere : Red Sea, Suez Canal, Persian Gulf, Indo-China.

28. *Nereis persica* (Fauvel, 1911)

1911. *Nereis Zonata-persica* Fauvel, *Arch. Zool. exp. gen. (Ser. 5) 6* : 385.

Diagnosis : Paragnaths on proboscis arranged as : Gr I = 1, Gr II = double row, Gr III = few conicals, Gr IV = 2 to 3 irregular rows, Gr V = 0, Gr VI = cluster of several denticles, Gr VII and Gr VIII = a broad band with an anterior row of large points and two to three posterior rows of fine points. Notopodial homogomph falcigers with 2-3 blunt teeth, neuropodial heterogomph falcigers with curved blades and a slight tenden at the tip.

Distribution : India : Gujarat, Goa, Tamil Nadu, Orissa.

Elsewhere : Red Sea, Tropical Indo-West Pacific.

Genus 24. *Neanthes*

Key to species

1. Notopodia trilobed *Neanthes indica*
- Notopodia bilobed 2
2. 3 to 4 irregular rows of several paragnaths on Gr VII and Gr VIII *Neanthes willeyi*
- A single row of 6 to 7 large paragnaths on Gr VII and Gr VIII. *Neanthes unifasciata*

29. *Neanthes indica* Kinberg, 1866

1866. *Nereis indica* Kinberg. *Ofvers. K. Vetensk. Akad. Forh.* **22** : 169.

Diagnosis : Proboscis with paragnath arranged as follows : Gr I = 1, Gr II = a double row, Gr III = an oval patch, Gr IV = Wedge shaped cluster, Gr V = 0, Gr VI = a group of 7 to 8 cluster, Gr VII and Gr VIII = 2 irregular rows. Notopodial falcigers absent, neuropodial heterogomph falcigers with sickle-shaped blade.

Distribution : India : Gujarat, Tamil Nadu, Andhra Pradesh, Orissa.

Elsewhere : Mozambique, Madagascar, Sri Lanka, Bangka Strait, Sumatra.

30. *Neanthes unifasciata* Willey, 1905

1905. *Nereis unifasciata* Willey. *Suppl. Rep. ceylon pearl oyster*, **4** : 271.

Material : 3 ex., Dwaraka, 16.1.90, B.P. Haldar.

Diagnosis : Prostomium short. Proboscis with paragnaths arranged as : Gr I = 1 to 6 in a line, Gr II = double rows, Gr III = a small group of 8 to 14, Gr IV = a wedge-shaped group, Gr V = 1, Gr VI = a rounded group of 4 to 8, Gr VII and Gr VIII = a single row of 6 to 8. Anterior feet with two notopodial lobes, posterior feet with two triangular lobes, and homogomph falcigers absent, neuropodial heterogomph falcigers with sickled-shaped blades.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : New Caledonia, Philippine Island, Indo-China.

31. *Neanthes willeyi* Day, 1934

1934. *Nereis willeyi* Day, *J. Linn. Soc. Zool.*, **39** : 54.

Diagnosis : Proboscis with paragnaths arranged as : Gr I = 1, Gr II = 18 to 20 in two oblique rows, Gr III = several in a cluster, Gr IV = a wedge-shaped group, Gr V = 1, Gr VI = a rosette of 5, Gr VII and Gr VIII = 3-4 rows of numerous denticles. Parapodia in anterior feet having 2 lobes each in dorsal and ventral rami with rounded tip. Dorsal cirri longer than ventral cirri, dorsal setae homogomph spinigers, Ventral setae homo and heterogomph spinigers and heterogomph falcigers.

Distribution : India : Gujarat, Orissa.

Elsewhere : Persian Gulf, Suez Canal.

Genus 25. *Perinereis* Kinberg, 1866

Key to species

1. A continues row of bars accross Gr V and Gr VI *Perinereis nuntia*
- Only one or two bars on Gr V and Gr VI .. 2
2. Two transverse paragnaths on Gr VI 3
- A single transverse paragnaths on Gr VI .. 4
3. Obtusely conical, little flattened paragnaths on Gr VI *Perinereis aibuhitensis*
- Two long and flattened paragnaths on Gr VI *Perinereis vancaurica*

4. Paragnaths missing on Gr V
 *Perinereis cavifrons*

— A triangular patch of three paragnaths or a single large one on Gr V 5

5. One to three paragnaths in line on Gr I, dorsal lobe of posterior feet not expanded
 *Perinereis cultrifera*

— Six to twelve paragnaths on Gr I, dorsal lobe of posterior feet expanded
 *Perinereis nigropunctata*

32. *Perinereis aibuhitensis* Grube, 1878

1878. *Perinereis aibuhitensis* Grube, *Mem. Acad. Sci., S. Peterb.*, **25** : 89.

Material : 4 ex., Okha M.B.R.S., 14.1.90, B.P. Haldar.

Diagnosis : Proboscis with paragnaths arranged as Gr I = 2 in a line, Gr II and Gr IV = in a cluster, Gr III = a transverse cluster of 3 rows, Gr V = 3 in a triangle, Gr VI = 2 bluntly conical flattened bars on each side, Gr VII and Gr VIII = 2 to 3 rows. Falcigerous bristle with long straight terminal piece.

Distribution : India : Gujarat, Maharashtra, Andhra Pradesh, Orissa, Andamans.

Elsewhere : Philippines, Batavia, Macassar, China.

33. *Perinereis cavifrons* Ehlers, 1920

1920. *Nereis cavifrons* Ehlers, *K. Ges. Wiss. Göttingen, Abh.*, n. Folge, **10** : 1 73.

Material : 2 ex., Okha, 14.1.90, B.P. Haldar, 1 ex., Okha, 4.2.92, N.V.S. Rao.

Diagnosis : Prostomium globular with 2 short frontal antennae. Proboscis with paragnaths arranged as : Gr I = 3 cones in vertical line, Gr II = several cones in crescentic patch, Gr V = 0, Gr VI = a transverse bar on each side, Gr VII and Gr VIII = several cones in 2-3 irregular rows. Dorsal cirri about the length of the dorsal ligule.

Distribution : India : Gujarat, Goa, Kerala, West Bengal.

Elsewhere : Java, Indonesia.

34. *Perinereis cultrifera* (Grube, 1840)

1840. *Nereis cultrifera* Grube, *Actinien Echinodermen und Würmen des Adriatischen und Mittelmeeres* : 74.

Material : 4 ex., Nagoa, 31.12.89, B.P. Haldar, 2 ex., Veraval, 3.1.90, A. Misra, 1 ex., Veraval, 5.1.90, B.P. Haldar, 5 ex., Pirotan Island, B.P. Haldar.

Diagnosis : Proboscis with paragnaths arranged as : Gr I = 1-3 cones in a line, Gr II and Gr IV = clusters of several cones, Gr III = an oval patch of three cones, Gr VI = a transverse bar on each side, Gr VII and Gr VIII = 2-3 irregular rows of several cones. Posterior parapodia not enlarged.

Distribution : India : Gujarat, Maharashtra, Travancore, Lakshadweep, Cape Comorine, Tuticorin, Orissa, Andamans.

Elsewhere : Widely recorded from Indian Ocean, Pacific Ocean and Atlantic Ocean.

35. *Perinereis nigropunctata* (Horst, 1889)

1889. *Nereis nigro-punctata* Horst, *Notes Leydon Mus. Jentink*, **11** : 171.

Material : 12 ex., Nagoa, 29.1.78, B.P. Haldar, 8 ex., Gulf of Kutch, 25.12.89, A. Misra, 5 ex., Diufort, 2.1.90, B.P. Haldar, 1 ex., Veraval, 5.1.90, B.P. Haldar.

Diagnosis : Proboscis with paragnaths arranged as : Gr I = a cluster of 10 to 12 conicals, Gr II = 2-3 rows as triangular, Gr III = a crescentic patch of several cones, Gr IV = several cones forming a wedge-shaped patch, Gr V = 3 conicals in a triangular patch, Gr VI = a transverse bar on each side, Gr VII and Gr VIII = a double rows of continuous belt, falcigerous bristle with short sickle-shaped blades.

Distribution : India : Gujarat, Goa, Tamil Nadu, Orissa, West Bengal, Andamans.

Elsewhere : Red Sea, Mozambique, Madagascar, Malay, Great Berrier Reef, Salomon Island.

36. *Perinereis nuntia* (Savigny) 1818

1818. *Lycoris nuntia* Savigny, *Histoire naturelle des animaux sans vertebres.* : 612.

Material : 4 ex., Mandavi, 28.7.72, K.V. Surya Rao, 16 ex., Jaleswar beach, 21.1.78, B.P. Haldar, 3 ex., Veraval port, 5.1.90, 2 ex., Dwaraka, 12.1.90, B.P. Haldar.

Diagnosis : Proboscis with paragnaths arranged as : Gr I = 1-2 cones in a line, Gr II and Gr IV = clusters of several cones, Gr III = rectangular patch, Gr V = 3 cones in a triangular, Gr VI = curved row of 6-10 small cones on each side, Gr VII and Gr VIII = 2-3 irregular rows. Dorsal ligule of posterior parapodia enlarged.

Distribution : India : Lakshadweep, Tamil Nadu, Orissa, Andaman, Gujarat, Maharashtra.

Elsewhere : Red Sea, Persian Gulf and also widely recorded in Indian Ocean.

37. *Perinereis vancaurica* (Ehlers, 1868)

1868. *Nereis vancaurica* Ehlers. *Die Borsten Wirmen nach systema tisehen und anatomischen untersuchungen dargestellt* : 748.

Material : 1 ex., Miani Beach, 27.8.72, K.V. Surya Rao, 6 ex., Razi Bandar, Jamnagar, 14.4.77, K.N. Reddy, 4 ex., Okha, 13.1.90, B.P. Haldar, 12 ex., Sachana, 24.1.90, B.P. Haldar.

Diagnosis : Proboscis with paragnaths arranged as : Gr I = 2 cones in a line, Gr II = several cones in two curved rows, Gr III = a square group, Gr IV = several cones forming triangular patch, Gr V = 3 cones in a triangular, Gr VI = 2 transverse bars on each side, Gr VII and Gr VIII = 3 irregular rows. Dorsal ligule of posterior parapodia not enlarged.

Distribution : India : Gujarat, Maharashtra, Goa, Lakshadweep, Orissa, Andamans.

Elsewhere : Red Sea, Mergui, Singapore, Indo-China, Philippines, Great Barrier Reef, New Zealand, Atlantic Ocean.

Genus 26. *Pseudonereis* Kinberg, 1866

Key to species

1. A single bar on Gr VI; one conical paragnaths on Gr V *Pseudonereis variegata*
— 6-10 short bars or conical paragnaths on Gr VI, paragnaths absent on Gr V 2
2. A single row of large paragnaths, more or less flattened, on Gr VII-VIII
..... *Pseudonereis anomala*
— Two alternating rows of paragnaths on Gr VII VIII *Pseudonereis rotnestiana*

38. *Pseudonereis anomala* Gravier, 1901

1901. *Pseudonereis anomala* Gravier, *Nouv. Archs. Mus. Hist. nat.* Paris, 3 : 191.

Material : 6 ex., Jaleswar, 8.1.90, B.P. Haldar, 10 ex., Okha, 14.1.90, B.P. Haldar.

Diagnosis : Proboscis with paragnaths arranged as : Gr I = 2 in a line, Gr II, Gr III and Gr IV = several pectinate paragnaths in rows, Gr V = 0, Gr VI = a transverse row of 7 to 8 conicals paragnaths on each side, Gr VII and VIII = one row. Dorsal ligule of posterior parapodia enlarged.

Distribution : India : Gujarat, Goa, Tamil Nadu, Orissa, Andamans.

Elsewhere : Red Sea, Madagascar, Australia, Indo-China.

39. *Pseudonereis rotnestiana* Augener, 1913

1913. *Pseudonereis rotnestiana* Augener, *Die Fauna Sudwest Australiens*, 4 : 184.

Material : 3 ex, Okha, 25.12.89, A. Misra.

Diagnosis : Proboscis with paragnaths on Gr I = 2 denticles, Gr II and Gr III = 4-5 rows of pectinate paragnaths, Gr IV = 5-6 rows of pectinate paragnaths and few conical paragnaths. Gr V = 0, Gr VI = a transverse row of 6-8 conical paragnaths on each side, Gr VII and Gr VIII = two alternating rows. Dorsal ligule of posterior parapodia enlarged.

Distribution : India : Gujarat, Andamans.

Elsewhere : Australia.

40. *Pseudonereis variegata* (Grube, 1857)

1857. *Nereilapas variegata* Grube, *Vidensk. Meddet. Fra.d.naturhist. Foren.* Kobenhavn, 11 : 164.

Material : 5 ex., Fudam, Diu, 1.1.90, B.P. Halder, 1 ex., veraval, 5.1.90, B.P. Halder, 3 ex., Holiday Camp, 7.1.90, B.P. Halder, 8 ex., Dwaraka, 16.1.90, B.P. Halder.

Diagnosis : Paragnaths on Gr I = 1, Gr II = Conicals, arranged in 4 transverse rows forming a triangular, Gr III = several conicals arranged in 3 transverse rows, Gr IV = 5 transverse rows of conicals and cluster of several conicals and bars, Gr V = 1, Gr VI = a single bar on each side, Gr VII and VIII = a single row of conicals forming a belt. Superior lobe of posterior parapodia large and flattened with a small cirrus on its upper border.

Distribution : India : Gujarat, Goa, Andamans.

Elsewhere : Widely distributed in circum-tropical region.

Genus 27. *Platynereis* Kinberg, 1866

41. *Platynereis abnormis* (Horst, 1924)

1924. *Nereis abnormis* Horst, *Siboga-Expedition*, 99 : 145-198.

Diagnosis : Proboscis with paragnaths arranged as : Gr I = 0, Gr II = a small concave row of paragnaths, Gr III = 0, Gr IV = a crescentic row of paragnaths, Gr V = 0, Gr VI = a triangular row of paragnaths, Gr VII and VIII = transverse group of 5 paragnaths in which three of them in median part and one on each side. Dorsal cirrus very long on 7th segment.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : Sri Lanka, Malaya Archipelago.

Genus 28. *Tylonereis* Fauvel, 1911

42. *Tylonereis bogoyawlenskyi* Fauvel, 1911

1911. *Tylonereis bogoyawlenskyi* Fauvel, *Archile, Zool. Exper. Gen.* Paris, 6 : 373.

Diagnosis : Paragnaths with soft conical papillae only; Gr I = 3, Gr II = 1, Gr III = 6-10, Gr VI = 1 on each side, Gr VII = 2, Gr VIII = 0, Setae all homogomph spinigers; dorsal ligule triangular and foliaceous; ventral ligule decreasing in size backward.

Distribution : India : Gujarat, Kerala, Tamil Nadu.

Elsewhere : Persian Gulf.

Family IX NEPHTYIDAE

Genus 29. *Nephtys* Cuvier, 1817

43. *Nephtys polybranchia* Southern, 1921

1921. *Nephtys polybranchia* Southern, *Mem. Indian. Mus.* 5 : 607.

Diagnosis : Prostomium rectangular, longer than wide, with a pair of antennae and a pair of palps. Pharynx eversible, divisible into short muscular distal and inflated proximal region; distal region with 20 bifid papillae and also with 22 longitudinal rows of papillae. Interramal proximal region smooth. Cirri rudimentary on setigers 2-5, but well developed, broad and foliaceous with median ridges, on setigers 6-30, extending nearly to the posterior end.

Distribution : India : Gujarat, Tamil Nadu, Orissa, West Bengal.

Elsewhere : Sri Lanka, Gulf of Siam, Vietnam.

Family X GLYCERIDAE

Genus 30. *Glycera* Savigny, 1818

Key to species

- Branchiae present; a short rounded postsetal lobe *Glycera convoluta*
- Branchiae absent; two rounded sub-equal postsetal lobe *Glycera tessellata*

44. *Glycera convoluta* Keferstein, 1862

1862. *Glycera convoluta* Keferstein, *Z. Wiss. Zool.* 12 : 106.

Diagnosis : Prostomium with 10-12 rings; 2 small eyes at the base and 4 small antennae

distally. Pharyngeal papillae of two kinds mostly cylindrical and others rounded. Parapodia of first setigers uniramous, subsequent ones biramous. Branchiae simple, appear about the dorsal edge of setigers 35-40, extending beyond the tip of presetal lobe at least in some setiger, continuing nearly to the posterior end.

Distribution : India : Gujarat, Goa, Maharashtra, Kerala, Orissa, West Bengal.

Elsewhere : South Africa, Madagascar, Mocambique, Persian Gulf, Japan, Western Canada to South California, East Atlantic from the English Channel to tropical West Africa, Mediterranean Sea.

45. *Glycera tessellata* Grube, 1863

1863. *Glycera tessellata* Grube, *Zahlreiche Gattungen*, 29 : 41.

Diagnosis : Prostomium with 12-14 rings; parapodia with 2 anterior triangular, subequal presetal ligules and 2 shorter, rounded subequal postsetal lobes. Branchiae absent. Pharynx very long, grooved papillae without ring.

Distribution : India : Gujarat, Daman, Andhra Pradesh, Orissa, West Bengal, Andamans.

Elsewhere : Red Sea, Madagascar, Maldives, Japan, Mediterranean Sea.

Family XI GONIADIDAE

Key to genera

- V-shaped chevrons present; body divided into to regions; all neurosetae composite spinigerous *Goniada*
- V-shaped chevrons absent; body divided into three regions; neurosetae composite falcigers in anterior region and spinigers in middle and posterior regions *Goniadopsis*

Genus 31. *Goniada* Audouin and Milne-Edwards, 1833

46. *Goniada emerita* Audouin and Milne-Edwards, 1833

1833. *Goniada emerita* Audouin and Milne-Edwards, *Annl. Sci. Nat.* 29 : 268.

Material : 1 ex, Mandvi, 30.7.72, K.V. Surya Rao.

Diagnosis : Prostomium long, conical with 8-10 rings, with 2 small eyes and 4 antennae. Pharynx eversible long and cylindrical with small rounded papillae, chevrons with 5-6 chitinous pieces on each side, for anterior paragnaths distally placed. Parapodia uniramous for 35-40 setigers, succeeding ones biramous. Notosetae robust, acicular.

Distribution : India : Gujarat, Vandrutti, Cochin, Vishakhapatnam, Hooghly estuary.

Elsewhere : Red Sea, Mozambique. South Africa, Madagascar, Australia, Chatham Island, North Atlantic from Scotland to Morocco, Mediterranean Sea.

Genus 32. *Goniadopsis* Fauvel, 1928

47. *Goniadopsis incerta* Fauvel, 1932

1932. *Goniadopsis incerta* Fauvel, *Mam. Indian Mus.* D 12 : 122.

Material : 16 ex., Navibandar, 30.12.89, A. Misra.

Diagnosis : Prostomum conical with four small antennae. Pharynx eversible long and cylindrical covered with small rounded papillae. Parapodia uniramous for anterior 20-22 setigers, succeeding ones biramous. Middle region with very long ventral cirri.

Distribution : India : Gujarat.

Elsewhere : Cape, Burma.

Family XII EUNICIDAE

Key to genera

1. Five antennae; branchiae usually present.... 2
- Three antennae; branchiae absent *Lysidice*
2. Tentacular cirri present *Eunice*
- Tentacular cirri absent *Marphysa*

Genus 33. *Eunice* Cuvier, 1817

Key to species

1. Branchiae simple with one or two filaments starting very far from head 2

- Branchiae branched starting anteriorly 3
2. Comb setae and acicular setae absent
..... *Eunice siciliensis*
- Comb setae and acicular setae present
..... *Eunice cincta*
3. Acicular setae tridentate 4
- Acicular setae bidentate 5
4. Branchiae starts anteriorly, and well developed
on the posterior part of body
..... *Eunice antennata*
- Branchiae anteriorly well developed on middle
part and absent on posterior part of body...
..... *Eunice australis*
5. Branchiae starts very far from the head (80th
to 100th segments) *Eunice gracilis*
- Branchiae starts anteriorly 6
6. Branchiae starts on the 4th to 6th segments,
with 6 filaments *Eunice tentaculata*
- Branchiae starts on about 25-30 segments, with
4 to 6 filaments *Eunice afra paupera*

48. *Eunice antennata* (Savigny, 1820)

1820. *Leodice antennata* Savigny, *Systeme Annelids
Description Egypte. Hist. Nat. Paris*, : 50.

Material : 1 ex., Hanuman Dandi (Beyt Island),
18.1.90, B.P. Haldar.

Diagnosis : Antennae deeply annulated,
branchiae commencing from setiger 6, simple on
first two setigers, then pinnately branched with
6-12 filaments. Acicular setae tridentate, parapodia
with comb setae, capillary setae and compound
setae.

Distribution : India : Gujarat, Lakshadweep,
Andamans.

Elsewhere : Red Sea, Gulf of Suez, Mozambique,
Madagascar, Cape, Natal, Philippines, Southern
California, North Carolina, Senegal.

49. *Eunice australis* Quatrefages, 1865

1865. *Eunice australis* Quatrefages, *Acad. Sci. Paris, C.R.*,
6 : 321.

Material : 1 ex., Subhasnagar (Porbandar),
31.12.89, A. Misra, 2 ex., Sikha, 22.1.90. B.P.
Haldar.

Diagnosis : Antennae annulated, branchiae
commencing from setiger 6, extending almost to
the middle part of body and having 6-14 filaments.
Acicular setae tridentate.

Distribution : India : Gujarat, Andamans.

Elsewhere : Red Sea, Mozambique,
Madagascar, Cape, Natal, Maldivé Archipelago,
Burma, Australia, New Zealand.

50. *Eunice gracilis* (Crossland, 1904)

1904. *Nicidion gracilis* Crossland, *Proc. Zool. Soc. London*,
: 327.

Material : 1 ex., Veraval, 5.1.90, B.P. Haldar.

Diagnosis : Antennae faintly annulated,
branchiae commencing very far from the body
and having simple filament (1-2), parapodia with
comb setae, acicular setae and compound setae.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : Zanzibar, Mergui, Indo-China,
Australia.

51. *Eunice cincta* (Kinberg, 1865)

1865. *Nicidion cincta* Kinberg, *Ofvers. K. Vetensk Akad.
Förh.*, 21 : 564.

Material : 2 ex., Gulf of Kutch, Okha, 25.1.89,
A. Misra.

Diagnosis : Antennae subequal, branchiae
present only in the last few segments, parapodia
with compound falcigerous setae, comb setae and
acicular setae.

Distribution : India : Gujarat, Lakshadweep.

Elsewhere : South Africa, Indian Ocean, South
Pacific, Senegal.

52. *Eunice tentaculata* Quatrefages, 1865

1865. *Eunice tentaculata* Quatrefages, *Paris, Libr. Encycl
de Roret*, 3 : 317.

Material : 2 ex., Veraval, 3.1.90, A. Misra.

Diagnosis : Antennae and tentacular cirri deeply annulated, branchiae commencing from 3-6 setiger and having 4-12 filaments, decreasing towards the end of the body. Compound setae falcigerous with two well defined teeth and rounded guards.

Distribution : India : Gujarat, Lakshadweep, Gulf of Mannar, Orissa, Andamans.

Elsewhere : South Africa, Sri Lanka, Western Australia, New Zealand.

53. *Eunice siciliensis* Grube, 1840

1840. *Eunice siciliensis* Grube, *Actinen Echinodermen und Wirmen des Adriatischen und Mittelmeeres* : 83.

Material : 3 ex., Gulf of Kutch, Okha 25.1.89, A. Misra, 1 ex., Fudam, Diu, 1.1.90, B.P. Haldar, 2 ex., Veraval, 5.1.90, B.P. Haldar.

Diagnosis : Body divided into two regions, anterior narrow and rounded, posterior soft and flattened, branchiae simple commencing very far from the head, parapodia with capillary setae and falcigers, comb setae and acicular setae absent.

Distribution : India : Gujarat, Lakshadweep, Gulf of Mannar, Andamans.

Elsewhere : Cosmopolitan.

54. *Eunice afra paupera* Grube, 1878

1878. *Eunice paupera* Grube, *Mem. Acad. Sci. S. Peterb.* 25 : 160.

Material : 2 ex., Okha (M.B.R.S.), 14.1.90, B.P. Haldar.

Diagnosis : Body elongated, flattened posteriorly. Branchiae commencing from setiger 19 with 2-4 filaments, gradually decreasing posteriorly and completely absent on the last few setigers. Acicular setae bidentate and black.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : Red Sea, Malay Archipelago, Philippines, New Caledonia.

Genus 34. *Lysidice* Savigny, 1818

Key to species

- Second dental plate with three heavy teeth *Lysidice natalensis*
- Second dental plate with four teeth *Lysidice collaris*

55. *Lysidice collaris* Grube, 1870

1870. *Lysidice collaris* Grube, *Mber. Akad. Wiss Berlin* : 495.

Material : 1 ex., Hanuman dandi, Beyt. Island (near Okha); 18.1.90, B.P. Haldar.

Diagnosis : Prostomium with three antennae, branchiae absent. Parapodia with acicular setae, capillary setae, comb setae and falcigers.

Distribution : India : Gujarat, Tamil Nadu : Kilakari and Pamban, Andamans.

Elsewhere : Maldiv Archipelago, Ceylon, Singapore.

56. *Lysidice natalensis* Kinberg, 1865

1865. *Lysidice natalensis* Kinberg, *Ofvers. K. Vetensk. Akad. Forh.* 21 : 566.

Material : 2 ex., Port Okha, Gulf of Kutch, 12.12.89, A. Misra.

Diagnosis : Prostomium bilobed, wider than long, with 3 stout tapering occipital antennae as long as prostomium. Parapodia usually with bluntly conical dorsal cirri, ventral cirri broad. Setae include capillaries, pectinate setae, composite falcigers, comb setae and subacicular hooks.

Distribution : India : Gujarat, Lakshadweep, Hooghly estuary.

Elsewhere : South Africa.

Genus 35. *Marphysa* Quatrefages, 1865

Key to species

- Inferior setae simple capillaries; comb setae absent *Marphysa mossambica*

— Inferior setae composite spinigers; comb setae present *Marphysa sanguinea*

57. *Marphysa mossambica* (Peters, 1854)

1854. *Eunice mossambica* Peters, *Mler. Akad. Wiss. Berlin* : 612.

Material : 1 ex., Marwad (Daman), 13.2.78, B.P. Halder.

Diagnosis : Prostomium with five antennae, branchiae commencing from setigers 26-30, with 5-8 filaments posteriorly. Parapodia with simple setae.

Distribution : India : Gujarat, Tamil Nadu, Kilakarai, Orissa, Gangetic Delta, Andamans.

Elsewhere : Red Sea, East Africa, Philippines, Australia.

58. *Marphysa sanguinea* (Montagu, 1815)

1815. *Nereis sanguinea* Montagu, *Trans. Linn. Soc. Lond.* 11 : 20.

Material : 1 ex., Rukmabati River Mouth, Mandovi, 30.7.72, K.V. Surya Rao.

Diagnosis : Prostomium bilobed, as long as wide with 5 smooth and slender occipital antennae. Branchiae commencing from setiger 16, initially as simple filament, later developed with a maximum of 4 filaments, extending up to the posterior end. Setae include capillaries, comb setae and composite spinigers.

Distribution : India : Gujarat, Marmugao Bay, Malvan, Umbargaon, Kerala, Travancore and Quilon, Krusadai Island, Pamban, Tuticorin, Vishakhapatam, Hooghly estuary.

Elsewhere : Red Sea, Sri Lanka, Western Australia, New Zealand, Japan, South California, Gulf of Mexico, Scotland, Mediterranean Sea.

Family XIII ONUPHIDAE

Genus 36. *Diopatra* Audouin and Milne Edward, 1833

59. *Diopatra neapolitana* Delle-chiaje, 1841

1841. *Diopatra neapolitana* Delle-chiaje, *Descrizione e*

notomia degli animali invertebrate della sicilia catereiore osservati vivi neglianni, Naples, 3 : 97.

Material : 5 ex., Rozi Bandar, Jamnagar, 14.4.77, K.N. Reddy.

Diagnosis : Prostomium rounded, 2 small frontal antennae, and five occipital antennae. Branchiae commencing on setigers 4-5, very long, decreasing in size posteriorly. Setae include capillaries, pseudo-compound bristle, comb-setae present, Acicular setae bidentate.

Distribution : India : Gujarat, Tamil Nadu, Orissa, Hooghly estuary.

Elsewhere : Red sea, Persian Gulf, Ceylon, Gulf of Onam, Gulf of Siam, Atlantic Ocean, Mediterranean Sea.

Family XIV LUMBRINERIDAE

Genus 37. *Lumbrineris* Blainville, 1828

Key to species

1. Capillary setae present; hooks absent 2
- Capillary setae and hooks present 3
2. Parapodial lobes short ... *Lumbrineris simplex*
- Parapodial lobes long and cirriform
..... *Lumbrineris pseudobifilaris*
3. Dorsal cirri absent *Lumbrineris polydesma*
- Dorsal cirri present 4
4. Dorsal cirri rudimentary hooded hooks from setiger 20 to 40 *Lumbrineris heteropoda*
- Dorsal cirri long strap-like; hooded hooks from setiger 40 to 45 *Lumbrineris notocirrata*

60. *Lumbrineris heteropoda* (Marenzeller, 1879)

1879. *Lumbriconereis heteropoda* Marenzeller, *Denskchr. Acad. Wiss. Wien*, 41 (2) : 138.

Material : 1 ex., Harshadha, 1.1.90, A. Misra.

Diagnosis : Prostomium conical. Anterior parapodia with presetal lobes low and rounded, postsetal lobes long and conical. Posterior parapodia with postsetal lobes being much longer.

sometimes erect. Postsetal lobes reduced to short processes in midbody region. Dorsal cirri rudimentary. Capillaries in anterior setigers long-bladed simple hooded hooks. Posterior setae short-bladed and sometimes with winged capillaries.

Distribution : India : Gujarat, Ratnagiri, Coast of Goa, Mormugao Bay, Mandovi Zuary estuary, Sundarbans, Godavari estuary.

Elsewhere : Red Sea, Mozambique, Madagascar, Persian Gulf, Indo-China, South Vietman, Japan, California.

61. *Lumbrineris polydesma* Southern, 1921

1921. *Lumbriconereis polydesma* Southern, *Mem. Indian Mus.*, 5 : 622.

Diagnosis : Prostomium bluntly conical, dorsal cirri absent, parapodia uniramous with an anterior short, rounded presetal lobe and a long postsetal one. Setae of two kinds, limbate setae and simple hooks. Anterior parapodia with limbate setae only, hooks appearing on setiger 30 and continuing up to the posterior end.

Distribution : India : Gujarat, Daman, Vellar estuary, Adyar estuary, Chilka Lake, Pulicat Lake, Chandipur, Gangetic delta.

62. *Lumbrineris notocirrata* (Fauvel, 1932)

1932. *Lumbriconereis notocirrata* Fauvel, *Mem. Indian Mus.*, 12 : 156.

Material : 1 ex., Port Okha, 14.1.90, B.P. Haldar.

Diagnosis : Prostomium bluntly conical. Parapodia sub-biramous, notopodia represented by small dorsal cirri supported by acicula, dorsal cirri long and strap-like in middle and posterior setigers. Setae of two kinds, limbate and simple hooks. Anterior setae all smooth, limbate setae with fine tips, simple hooded hooks from setiger 40.

Distribution : India : Gujarat, Vishakhapatnam back-water, Chandipur, Hooghly estuary.

63. *Lumbrineris pseudobifilaris* (Fauvel, 1932)

1932. *Lumbriconereis pseudobifilaris* Fauvel, *Mem. Indian Mus.*, 12 : 154.

Diagnosis : Prostomium conical. Parapodia with only winged capillary setae, hooks absent, anterior parapodial ligules short rounded, posterior ones long tapering at the tip.

Distribution : India Gujarat, Cochin, Travancore.

Elsewhere : Burma.

64. *Lumbrineris simplex* Southern, 1921

1921. *Lumbriconereis simplex* Southern, *Mem. Indian Mus.*, 12 : 625.

Diagnosis : Prostomium triangular. Parapodia with only simple setae, hooks absent, anterior parapodial ligules short rounded, posterior ligules blunt and conical.

Distribution : India : Gujarat, Cochin back water, Chilka Lake.

Family XV ARABELLIDAE

Genus 38. *Arabella* Grube, 1850

65. *Arabella iricolor* (Montagu, 1804)

1804. *Nereis iricolor* Montagu, *Trans. Linn. Soc. London*, 7 : 84.

Diagnosis : Prostomium conical, with 4 eyes, parapodia without branchiae and cirri, anterior ligules short and posterior elongated. Setae simple, dorsal setae geniculate with a denticulate crest, ventral setae with smooth edges.

Distribution : India : Gujarat, Gulf of Mannar, Vishakhapatnam, Andamans.

Elsewhere : Cosmopolitan.

Family XVI LYSARETIDAE

Genus 39. *Oenone* Savigny, 1820

66. *Oenone fulgida* (Savigny, 1818)

1818. *Aglaura fulgida* Savigny, *Histoire naturelle des animaux sans vertebres* : 326.

Material : 1 ex., Pirotan Island, 15.1.90, B.P. Haldar.

Diagnosis : Prostomium rounded with two pairs of eyes, anterior pair larger; 3 antennae, much shorter than the prostomium, hidden under peristomial fold. Dorsal cirri chopper-like. Anterior ligule short and rounded, posterior ligule more elongated. Setae capillaries in posterior segments. Acicular setae yellow and bidentate.

Distribution : India : Gujarat, Kilakarai, Andamans.

Elsewhere : Red Sea, Persian Gulf, Tropical Indo-West Pacific, Atlantic Ocean.

Family XVII ORBINIIDAE

Genus 40. *Nainereis* Blainville, 1828

67. *Nainereis laevigata* (Grube, 1855)

1855. *Aricia laevigata* Grube, *Arch. Naturgesch.* 21 : 112.

Diagnosis : Prostomium rounded and without antennae and palps; proboscis with many marginal lobes. Thorax flattened and with 20-26 setigers. Branchiae simple commencing from 5th to 6th setiger. Dorsal ramus with knife-like dorsal cirrus. Thoracic notosetae include a few forked setae and crenulate capillaries. Thoracic neurosetae include rows of hooks, crenulate capillaries and often intermediate setae subulunciri. Thoracic neuropodia with a food-papilla. Abdominal setae include fork setae and crenulate capillaries.

Distribution : India : Gujarat, Andamans.

Elsewhere : Japan, China, Persian Gulf, Mediterranean Sea.

Family XVIII CIR RATULIDAE

Key to genera

- Dorsal tentacular cirri first present from the same segment as the anteriormost branchiae *Cirratulus*
- Dorsal tentacular cirri first present posterior to the anteriormost branchiae *Cirriformia*

Genus 41. *Cirratulus* Lamarck, 1801

68. *Cirratulus chryso derma* Claparede, 1868

1868. *Cirratulus chryso derma* Claparede, *Mem. Soc. Phys. Hist. nat. Geneva*, 19 (2) : 262.

Material : 2 ex., Balapur Bay, 17.1.90, B.P. Haldar.

Diagnosis : Prostomium bluntly conical with indistinct eyes, branchiae commencing on 6 segments restricted to the anterior part of the body arising closer to notosetae, Capillaries in both rami throughout. Acicular setae absent.

Distribution : India : Gujarat, Lakshadweep, Pamban.

Elsewhere : South Africa, Persian Gulf, Japan, Mediterranean Sea.

Genus 42. *Cirriformia* Hartman, 1936

Key to species

1. Branchiae of the middle segments arise closer above the notosetae than distance between notosetae and neurosetae
..... *Cirriformia tentaculata*
- Branchiae of the middle segments arise further above the notosetae than distance between notosetae and neurosetae 2
2. Body speckled with black pigments, branchiae and tentacles barred *Cirriformia punctata*
- Body uniformly brown, branchiae and tentacles uniformly yellow or orange
..... *Cirriformia filigera*

69. *Cirriformia filigera* (Delle-chiaje, 1825)

1825. *Lumbricus filigerus* Delle-chiaje, *Memorie Sulla storia e notomia degli animalisenza vertebra del regnodi Napoli*, Nepler, 3 : 178.

Material : 1 ex., Okha, 17.1.90, B.P. Haldar.

Diagnosis : Prostomium bluntly conical, numerous tentacular filaments arising on setiger 5-7. Branchiae appearing on setiger 1 extending posterior part of the body, capillaries in both rami throughout, hooks present on setiger 12 onwards.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : Mozambique, Persian Gulf, Sri Lanka, Gulf of Mexico, Mediterranean Sea, North Carolina.

70. *Cirriiformia punctata* (Grube, 1859)

1859. *Cirratulus punctata* Grube, *Annulata Orstediana*, 3 : 107.

Diagnosis : Prostomium rounded without eyes, numerous tentacular filaments appearing on setiger 4. Branchiae from setiger 1 and near the posterior part of the body. Capillary setae in both rami, slender hooks from setiger 12 onwards.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : Widely recorded in Circum-tropical region.

71. *Cirriiformia tentaculata* (Montagu, 1808)

1808. *Terebella tentaculata* Montagu, *Trans. Linn. Soc. London*, 9 : 110.

Diagnosis : Prostomium pointed. Tentacular filaments numerous arising in two clusters above setiger 5-7. Branchial filaments from setiger 1 to the end of the body. Capillary setae in both rami throughout, hooks unidentate appearing posteriorly (from about setiger 45-50).

Distribution : India : Gujarat, Lakshadweep.

Elsewhere : South West Africa, Persian Gulf, Caledonia, Japan, English channel.

Family XIX FLABELLIGERIDAE

Genus 43. *Pherusa* Oken, 1807

72. *Pherusa parmata* (Grube, 1878)

1878. *Stylarioides parmatus* Grube, *Mem. Acad. Sci. S. Peterb.* 25 : 199.

Material : 4 ex., Dwaraka, 27.11.89, A. Misra, 4 ex., Veraval port, 5.1.90, A. Misra, 2 ex., Holiday camp, 7.1.90, B.P. Haldar, 1 ex., Okha, 11.1.90, B.P. Haldar, 1 ex., Balapur, Beyt Island, 17.1.90, B.P. Haldar.

Diagnosis : Body fusiform. Prostomium and peristomium retractable between the first 3 setigers. Prostomium a slender ridge with palps situated posteriorly. Peristomium with an expanded dorsal membrane bearing branchial filaments many pairs, caphalic cage formed by long

capillaries, very long and stout, beautifully iridescent on third setiger. Neurosetae capillaries in anterior 6-8 setigers.

Distribution : India : Gujarat, Tamil Nadu.

Elsewhere : Madagascar, Philippine Island, New Zealand.

Family XX OPHELIIDAE

Key to genera

- Body vermiform; eye-spots present on middle segments *Armandia*
- Body elongated; eye-spots absent from body *Ophelina*

Genus 44. *Armandia* Filippi, 1861

73. *Armandia leptocirrus* Grube, 1878

1878. *Armandia leptocirrus* Grube, *Mem. Acad. Sci. S. Peterb.* 25 : 194.

Material : 1 ex., Balapur Bay, Beyt Island, 17.1.90, B.P. Haldar.

Diagnosis : Prostomium conical. Branchiae from setiger 2 to the last one. 10-16 pairs of eyes on setiger 7 onwards. Anal funnel long, fringed with long 12-16 fine papillae. A long anal cirrus.

Distribution : India : Gujarat, Krusadai Island, Andamans.

Elsewhere : Red Sea, Persian Gulf, Philippine Island, Indo-China.

Genus 45. *Ophelina* Savigny, 1818

74. *Ophelina acuminata* Oersted, 1843

1843. *Ophelina acuminata* Oersted, *Annulorum donicorum conspectus*, 46, Kobenhavn.

Diagnosis : Prostomium conical. Branchiae from setiger 2 and near the posterior part of the body. Parapodia biramous with short setigerous lobes and two bundles of simple setae, ventral cirrus small.

Distribution : India : Gujarat, Tamil Nadu, Orissa Coast.

Elsewhere : Persian Gulf, Philippine Island.

Family XXI CAPITELLIDAE

Genus 46. *Notomastus* Sars, 1851

75. *Notomastus latericeus* Sars, 1851

1851. *Notomastus latericeus* Sars, *Nyt. Mag. Naturvid.* 6 : 199.

Diagnosis : Prostomium blunt. Peristomium achaetous, thoracic setigers 11. Thorax with capillary setae only. Abdominal neuropodia with long rows of hooks. Branchiae rudimentary and represented by small swelling of abdominal notopodia and slightly longer triangular projection of the superior edge of neuropodia.

Distribution : India : Gujarat, Lakshadweep, Andamans.

Elsewhere : Cosmopolitan.

Family XXII SABELLARIIDAE

Genus 47. *Sabellaria* Savigny, 1818

76. *Sabellaria cementarium* Moore, 1906

1906. *Sabellaria cementarium* Moore, *Proc. Acad. Nat. Sci. Philadelphia*, 58 : 248.

Diagnosis : Opercular stocks short, each having three concentric rows of paleae, outer paleae ending in a long, slender, smooth spine; middle short, smooth, spoon like and inner long spoon-like with pointed tip.

Distribution : India : Gujarat, Tuticorin.

Elsewhere : Pacific Ocean.

Family XXIII Trichobranchidae

Genus 48. *Terebellides* Sars, 1935.

77. *Terebellides stroemi* Sars, 1835.

1835. *Terebellides stroemi* Sars, *Beskrivelsar og Iagttagelser over nogle moerkelige eller nye i Havet ven den Bergenske kyst levende Dyr of polypernes, Acalephernes, Radiateres, Annelidernes og Molluskernes classer, med en kort oversigt over de hidtil of Forflalteren sammesteds fudne Arterog deres. Forekommen* : 81 Bergen.

Diagnosis : Branchiae as stout trunk bearing four distal lamellate lobes. Thoracic segments 20, with notopodial capillaries from segments 3; neuropodial uncini from setiger 6, uncini of 6th setigers long, acicular with unidentate hooks; thoracic uncini of the next 12th setigers with blunt tip and several small denticles above. Abdominal uncini avicular with 1 to 2 rows of denticles above the main frang.

Distribution : India : Gujarat, Lakshadweep, Tamil Nadu, Orissa, Andamans.

Elsewhere : Pacific Ocean, Atlantic Ocean and Mediterranean Sea.

Family XXIV TEREPELLIDAE

Key to genera

1. Branchiae present as simple filament usually *Streblosoma*
— Branchiae present as branched filaments usually 2
2. Notosetae with denticulate tips *Terebella*
— Notosetae with smooth tips 3
3. No lateral lobes on segment 2 to 4 .. *Nicolea*
— Lateral lobes present 4
4. Uncini pectiniform with a simple verticle series of teeth *Loimia*
— Uncini avicular with a close set arcs of denticles above main frng 5
5. Small lateral lappets on segment 2 and 3; uncini not set back to back *Eupolymnia*
— Large lateral lappets on segment 2 and 4; uncini set back to back on posterior thorax *Lanice*

Genus 49. *Eupolymnia* Verrill, 1900

78. *Eupolymnia nebulosa* (Montagu, 1818)

1818. *Terebella nebulosa* Montagu, *Trans. Linn. Soc. Lond.*, 12 : 343.

Material : 2 ex., Okha, 14.1.90, B.P. Haldar.

Diagnosis : Tentacular lobe short and collar-shaped with numerous tentacles with several eyes. Branchiae 3 pairs on setiger 4, notosetae winged with smooth tips on segments 4 to 17. Uncini from segments 5, each having two large teeth set double rows on the posterior thorax.

Distribution : India : Gujarat, Lakshadweep, Pamban, Andamans.

Elsewhere : South Africa, Madagascar, Persian Gulf, Maldives, Japan, Mediterranean Sea.

Genus 50. *Lanice* Malmgren, 1866

79. *Lanice socialis* (Willey, 1905)

1905. *Polymnia socialis* Willey, *Roy. Soc. Rep. on Pearl oyster Fisheries*, 30 : 299.

Diagnosis : Tentacular lobe short and collar-shaped with numerous long tentacles and eye-spots. Branchiae 3 pairs on setigers 2, lateral lobes on first three segments. Notosetae with smooth tips. Uncini avicular appear on setigers 4 and set in double rows back to back posteriorly.

Distribution : India : Gujarat.

Elsewhere : Sri Lanka.

Genus 51. *Loimia* Malmgren, 1866

80. *Loimia medusa* (Savigny, 1820)

1820. *Terebella medusa* Savigny, *Système des annélides. Principalement de celles des côtes de Egypte et de la Syrie*, : 95.

Material : 2 ex., Balapur Bay, Okha, 17.1.90, B.P. Haldar, 1 ex., Gulf of Kutch, 22.1.90, B.P. Haldar.

Diagnosis : Tentacular lobes short with several eyespots. thoracic setigers 17, uncini pectiniform with a single verticle series of 5 to 6 teeth, uncini in double rows back to back on posterior thorax.

Distribution : India : Gujarat, Mumbai, Vembanad Lake, Gulf of Mannar, Adyar estuary, Andamans, Chandipur, Hooghly estuary.

Elsewhere : Red Sea, Mozambique, South Africa, Madagascar, Persian Gulf, Western Australia, New South Wales.

Genus 52. *Nicolea* Malmgren, 1866

81. *Nicolea gracilibranchis* (Grube, 1878)

1878. *Terebella gracilibranchis* Grube, *Mem. Acad. Sci. S. Peterl*, 25 : 230.

Diagnosis : Seventeen thoracic setigers, lateral lobes absent. Eye-spots hidden under cephalic fold. Branchiae 2 pairs on setiger 3. Dorsal capillary setae smooth at the tip. Uncini avicular from setigers 2 with two teeth above the main fang.

Distribution : India : Gujarat, Lakshadweep, Pamban, Tuticorin, Andamans.

Elsewhere : Japan, Philippine Island.

Genus 53. *Streblosoma* Sars, 1872

82. *Streblosoma persica* (Fauvel, 1908)

1908. *Grymaea persica* Fauvel, *Bull. Mus. Hist. nat. Paris*, 14 : 386.

Diagnosis : Prostomium rounded, tentacle long, stout and grooved. Branchiae 3 pairs each with numerous coiled filaments. Thorax with 30 setigers. Dorsal setae starting from setiger 2. Uncini appearing from setiger 3, Uncini avicular in single rows.

Distribution : India : Gujarat, Krusadai Island, Pamban, Orissa.

Elsewhere : Persian Gulf, Tropical Western Africa to Angola.

Genus 54. *Terebella* Linnaeus, 1767

83. *Terebella ehrenbergi* Grube, 1870

1870. *Terebella ehrenbergi* Grube, *Mber. Akad. Wiss. Berlin*, 511.

Material : 1 ex., Veraval, 5.1.90, B.P. Haldar.

Diagnosis : Tentacular lobe short and collar-shaped, numerous tentacles with eyes. Branchiae 3 pairs on segments 2-4, no lateral lobes. Notosetae appear on setiger 4, having long uniformly narrow wings and serrated denticulate tips. Uncini avicular each with 3-4 teeth set alternate rows face to face on the posterior thorax.

Distribution : India : Gujarat, Krusadai Island, Pamban, Kilakarai, Andamans.

Elsewhere : Japan, China.

Family XXV SABELLIDAE

Key to genera

1. Thoracic neuropodial companion setae present 2
- Thoracic neuropodial companion setae absent 3
2. Notosetae of the collar segment in a long row; base of branchial lobe long; radioles always with eyes-spots *Hypsicomus*
- Notosetae of the collar segment in a tuft; base of branchial lobe short; radioles with or without eyes-spots *Sabella*
3. Radioles with well develop external stylodes *Branchioma*
- Radioles without external stylodes 4
4. Thoracic spatulate notosetae present *Laonome*
- Thoracic spatulate notosetae absent *Sabellastrate*

Genus 55. *Laonome* Malmgren, 1866

84. *Laonome indica* Southern, 1921

1921. *Laonome indica* Southern, *Mem. Indian. Mus.* 5 : 652.

Diagnosis : Branchial lobes symmetrical without stylodes and eye-spots, notosetae of two kinds, one long and narrow capillaries and the other soft spatulate. Thoracic uncini stout with several small teeth in 4-5 rows above the main fang.

Distribution : India : Gujarat, Chilka Lake.

Genus 56. *Branchiomma* Kolliker, 1858

85. *Branchiomma serratibranchis* (Grube, 1878)

1878. *Sabella (Dasychone) serratibranchis* Grube, *Mem. Acad. Sci. S. Peterb.* 25 : 262.

Diagnosis : Body pale with purple colour band,

branchial lobes semi-circular without eyes. Stylodes small, triangular lobe-like. Thoracic uncini with broad necks and having 4-5 rows of small coarse teeth above the main fang.

Distribution : India : Gujarat, Pamban, Andamans.

Elsewhere : Natal, Indo-west Pacific, Philippine Island, Japan, Australia to New Zealand.

Genus 57. *Hypsicomus* Grube, 1870

86. *Hypsicomus phaeotaenia* (Schmarda, 1861)

1861. *Sabella phaeotaenia* Schmarda, *New Wirbel-lose Thiere beobachtet und gesammelt aufeiner Reise um die Erde* : 35.

Material : 1 ex., Okha, Adatra beach, 11.1.90, B.P. Haldar, 1 ex., Sikka, 22.1.90, B.P. Haldar.

Diagnosis : Branchial lobes borne on a long stalk, collar very low with a small straight margin. Collar setae with very short and broad blades set in double rows. Thoracic notosetae with winged capillaries and paleae with rounded blades. Thoracic neurosetae include both pick-axe setae and avicular uncini. Abdominal notosetae avicular uncini and neurosetae of winged capillaries and paleae.

Distribution : India : Gujarat, Lakshadweep, Gulf to Mannar, Andamans.

Elsewhere : Red Sea, Madagascar, Persian Gulf, Tropical Indo-West Pacific, West Pacific, West Australia, Japan, Western-Africa, Mediterranean Sea.

Genus 58. *Sabella* Linnaeus, 1767

Key to species

- Base of branchiae swollen but setigers 1-4 not glandular dorsally *Sabella penicillus*
- Base of branchiae and setigers 1-4 swollen and glandular dorsally *Sabella fusca*

87. *Sabella fusca* Grube, 1870

1870. *Sabella fusca* Grube, *Moer. Akad. Wiss. Berlin* : 516.

Material : 1 ex., Balapur Bay, 17.1.90, B.P. Haldar.

Diagnosis : Branchial base with dorsal glandular area extending up to 3 to 4 setiger. Collar widely separated dorsally and attached back to setiger 2, notched laterally with a pair of stout-lappetes ventrally.

Distribution : India : Gujarat, Andamans.

Elsewhere : Red Sea, Mozambique, Zanzibar, North Australia.

88. *Sabella penicillus* Linnaeus, 1767

1767. *Sabella penicillus* Linnaeus, *Systema, naturae, etc. editio*, 12, Halmiae, 1269.

Material : 2 ex., Narara Beyt from Vidiger, 31.1.92, N.V.S. Rao.

Diagnosis : Branchial base without glandular cushions but with annular rings. Collar widely separated dorsally and reflected back dorso-laterally to form four blades.

Distribution : India : Gujarat.

Elsewhere : N. Atlantic from Scotland to Morocco, Senegal and Mediterranean.

Genus 59. *Sabellastrate* Kroyer

89. *Sabellastrate sanctijosephi* (Gravier, 1906)

1906. *Eurato sancti-josephi* Gravier, *Bull. Mus. Hist. nat.*, 12 : 105.

Diagnosis : Body purple and branchiae banded. Branchial lobe semi-circular without stylodes and eye-spots, thoracic notosetae simple, winged capillary of unequal size. Thoracic neurosetae in single row of avicular uncini with several small teeth above main one.

Distribution : India : Gujarat, Tamil Nadu, Andamans.

Elsewhere : Red Sea, Japan, New Caledonia, Western Africa.

Family XXVI SERPULIDAE 1788

Genus 60. *Serpula* Linnaeus, 1758

90. *Serpula vermicularis* Linnaeus, 1767

1767. *Serpula vermicularis* Linnaeus, *Systema. naturae*, 3 : 1266.

Material : 1 ex., Pirotan Island, 15.1.90, B.P. Haldar.

Diagnosis : Body symmetrical with seven thoracic setigers. Opercular stalk smooth. Operculum funnel-shaped with marginal serrations. Collar setae with capillaries and bayonet setae with two to four conical bosses at the base of hispid blade. Thoracic notosetae limbate capillaries and neurosetae wingless capillaries with curved tips.

Distribution : India : Gujarat, Tamil Nadu, Orissa coast.

Elsewhere : Persian Gulf, Burma.

SUMMARY

The paper deals with a short taxonomic account of 90 species under 60 genera and 26 families of polychaeta hitherto known from the Gujarat coast, of which 51 species are collected by the authors. The rest of the species is included here from the study of the already reported forms available with the authors and from the study of literature. The work includes new locality records of 13 species from the area under study including two species recorded for the first time from the Indian waters. The paper also includes a classified list of polychaetes so far known from the Gujarat coast along with an exhaustive key to the species.

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REFERENCES

- DALAL, N.M. & DUBALE, M.S. 1975. Polychaetes of Saurashtra sea coast. *Proc. 62nd Indian Sci. Congress Abs.*, Abstract **III** : 85.
- DALAL, N.M. & DUBALE, M.S. 1976. Polychaetes of Saurashtra ses coast. *Proc. 63rd Indian Sci. Congress Ass.* Abstract **III** : 216.
- DALAL, N.M., DUBALE, M.S. & SHAH, K.C., 1978. Polychaetes of Saurashtra sea coast : Ecological studies. *Proc. 65th Indian Sci. Congress Ass.* Abstract **III** : 298.
- DALAL, N.M., 1982. Observation on some aspects of ecology of polychaetes of Okhamandal region. *Comp. physiol Ecology*, **7** (4) : 313-320.
- FAUVEL, P., 1932. Annelida Polychaeta of the Indian Museum, Calcutta. *Mem. Indian Mus.*, **12** : 1-262.
- FAUVEL, P., 1953. *The fauna of India, Polychaeta Annelida* : 507 pp.
- MISRA, A. & CHAKRABORTY, R.K., 1983. Further records of polychaetes from Gujarat coast. *Rec. zool. Surv. India*, **81** : 69-75.
- RAO, C.A.N. & SOOTA, T.D., 1981. On some polychaetes from Gujarat coast. *Rec. zool. Surv. India*, **79** (1 & 2) : 73-82.
- SOOTA, T.D., MISRA, A. & CHAKRABORTY, R.K., 1981. Polychaete fauna of Gujarat coast. *Rec. zool. Surv. India*, **79** (1 & 2) : 93-104.

ECHIURA

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INTRODUCTION

Echiurans, soft-bodied and almost defence-less sedentary creatures, always live in protected places and are well adapted for living in crevices or burrows. Echiurans of west coast of India, particularly Gujarat coast, has been dealt with by Dattagupta and Menon (1961, 1963, 1964 & 1965), Menon and Dattagupta (1962 & 1964), Jose (1964) and Haldar (1981 & 1985). As a result, ten species under six genera and three families have been described/reported so far.

The present study is based on material collected by author and his colleagues in 1977, 1989, 1990 and 1992 from various localities along the Gulf of Cambay, Gulf of Kutch, Dwarka and Port Okha. The present study in combination with previous records reveals the occurrence of eighteen species under nine genera and three families. Out of them seven species are new to the area under study and one species is recorded for the first time from the Indian coast.

All the families, genera and species have been keyed and short descriptions of the species along with their distribution both in India and elsewhere have been provided. In addition, state-wise distribution of the species dealt with is given in a table. Further, the present article provides method of collection, narcotisation and preservation, morphology and terminology, diagnostic characters of families and taxonomic account of all the species and their distribution.

METHOD OF COLLECTION, NARCOTISATION AND PRESERVATION

The presence of an echiuran in sandy bed or mud-flat is often indicated by the opening of its

burrow or sometimes by catching sight of its proboscis. Such echiurans have to be removed by digging, the position of the worm can be marked by pushing a piece of rubber tube down the hole made by the proboscis. Careful digging on one side of the line connecting the ends of the burrow will ultimately expose the animal which is to be lift-up by the trunk. Proboscis of this group is usually deciduous, so it should be collected, fixed and stored along with the trunk. Most of the species under study occurred in the intertidal area close to high water mark.

Sometimes, echiurans are simply picked up under rocks at lowtide. Those that live in rocks or in coral may be difficult to dislodge. Sometimes if the rock is struck sharply with a hammer it will crack along the fissure or gallery in which the animal inhabits. Then the animal can be lifted out with the aid of forceps. Sometimes, it may be useful by immersing the piece of coral block in a bucket containing a dilute solution of formalin, then the echiurids or bonellids will move out of their burrows.

After collection the animal should be placed in plenty of cool water before narcotisation which is desirable to prevent it from distortion and contraction when directly placed in fixatives. The animals are to be narcotised (i) by placing in a shallow dish containing cool water on the top of which some crystals of menthol have to be sprinkled or (ii) by placing them in a 7% solution of magnesium chloride to sea water or (iii) by placing them in sea water to which is added very carefully a small quantity of 90% alcohol (drop by drop). The animals are to be left in the relaxing medium over a period of three to six hours until they do not respond to touch. The worms are then transferred to 4% formalin for fixation and finally to 70% alcohol for permanent storage.

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MORPHOLOGY AND TERMINOLOGY

Structures related to the identification of the worms are only dealt here.

Alimentary canal : A very long and much coiled tube running from mouth to anus and consisting of three parts, i.e., fore-gut, mid-gut and a short hind-gut or cloaca into which anal vesicles open.

Anal setae : One or two rings of hook-like structures encircling posterior extremity of trunk, found only on *Echiurus* and *Urechis*.

Anal vesicles : A pair of usually large, often tubular or sac-like simple or complexly branched structures in the body cavity, discharging the products into cloaca; surface usually bearing a few to numerous excretory tubules having a ciliated cup or funnel.

Anus : Posterior aperture of alimentary canal at posterior extremity of trunk.

Ciliated funnel : Small, ciliated funnel- or cup-shaped structure at the coelomic extremities of excretory tubules.

Circular muscles : Outermost muscle layer of body wall.

Dorsal blood vessel : A prominent, tubular blood vessel lying dorsally in anterior part of body cavity and often associated with foregut.

Excretory tubules : Small, delicate tubules often present in large numbers on coelomic surface of anal vesicles or their branches and each ending in ciliated cup or funnel.

Genital groove: A depression extending from nephridiopore(s) to mouth on ventral surface in some genera of Bonelliidae.

Interbasal muscle : A strong, narrow muscular band of tissue connecting the sheaths of two ventral setae: prominent in some but absent in others.

Longitudinal muscle bands : Longitudinal muscle layer of body wall in some species of Echiuridae thickened into bundles and usually visible externally.

Mouth : Anterior opening of alimentary canal.

Nephridia/ Gonads : Thin walled, elongated or sac-like vessels, one end being attached to antero-ventral surface of body wall and other end lying free in body cavity; due to storage of eggs and sperms they are also called gonad; number varying from one to numerous.

Nephridiopore/Gonopore : External opening of a nephridium/gonad may or may not be clearly visible on external surface.

Nephrostome/Gonostome : Coelomic opening of a nephridium/gonad for entrance of sex cells from body cavity to sac, and basal or terminal in position.

Nephrostomal/Gonostomal lip : Lip-like tissue surrounding nephrostome/gonostome, inconspicuous, expanded or leaf-like or extended into long threads, may or may not be spirally coiled.

Neurointestinal blood vessel : A prominent blood vessel branching from central blood vessel at a point posterior to setae and connecting dorsal blood vessel directly or indirectly.

Oblique muscle : Innermost muscle layer of body wall.

Papillae : Wart-like or rounded, often prominent, tubercles found on the surface; almost uniform in size but usually largest towards anterior and posterior extremities of trunk; uniformly or scatterly distributed.

Proboscis : A highly muscle and sensitive food gathering and respiratory organ extending from anterior region of trunk near mouth; deciduous or non-deciduous in nature but present in nearly all echiurans, either reduced or well developed : bifid in some bonellians.

Ring vessel : A ring of vascular tissue surrounding posterior part of foregut - a bifurcation of neurointestinal vessel.

Trunk : Cylindrical or sac-like body of an echiuran.

Ventral setae : Hook-like structures piercing ventral wall just posterior to mouth.

Ventral blood vessel : A prominent blood vessel running along-side ventral nerve cord.

LIST OF SPECIES KNOWN FROM THE GUJARAT COAST

(Classification followed after Dattagupta, A.K., 1976)

Phylum ECHIURA

Class ECHIURIDA

Order ECHIUROINEA

Family I. THALASSEMATIDAE

Sub-Family THALASSEMATINAE

Genus 1. *Anelassorhynchus* Annandale

- (1) *Anelassorhynchus branchiorhynchus* (Annandale & Kemp, 1915)
 (2) *Anelassorhynchus loborhynchus* Dattagupta & Menon, 1965
 (3) *Anelassorhynchus sabinus* (Lanchester, 1905)

Genus 2. *Thalassema* Lamarck

- *(4) *Thalassema diaphanes* Sluiter, 1888
 **(5) *Thalassema thalassema* (Pallas, 1766)

Sub-family OCHETOSTOMATINAE

Genus 3. *Ochetostoma* Leuckart & Ruppell

- *(6) *Ochetostoma bombayensis* (Prashad & Awati, 1929)
 *(7) *Ochetostoma erythrogrammon* Leuckart & Ruppell, 1828
 *(8) *Ochetostoma palense* (Ikeda, 1924)
 (9) *Ochetostoma zanzibarensis* Stephen & Robertson, 1952

Genus 4. *Listriolobus* Spengel

- *(10) *Listriolobus brevirostris* Chen & Yeh, 1958
 *(11) *Listriolobus capensis* (Jose & Stephen, 1955)

Family II. IKEDAIDAE

Genus 5. *Rubricelatus* Dattagupta & Menon

- (12) *Rubricelatus pirotansis* (Menon & Dattagupta, 1962)

Family III. BONELLIDAE

Sub-family BONELLINAE

Genus 6. *Eubonellia* Fisher, 1946

- *(13) *Eubonellia valida* Fisher, 1946

Genus 7. *Achaetobonellia* Fisher

- (14) *Achaetobonellia maculata* Fisher, 1953

Sub-family ACANTHOBONELLINAE

Genus 8. *Acanthobonellia* Fisher, 1948

- (15) *Acanthobonellia miyajimai* (Ikeda, 1904)
 (16) *Acanthobonellia pirotanensis* Jose, 1964
 (17) *Acanthobonellia rollandoe* Menon, Dattagupta & Johnson, 1964

Genus 9. *Ikedella* Monro,

- (18) *Ikedella misakiensis* (Ikeda, 1904)

* Indicates new locality records

** Indicates new record from the Indian coast.

SYSTEMATIC ACCOUNT

Class ECHIURIDA

Diagnosis : Body wall with innermost circular and oblique layers of muscles; anal vesicles, collateral intestine or siphon present; proboscis and anterior setae in nearly all species

Remarks : Out of two orders under this class only one is represented widely along the Indian coast and the other represented by a single family, is so far restricted to Japan, California and South American seas.

Order ECHIUROINEA

Diagnosis : Closed vascular system; no specialisation of the intestine for anal respiration; anal vesicles sac-like bearing usually sessile funnels.

Remarks : Out of four families under this order only Echiuridae represented by single genus is known from Arctic and Antarctic waters.

Family I. THALASSEMATIDAE

Diagnosis : Gonoducts with lateral gonostome; one to seven pairs or paired groups of gonoducts.

Remarks : Family is divided into two sub-families, viz., Ochetostomatinae and Thalassematinae, and both are represented by two genera each.

Key to sub-family of THALASSEMATIDAE

- Longitudinal muscles of body wall gathered into bands OCHETOSTOMATINAE Dattagupta
- Longitudinal muscles of body wall continuous without forming any bands THALASSEMATINAE Bock emended

Key to genera of THALASSEMATINAE

- Gonostomal lips prolonged and usually spirally coiled *Anelassorhynchus*
- Gonostomal lips not elongated and not spirally coiled *Thalassema*

Genus I. *Anelassorhynchus* Annandale

1922. *Anelassorhynchus*, Annandale. *Bijdr. Dierk.*, **22** : 148

1995. *Anelassorhynchus*, Haldar, *Zool. Surv. India, Estuarine Ecosystem Series, Pt. 2, Hooghly Matla Estuary, West Bengal* : 33

Diagnosis : Longitudinal and inner oblique muscle layer of uniform thickness and without specialised bands; gonostomal lips prolonged and spirally coiled.

Remarks : The genus is the next largest (*Ochetostoma* having the largest number of species) of all the echiuran genera and comprises seventeen species. In the Indian coast it is represented by seven species, of which only three is reported from the Gujarat coast.

Key to species of *Anelassorhynchus*

- 1. Margin of proboscis with outgrowths *A. branchiorhynchus*
- Margin of proboscis without outgrowths ... 2
- 2. Proboscis anteriorly bilobed. *A. lobarhynchus*
- Proboscis not bilobed *A. sabinus*

1. *Anelassorhynchus branchiorhynchus*

(Annandale & Kemp)

1915. *Thalassema branchiorhynchus*, Annandale & Kemp, *Mem. Indian Mus.*, **5** : 61-63, figs. 2,3

1995. *Anelassorhynchus branchiorhynchus*, Haldar, *Estuarine, Ecosystem Series, pt. 2, Hugli-Matla Estuary Zool. Surv. India* : 34.

Material examined : 1 ex., Adatra beach, Port Okha, (in the Museum of Fisheries Department, Government of Gujarat): 2 exs., Balapur Bay Island, 17.1.1990, B.P.Haldar.

Diagnosis : Living specimens pink coloured, translucent, posterior extremity somewhat paler; proboscis purplish pink and dendritic outgrowths bright red; body 95-130 mm long while proboscis 35-60 mm long; dendritic outgrowths of proboscis having gill-like appearance, most conspicuous and confined at proximal part of proboscis; body wall covered throughout with papillae, most prominent at posterior part of body: ventral hooks golden yellow in colour and situated anterior to gonopore, each hook having long straight shaft with a curved terminal end; interbasal muscle absent.

Gonad two pairs, lips of gonostome spirally coiled; anal vesicles about half the length of body and swollen at base, each bears two rows of microscopic funnels.

Remarks : In the Hugli-Matla estuarine belt the animal inhabit in hard muddy bottom where U-shape of the burrow is clearly visible (Haldar, 1995). But in Balapur Bay muddy bed is very soft so nature of burrow is not discernable as a result commensal forms are unable to trace.

Distribution : This species is an endemic form. Though it was described from estuarine water it has been reported from marine habitat also.

In India : West Bengal : 24 Parganas (South) (Annandale & Kemp, 1915 : Haldar, 1978, 1995) : Medinipur (Haldar, 1995) : Orissa (Prashad, 1919) : Gujarat (Dattagupta *et al.*, 1963; present record).

2. *Anelassorhynchus lobarhynchus* Dattagupta & Menon

1965. *Anelassorhynchus lobarhynchus*, Dattagupta & Menon. *Ann. Mag. nat. Hist.*, (13) **8** : 198-199, fig. 2 B,C.

Material examined : None.

Diagnosis : Preserved specimen pinkish-brown in colour; body 38 mm long while proboscis 24 mm long and its anterior tip bilobed; dendritic outgrowths on proboscis absent but lateral margins of proboscis meeting to form a complete tube leading to mouth; body covered with numerous oval papillae, bigger towards posterior end and arranged somewhat transversely; longitudinal muscles of body continuous; ventral setae yellowish, situated about 1 mm away from mouth; interbasal muscle absent.

Internally, five big gonads, of which three on the left and two on the right; gonostomes close to gonopores and gonostomal lips produced into a pair of short filaments; anal vesicles tubular and provided with numerous sessile funnels.

Remarks : No specimen of this species has been examined by the author. The main features of the type material as embodied in Dattagupta and Menon (1965 : 198-199) is dealt under diagnosis.

Distribution : Since its description in 1965 the species has so far not been reported, as far as author's knowledge goes, from any where.

In India : Gomoti Creek, Dwarka (Gujarat).

3. *Anelassorhynchus sabinus* (Lanchester)

1905. *Thalassema sabinum* Lanchester. *Proc. zool Soc. Lond.*, 1 : 40-41, pl. 2, fig.5.

1978. *Anelassorhynchus sabinus* : Haldar, *Bull. zool. India*, 1 (3) : 316.

Material examined : 1 ex., Gopnath, Bhavnagar, Gulf of Cambay, 1.2.1978, B.P. Haldar.

Diagnosis : In living condition, specimen colourless having minute colourless papillae; skin more or less thin and transparent, nerve cord visible from outside; body measuring 12 mm in length while proboscis about 2.2 mm, tubular in shape at base and with indentate margins; ventral setae two, placed close to proboscis and anterior to gonopores; muscle layer of body wall continuous.

Internally, gonads four, small and each with a pair of long, coiled filaments; anal vesicles short,

about 2 mm in length and provided with funnels of sessile in nature.

Remarks : The three species of *Anelassorhynchus*, viz., *A. branchiorhynchus*, *A. dendrorhynchus* (so far not reported from this coast) and *A. sabinus* show close similarity so far as the structure of proboscis is concerned. According to Prashad (1919) peculiarities in the structure of proboscis are probably correlated with their mode of life and *A. branchiorhynchus* is the most highly evolved with respect to gills, *A. dendrorhynchus* intermediate and *A. sabinus* "shows the beginning of the formation of these structure" Findings of Dattagupta and Menon (1963) also corroborate the fact.

Distribution : The species is restricted to Indo-West Pacific waters and so far not reported from the western Indian Ocean.

In India : Gujarat (Pirotan Island-Dattagupta and Menon, 1963; Bhavnagar, Gulf of Cambay-present record); Tamil Nadu (Haldar, 1978).

Elsewhere : Japan (Sato, 1934, 1939); Korea (Sato, 1939); Indonesia (Lanchester, 1905); Thailand (Prashad, 1919).

Genus 2. *Thalassema* Lamarck

1801. *Thalassema* Lamarck. *Histoire naturelle des animaux sans vertebres*, 3 : 328.

1988. *Thalassema* : Biseswar. *S. Afr. J. Zool.*, 23 (2) : 82.

Diagnosis : Proboscis well developed; longitudinal and inner oblique muscle layers continuous and not grouped into bands; gonads one or two pairs; gonostomal lips not elongated and not spirally coiled.

Remarks : So far only one species under this genus is known from India. The present study adds one more to this list.

Key to species of *Thalassema*

- Interbasal muscle present *T. diaphanes*
- Interbasal muscle absent *T. thalassemum*

4. *Thalassema diaphanes* Sluiter

1888. *Thalassema diaphanes* Sluiter. *Natuurk. Tijdschr. Ned.-Indie.* 45 : 244-248, pl. 3, text-figs. 1-7.

1991. *Thalassema diaphanes* : Halder and Dattagupta. *State Funna Series 2 : Funna of Lakshadweep* : 187, fig. 1 A.

Material examined : 2 exs., Sikka, Gulf of Kutch, 20.12.1989, A. Misra.

Diagnosis : Large specimen cylindrical in shape with a trunk length 32 mm and 5.5 mm along the broadest part, tapering towards posterior end; proboscis contracted, measuring 12 mm in length, more or less flat distally but lateral margins of proximal part curl inwards and join at ventral margin of mouth; body wall thin and transparent; papillae small, irregularly placed over major part of trunk but posterior part smooth and devoid of papillae; ventral hooks golden yellow in colour having cylindrical shaft with curved tips ending sharply; replacement hook present along with functional ones; cylindrical interbasal muscle present.

Internally, alimentary canal long, much coiled and attached to body wall at various points by thin mesenteric strands; oesophagus narrow with thick muscular walls and foregut small; intestine thin walled and transparent, filled with mud and mud pellets; rectal caecum absent; anal vesicles thin-walled and transparent, narrow anteriorly but dilated and sac-like posteriorly; gonoducts two, elongate, tubular and swollen at base, and placed posterior to ventral hooks; gonostomes oval with smooth margins.

Remarks : The distinguishing features of this species are (i) flat oval gonostomes, and gonoducts posterior to ventral hooks, (ii) thin and transparent body wall covered with minute papillae, (iii) cylindrical interbasal muscle so far mentioned only by Wesenberg-Lund (1959) and (iv) absence of rectal caecum.

Distribution : The species is circumtropical in distribution.

In India : Andaman Island (Prashad, 1935); Tamil Nadu Porto Novo (Halder, 1978); Lakshadweep (Shiple, 1902; Halder & Dattagupta, 1991); Gujarat (present record).

Elsewhere : West coast of Africa & Ivory coast (Wesenberg-Lund, 1959a); Natal coast (Biseswar, 1988) : Maldive (Shiple, 1902) : Indonesia - Bay of Batavia (Sluiter, 1988).

5. *Thalassema thalasseum* (Pallas)

1766. *Lumbricus thalassema* Pallas. *Miscellanea Zoologica* : 8-9.

1988. *Thalassema thalasseum* : Biseswar. *S. Afr. J. Zool.* 23 (2) : 89-90.

Material examined : 2 exs., Old Kandla Port, Gulf of Kutch, 28.4.1977, K.N. Reddy.

Diagnosis : Proboscis very contractile and about three times the trunk length when fully stretched; trunk 45 and 53 mm, brightly coloured in one and pale pink in other; body much distended, covered with papillae - largest and most densely aggregated at posterior end; skin transparent; ventral setae two, connected by an interbasal muscle.

Internally, muscles form a continuous layer; gonoducts two pairs and postsetal in position; gonostomal lips semicircular and frilled; anal vesicles long brown tubes with unstalked funnels; rectal caecum present.

Remarks : This species is closely related to *Thalassema steinbecki* Fisher, 1946 which differs in having gonostomes with smooth margins and proboscis is about as long as trunk.

Distribution : This species is widely distributed in the Atlantic Ocean and penetrates into the Indian Ocean through southern Africa. This is for the first time recorded from the Indian coast.

In India : Kandla Port, Gulf of Kutch (present record).

Elsewhere : England (Pallas, 1766; Greef, 1879; Jameson, 1899); Ireland (Southern, 1913); France (Cuenot, 1922); Mediterranean (Fischer, 1914, 1922); West Africa (Wesenberg -Lund, 1959); Southern Africa : Port Elizabeth & Durban (Wesenberg-Lund, 1963).

Key to genera of *Ochetostomatinae*

— Inner oblique muscles between longitudinal muscle bands form fascicles ... *Ochetostoma*

— Inner oblique muscles between longitudinal muscle bands not form fascicles *Listriolobus*

Genus 3. *Ochetostoma* Leuckart & Ruppell

1828. *Ochetostoma* Leuckart & Ruppell. *Atlas Zur der Reise in nordlichen Africa*, I, Zoology : 7-8.

1988. *Ochetostoma*, Biseswar. *Annals S. Afr. Mus.*, 98 (2) : 30.

Diagnosis : Longitudinal muscle layer of body wall gathered into distinct bundles; inner oblique muscles between longitudinal bands form fascicles; anal or posterior setae absent; gonoducts paired, ranging from one to seven pairs; gonostomal lips elongated and usually coiled.

Remarks : The genus is the largest of all the echiuran genera and comprises 24 species, of which 13 species is known from India and one species is so far reported from Gujarat coast.

Key to species of *Ochetostoma*

1. Gonoducts 7 pairs *O. zanzibarensis*
- Gonoducts 5 pairs or less 2
2. Gonoducts 5 pairs *O. bombayensis*
- Gonoducts 3 pairs 3
3. Alimentary canal short; 15 longitudinal muscle bands *O. palense*
- Alimentary canal long; 12-18 longitudinal muscle bands *O. erythrogrammon*

6. *Ochetostoma bombayensis* (Prashad & Awati)

1929. *Thalassema bombayensis* Prashad & Awati. *Rec. Indian Mus.*, 31 (3) : 259-262, pl. 12, figs. 1-6.

1971. *Ochetostoma bombayensis* : Dattagupta & Menon. *Rec. zool. Surv. India*, 65 (1-4) : 178.

Material examined : 1 ex., Salaya near Jamnagar, Gulf of Kutch, 21.12.1989; 1 ex., Balapur Bay, Beyt Island, Gulf of Kutch, 17.1.1990, B.P. Haldar.

Diagnosis : Trunk elongated, cylindrical gradually tapering posteriorly and rounded anteriorly; largest one 5.5 cm in length; proboscis elongated, truncated at distal end and measuring 1.8 cm in length; papillae covering whole body,

conspicuous at both ends and arranged in rings; ventral setae two, golden yellow in colour; longitudinal muscle layer grouped into 10 bundles.

Internally, gonoducts 5 pairs, first two pairs presetal in position, spirally coiled lobes present in all; anal vesicles very long, funnels arranged irregularly on anterior half; rectal caecum absent.

Remarks : Prashad & Awati (1929) reported that the animal is gregarious and found in colonies. The author did not observe their gregarious nature.

Distribution : Endemic to the Indian waters. The present findings extend the range of distribution northwards from Bombay coast.

In India : Coast of Bombay (Prashad & Awati, 1929; Awati & Deshpande, 1936; Awati, 1936); Andamans (Dattagupta & Menon, 1971); Gujarat (present record).

7. *Ochetostoma erythrogrammon*

Leuckart & Ruppell

1882. *Ochetostoma erythrogrammon* Leuckart & Ruppell. *Atlas Zur der Reise in nordlichen Africa*, I. Zoology : 7-8,

1971. *Ochetostoma erythrogrammon* : Dattagupta & Menon. *Rec. zool Surv. India*, 65(1-4) : 174-176.

Material examined : 2 exs., Rukmavati river mouth, Mandvi, Gulf of Kutch, 25.1.1992, D.R.K. Sastry.

Diagnosis : Preserved specimens pinkish grey in colour; trunk measuring 50 mm and 17 mm while proboscis 12 mm and 7 mm respectively; skin thick and opaque at both ends while middle part more or less transparent through which longitudinal muscles visible; papillae densely crowded at both extremities but arranged in rings at posterior end.

Internally, longitudinal muscle bands 14 & 15; gonoducts three pairs, the first pair being presetal in position and second pair being the largest; gonostome funnel-like, margin short and slightly curved; anal vesicles long, more than half the body length with short stalked funnels.

Remark : Specimens collected from wet sandy beach under stone, appears to have gregarious tendencies.

Distribution : The species, originally described from Red Sea, has been reported from both the Indian and Pacific Oceans.

In India : Andamans (Dattagupta & Menon, 1971) : Gujarat (present record)

Elsewhere : Zanzibar (Stephen & Robertson, 1971); Cape Province & Mauritius (Wesenberg-Lund, 1959); Indonesia (Sluiter, 1902); Annam (Wesenberg-Lund, 1959); Indian Ocean (Shiple, 1899); Pacific Ocean (Wesenberg-Lund, 1954); Japan (Sato, 1935); Red Sea (Stephen, 1952); Mediterranean (Herubel, 1904).

8. *Ochetostoma palense* (Ikeda)

1924. *Thalassema palense* Ikeda. *Jap. J. Zool.*, 1: 39-41, figs. 13-15.

1991. *Ochetostoma palense* : Haldar & Dattagupta. *State Fauna Series 2 : Fauna of Lakshadweep* : 188-189, figs. 2 A, B.

Material examined : 1 ex., Ghogha, South-east of Bhavnagar, Gulf of Cambay, 2.2.1978, B.P. Haldar.

Diagnosis : Preserved specimen off-white in colour; proboscis 10 mm in length and 6mm in breadth, its lateral edges curl inwards; trunk 33 mm in length, cylindrical, tapering towards posterior end; body wall thin and covered with small papillae irregularly spreaded over whole surface; ventral setae two, very small, brown in colour with golden yellow tips.

Internally, longitudinal muscle bands inconspicuous, 15 in number intestine held to the body wall by thin mesenteries; rectal caecum absent; anal vesicles moderately long tubes; gonoducts 3 pairs, first pair being presetal in position; gonostomal lips turning into long filaments, rest two pairs larger than the first pair.

Remarks : The present findings differ from the description of holotype (a small specimen) in the structure of proboscis which is slender. According to Biseswar (1988) the proboscis is spatulate and non-deciduous, anus at tip of small conical projection and presence of a small, spherical rectum caecum (absent in holotype).

Distribution : The species is originally described from eastern Pacific and subsequently reported from the western Indian Ocean.

In India : Lakshadweep (Haldar & Dattagupta, 1991) : Gujarat (present record).

Elsewhere : Palau Is., Japan (Ikeda, 1924); Ispingo beach, Natal (Biseswar, 1988).

9. *Ochetostoma zanzibarensis*

Stephen & Robertson

1952. *Ochetostoma zanzibarensis* Stephen & Robertson. *Proc. R. Soc. Edinb.*, 64 : Sec. B (22) : 431-432, pl. 1, fig. 1.

1963. *Ochetostoma zanzibarensis* : Dattagupta, Menon & Johnson. *Ann. Mag. nat. Hist.*, (13) 6 : 61.

Material Examined : None

Diagnosis : Proboscis, a solid structure, about 25 mm in length, pale yellow in colour, lateral margins inflected; the region of attachment of proboscis and body very delicate; trunk a little over 150 mm in length and greenish red in colour; papillae green in colour covering whole body; ventral setae one pair; longitudinal muscle bands 12 in number; gonoducts of characteristic shape with spirally coiled filaments; anal vesicles sac-like.

Remarks : No specimen of this species is available for study with the author. The lone specimen collected by Dattagupta and Menon from low tide belt of Pirotan Island in the Gulf of Kutch, 10 miles of Jamnagar on 22nd Sept., 1960 has been reported and figured by them in 1961 and also in 1963. Under diagnosis Dattagupta and Menon's (1961) description has been provided. But they have not mentioned the number of gonoducts and the openings of them, whether presetal or postsetal, the main characters for identification.

Distribution : So far the species is restricted to West Indian Ocean only.

In India : Gujarat : Pirotan Island (Dattagupta & Menon, 1961; Dattagupta *et al.*, 1963).

Elsewhere : Zanzibar (Stephen & Robertson, 1952); Mauritius (Wesenberg-Lund, 1959).

Genus 4. *Listriolobus* Spengel

1912. *Listriolobus* Spengel. *Verh. dtsh. Zool. Ges.* **22** : 316.

1989. *Listriolobus* : Biseswar & Moodley. *S. Afr. J. Zool.*, **24** (4) : 337-339.

Diagnosis : Longitudinal muscles of body wall grouped into bands (faint or visible only in posterior region in young form); inner oblique layer of muscles not separated into transverse fascicles; gonoducts two to three pairs; gonostomal lips elongated and spirally coiled; interbasal muscle present.

Remarks : Only one species under this genus is so far known from Kerala, India and one more species is added to this list. This genus is fairly widely distributed, mainly in tropical and subtropical waters of the Indo-Pacific and Atlantic Oceans.

Key to species of *Listriolobus*

- Rectal caecum present; gonostomal lips long, gradually tapering *L. brevirostris*
- Rectal caecum absent; gonostomal lips long spiral filaments *L. capensis*

10. *Listriolobus brevirostris* Chen & Yeh

1958. *Listriolobus brevirostris* Chen & Yeh. *Acts zool. sin.*, **10** : 265-278, figs. 5-7.

1965. *Listriolobus brevirostris* : Dattagupta & Menon. *Ann. Mag. nat. Hist.*, (13) **8** (1) : 193-195, fig. 1 A.

Material examined : 1 ex., Shivarajpur near Kacchigad Light House, 8.2.1992, D.R.K. Sastry.

Diagnosis : The animal 65 mm in length including proboscis which is short, tubular, nearly open at base with indentations on lateral side and fleshy pink in colour; trunk cylindrical, tapering at both ends, pinkish in colour; body wall thin; papillae small, round covering whole body except posterior end; longitudinal muscle bands seven in number visible from outside except on posterior end which is smooth; inner oblique layer of muscles not separated into transverse fascicles; ventral setae two in number, encased in muscular sheath, slender interbasal muscle connecting two sheaths.

Internally, gonoducts two pairs, postsetal in position, gonostomal lips long, gradually tapering; anal vesicles sac-like with very long tubular diverticulae; numerous short stalked funnels arranged over the surface; rectal caecum present.

Distribution : This is an Indo-Pacific form originally described from Kiao-chow Bay, Shantung (type locality).

In India : Thevra, Kerala (Dattagupta & Menon, 1965); Gujarat coast (present record).

Elsewhere : As for type locality.

11. *Listriolobus capensis* (Jones & Stephen)

1955. *Ochetostoma capensis*, Jones & Stephen. *Trans. R. Soc. S. Afr.*, **34** : 273-278, figs. 1-3.

1991. *Ochetostoma capensis*, Haldar & Dattagupta. *State Fauna Series 2 : Fauna of Lakshadweep* 189-190, figs. 2 C.D.E.

Material examined : 1 ex., Adatra beach, Okha, 6.4.1977, K.N. Reddy.

Diagnosis : Trunk sausage-shaped, 40 mm in length and widest in the middle part; proboscis about one-seventh of trunk length, ventral edges crenate and creamy in colour; papillae thickly covered on antero-ventral surface but less towards posterior end; longitudinal muscle bands grouped into seven main bands with a few weakly developed ones between the main bands, usually prominent at anterior and posterior ends; oblique muscle layer, between longitudinal muscle bands, not formed fascicles; ventral setae one pair, shaft straight with curved terminal end.

Internally, gonoducts two, postsetal in position; gonostomal lips turn into long spiral filaments; anal vesicles long, thin, brown tubes bearing minute ciliated funnels, numerous towards free end; rectal caecum absent; interbasal muscle present.

Remarks : Jones and Stephen (1955) overlooked the disposition of oblique muscle. The nature of oblique muscle layer, only discernable by histological studies, forms a continuous sheet and is not separated into transverse fascicles (Biseswar and Moodley, 1989). Further, an interbasal muscle is present. On the basis of the aforesaid two characters they proposed the transfer of *Ochetostoma*

capense to the genus *Listriolobus* and the present author fully agrees with them.

Distribution : So long this species appears to an endemic one since it has been reported three times from the south African region. This is the second record from the Indian coast.

In India : Lakshadweep (Haldar & Dattagupta, 1991); Gujarat-Okha (present record).

Elsewhere : South Africa : Cape Province (Jones & Stephen, 1955; Biseswar & Moodley, 1989); Durban Bay (Wesenberg-Lund, 1963).

Family II. IKEDAIDAE

Diagnosis : Gonoducts numerous with terminal gonostome; proboscis very long; heart situated between pro-and mid-intestine; dorsal vessel long; gizzard absent; pro-intestine without ciliated groove.

Remarks : The family contains two genera, viz., *Ikeda* and *Rubricelatus*, of which the latter is known from India.

Genus 5. *Rubricelatus* Dattagupta & Menon

1976. *Rubricelatus* Dattagupta & Menon. *Proc. Symp. Biology Sipuncula and Echiura*, Kotor, 2 : 137-138.

Diagnosis : Longitudinal muscles of body wall continuous lying inner to circular layer; proboscis long without lacunae; gonoducts 8-20 pairs; an accessory ventral vessel present; neuro-intestinal vessel not forming a loop around interbasal muscle; a muscle plug between the setae.

Remarks : The genus is unique on account of the distal position of its gonostome. Due to its general shape, and in the number and arrangement of the gonoducts Menon and DuttaGupta (1962) placed their new species *pirotansis* under the genus *Ikedosoma* Bock, 1942 overlooking the disposition of longitudinal muscles and oblique muscles.

12. *Rubricelatus pirotansis* (Menon & Dattagupta)

1962. *Ikedosoma pirotansis* Menon & Dattagupta. *Ann. Mag. nat. Hist.* (13) 5 (53) : 305-309, 3 figs.

1972. *Prashadus pirotansis*, Stephen & Edmonds. *The Phyla Sipuncula and Echiura*, British Museum (Nat. Hist.), London : 463, Fig. 58 A, B.

1985. *Rubricelatus pirotansis*, Haldar. *Proc. Symp. Endangered Marine Animals and Marine Parks*, 1 : 401-402.

Material examined : 1 ex., Bedi Port, near Jamnagar, 22.12.1989, A. Misra; 1 ex., Narara Beyt, 10 km. east of Vadiner, 31.1.1992, D.R.K. Sastry.

Diagnosis : The specimens in living state 85 and 100 mm in length including proboscis; trunk pale red in colour while proboscis pale white with dark spots on ventral surface but on fixation colour disappears, and in contracted specimens trunks and proboscis measuring 15-18 mm and 6-10 mm respectively; body wall thin, and longitudinal, circular and oblique muscles forming continuous sheets; papillae present all over the surface, larger and denser on dorsal surface of trunk; ventral setae paired, golden and sickle-shaped.

Internally, gonoducts 8-20 pairs; gonopores separate but not easily discernible externally; anal vesicles unbranched, elongated sacs, ventrolaterally placed, numerous excretory tubules opening into sacs; accessory ventral present; neuro-intestinal vessel not forming a loop around the interbasal muscle.

Remarks : In the original description Menon and Dattagupta (1962) did not mention the nature of longitudinal musculature but stated the presence of well developed muscular pad. Dattagupta and Menon (1976) mentioned the continuous nature of longitudinal musculature. In the specimens at hand muscular pad between the setae is not observed.

Distribution : This is an endemic form restricted to the intertidal belt of the coast of the Arabian Sea.

In India : Gujarat : Gulf of Kutch (Menon & Dattagupta, 1962; Haldar, 1985; present record); Gulf of Cambay (Haldar, 1981).

Elsewhere : Saudi Arabia and Kuwait Bay (Hughes & Crisp, 1976).

Family III. BONELLIDAE

Diagnosis : Sexually dimorphic : gonoducts 1-2 : gonostome basal, lateral or terminal : anal vesicles generally branched bearing stalked funnels.

Remarks : Family Bonellidae is divided into four sub-families, viz., Acanthobonellinae, Bonellinae, Acanthoheminae and Archibonellinae, out of which later two are not represented in the Indian coast.

Key to sub-families of BONELLIDAE

- Male sac distinctly marked off in gonoduct; gonostome away from genital pore
..... ACANTHOBONELLINAE
- Male sac not distinctly marked off in gonoducts; gonostome basal or terminal
..... BONELLINAE

Key to genera of BONELLINAE

- Gonostome on a short stalk and placed basally
..... *Achaetobonellia*
- Gonostome not on short stalk but an expansion of distal extremity of gonoduct; setae absent
..... *Eubonellia*

Genus 6. *Eubonellia* Fisher

1946. *Eubonellia*, Fisher. *Proc. U.S. natn. Mus.*, **96** : 255-256.

1972. *Eubonellia*, Stephen & Edmonds. *The Phyla Sipuncula and Echiura, British Museum (Nat. Hist.)* : 383.

Diagnosis : Proboscis well developed and bifurcated; no ventral setae; gonad single, rim of gonostome plicate; anal vesicle tube-like with numerous branches.

Remarks : The genus contains only one species. The genus is close to both *Bonelliopsis* Fisher and *Ikedella* Monro. It differs from former in lacking setae and from latter in the position of gonostome.

13. *Eubonellia valida* Fisher

1946. *Eubonellia valida* Fisher. *Proc. U.S. natn.* **96** : 255-257 pl. 28.

1991. *Eubonellia valida* : Haldar & Dattagupta. *State Fauna Series 2 : Fauna of Lakshadweep* : 194, fig. 1 C.E.

Material examined : 1 ex. Female, Poshitra Bay, Gulf of Kutch, 15.1.90, B.P. Haldar.

Diagnosis : Preserved specimen oblong, cylindrical in shape measuring 35 mm in length and 14 mm in breadth at middle part of trunk; proboscis broad and flat, deciduous bifurcated at its distal end, measuring 20 mm in length and 12 mm in breadth; bifurcated ends turning into two small lobes; lateral margins of proximal part of proboscis folding inwards and giving it a tubular shape; body wall tough and muscular with transverse wrinkles while circular muscle layer smooth; ventral setae absent and therefore, no vestiges of sacs or muscle present.

Internally, single large gonad provided with a terminal large gonostome and a simple duct opening to the exterior on median line; anal vesicles elongated, dendritic type and attached to each side of small cloacal chamber.

Remarks : Haldar and Dattagupta (1991) reported the occurrence of this species at Lakshadweep outside its type locality (Sea of Okhotsk, off the coast of Sakhalin Island). The present record extends its range of distribution along the west coast of India. The specimen at hand conform the description of type on one hand and that of from the Lakshadweep.

Distribution : *In India* : Lakshadweep (Haldar & Dattagupta, 1991; Gujarat Gulf of Kutch, present record).

Elsewhere : As for the type locality

Genus 7. *Achaetobonellia* Fisher

1953. *Achaetobonellia* Fisher. *J. Wash. Acad. Sci.*, **43** : 258.

1972. *Achaetobonellia* : Stephen & Edmonds. *The Phyla Sipuncula and Echiura, British Museum (Nat. Hist.)* London : 367.

Diagnosis : Proboscis bifid; ventral setae absent; gonoduct single and gonostome placed sub-basally; anal vesicles numerous, arborescent structures attached to walls of cloaca.

Male : Trunk non-ciliated; devoid of ventral setae.

Remarks : The genus contains the single species, *A. maculata*.

14. *Achaetobonellia maculata* Fisher

1953. *Achaetobonellia maculata* Fisher. *J. Wash. Acad. Sci.*, **43** : 258-259.

1978. *Achaetobonellia maculata* : Dattagupta & Singhal. *Zool. Anz.*, **201** : 136-142, 2 pls.

Material examined : None

Diagnosis : Female : Trunk sausage-shaped, measuring 50-60 mm in length and 10-12 mm across the broadest part; proboscis in preserved state 50-70 mm in length and around 4.5 mm in breadth, lobes of proboscis varying in size and often unequal; papillae covering whole trunk but more pronounced at anterior and posterior ends; ventral setae absent; gonopore single, located on mid-ventral line and papillae arranged concentrically around gonopore.

Internally, gonoduct single, located on mid-ventral line, and male sac and egg sac of gonoduct clearly distinguishable; gonostome stalked and circular gonostomal lip frilled at its margin; anal vesicles arborescent opening by a common duct into rectum close to anus ventrally, primary ducts of vesicles branching elaborately bearing stalked funnels.

Male : Large, nematoform, remaining in a coiled state within the male sac of gonoduct of female, measuring 20-35 mm in length.

Remarks : No specimen of this species is available for study with the author. 7 specimens collected from the Pirotan Island, Gulf of Kutch, in Sept., 1972 was studied by Dattagupta & Singhal and reported in 1978. Under diagnosis their description has been provided.

Distribution : The species was reported for the first time outside its type locality, central lagoon of Onotoa, Gilbert Island.

Sub-family ACANTHOBONELLINAE

Diagnosis : Male sac distinctly marked off by a constriction in the gonoduct; gonostome away from genital pore; anal vesicles branched.

Remarks : Three genera are so far known under this sub-family. They are *Acanthobonellia*, *Ikedella* and *Metabonellia*, of which last one is unrepresented in the Indian coast.

Key to genera of *Acanthobonellinae*

- Gonostome basal in position; setae usually numerous *Acanthobonellia*
- Gonostome placed distally; setae absent.....
..... *Ikedella*.

Genus 8. *Acanthobonellia* Fisher

1948. *Acanthobonellia* Fisher. *Ann. Mag. nat. Hist.*, (11) **14** : 857.

1972. *Acanthobonellia*, Stephen & Edmonds. *The Phyla Sipuncula and Echiura, British Museum (Nat. Hist.)* : 361.

Diagnosis : Female : Trunk with bifid proboscis and with setae (usually numerous) embedded in one or two muscular pads anterior to gonopore; dorsal and neuro-intestinal blood vessels in direct communication; single gonoduct; anal vesicles branching.

Male : Unusually large with ciliated epidermis; setae absent.

Remarks : This genus contains four species, viz., *A. miyajimai* (Ikeda), *A. pirotanensis* Jose, *A. rollandoe* Menon, Dattagupta and Johnson, and *A. vulgaris* Menon, Dattagupta and Johnson. According to Stephen & Edmonds (1972) *A. vulgaris* is synonymous with *A. pirotanensis* and according to Dattagupta and Singh (1965) the remarkable similarity between the two species is of stimulating interest but the histological difference in the intestinal epithelium of the two species is a significant feature.

Key to species of *Acanthobonellia*

1. Setae barbed and single *A. rollandoe*
- Setae not barbed and more than one 2
2. Two to fourteen setae embedded in a single muscular cushion having no radiating muscle
..... *A. pirotanensis*

— Not less than twenty nine setae embeded in two muscular cushions having several radiating muscles *A. miyajimai*

15. *Acanthobonellia miyajimai* (Ikeda)

1904. *Bonellia miyajimai* Ikeda. *J. Coll. Sci. Imp. Univ. Tokyo*, **20** (4) : 7

1964. *Acanthobonellia miyajimai*, Menon, Dattagupta & Johnson. *Ann. Mag. nat. Hist.*, (13) **7** : 49-57, fig. 1

Material examined : 1 ex., Dwarka, adjacent to Light House, 12.1.1990, B.P. Haldar.

Diagnosis : Trunk short, cylindrical, narrow towards both extremities; proboscis very slender, about four times as long as trunk; colour greyish brown with minute blackish brown flecks; papillae minute and sparsely distributed; gonopre single, placed on a raised area; ventral setae 18 in number in two bundles embeded in two closely placed muscular pads lying on either side of nerve cord.

Internally, gonoduct single (left), gonostome placed basally; anal vesicles paired, placed on either side of rectum, branched, bearing numerous minute funnels.

Male : Ashy white, found in coiled state in the gonoduct.

Remarks : The presence of two bundles of setae embeded in two cushions distinguishes this species from other two of this genus.

Distribution : Indo-Pacific form rarely reported.

In India : Gujarat Gulf of Kutch (Menon *et al.*, 1964); Dwarka (present record).

Elsewhere : Japan (Ikeda, 1904).

16. *Acanthobonellia pirotanensis* Jose

1964. *Acanthobonellia pirotanensis* Jose. *J. Morph.*, **115** (1) : 53-68

1972. *Acanthobonellia pirotanensis* Stephen & Edmonds. *The Phyla Sipuncula and Echiura, British Mus. (Nat. Hist.)*; **15**

Material examined : 1 ex., Beacon Point, Pirotan Island, Gulf of Kutch, 20.4.1977, K.N. Reddy.

Diagnosis : Trunk sausage-shaped, measuring 140 mm including long and bifid proboscis; trunk surface wrinkled and verrucose, particularly at both extremities; body wall greyish brown with a few papillae at anterior and posterior ends; ventral setae 5, very small, placed on a small circular muscular cushion very close to mid-ventral line on its left side.

Internally, gonoduct single, situated on left side of nerve cord; gonostome ciliated funnel-like and placed basally; anal vesicles paired, branched and placed on either side of rectum.

Male : Spindle-shaped, measuring 20 mm in length, non-pigmented and lacking setae.

Remarks : The specimens of *Ikedella misakiensis* (Ikeda) reported by Gideon *et al.*, (1956) and further studied by Jose in 1964 revealed that it is a new species and described as *Acanthobonellia pirotanensis*. Menon *et al.*, (1964)'s specimens were from the same area and described as *A. vulgaris*.

Distribution : Endemic to the Indian waters.

In India : Gujarat : Gulf of Kutch Pirotan Island (Jose, 1964; Menon *et al.*, 1964; present record); Andamans (Dattagupta & Menon, 1971).

17. *Acanthobonellia rollandoe*

Menon, Dattagupta & Johnson

1964. *Acanthobonella rollandoe* Menon *et al.* *Ann. Mag. nat. Hist.* (13) **7** : 54-56, fig. 2 a.

1972. *Acanthobonella rollandoe* Stephen & Edmonds. *The Phyla Sipuncula and Echiura, British Mus. (Nat. Hist.)* : 364 figs. 43 E-G.

Material examined : None.

Diagnosis : Specimen ashy black in colour; trunk measuring 35 mm in length; papillae small, round, uniformly distributed; proboscis very long and bifid; seta single passing through muscular pad, arrow-shaped with barbed tip; gonopore single, situated on right side about 6 mm away from junction of proboscis and trunk.

Internally, anal vesicles tubular and branched, branches bearing a cluster of stumpy funnels;

neuro-intestinal system not studied due to poor preservation of these parts.

Remarks : According to Menon *et al.*, (1964) setae have undergone extreme reduction numerically in this species and seta and muscle pad are of characteristic shapes.

No specimen of this species is available for study with the author. Hence, the description of a single type specimen of Menon *et al.*, (1964) has been dealt under diagnosis.

Distribution : So far endemic to the Indian waters.

In India : As for the type locality.

Genu 9. *Ikedella* Monro

1927. *Ikedella* Monro. *Ann. Mag. nat. Hist.*, (9) 20 : 618.

1972. *Ikedella* Stephen & Edmonds. *The Phyla Sipuncula and Echiura, British Museum (Nat. Hist.)* London : 386

Diagnosis : Female : Proboscis long and bifid; ventral setae absent; gonoduct single, present on left side; anal vesicles comparatively short and branched at least three times; funnels present invariably on tertiary branches and sometimes on secondary branches.

Male : Located at anterior part of gonoduct; surface ciliated; ventral setae absent.

Remarks : The genus contains two species, viz., *I. achaeta* and *I. misakiensis*, of which the latter one is only known from the Indian coast.

18. *Ikedella misakiensis* (Ikeda)

1904. *Bonellia misakiensis* Ikeda. *Annotnes zool. Jap.*, 5 : 74-76, Figs 24, 103

1964. *Ikedella misakiensis* : Menon, Dattagupta & Johnson. *Ann. Mag. nat. Hist.*, (13) 7 : 56.

Material examined : 1 ex., Female, Beacon Point, Pirotan Island, Gulf of Kutch, 20.4.1977, B.P. Haldar.

Diagnosis : Trunk 40 mm in length, cylindrical and sausage-shaped; proboscis 92 mm in length,

ribbon-like, grooved on ventral surface and greyish-brown in colour but a thin white border along outer margin in the bifid region; skin semi-transparent through which ventral nerve cord visible; gonopore opening in anterior region of trunk on left of mid-ventral line. Ventral setae absent. Internal organs damaged.

Remarks : External features of the specimen is similar to the description of Gideon *et al.* (1956). Menon *et al.*, (1964) mentioned only "the anal vesicles bear excretory bodies as has been found in *Acanthobonellia*."

Distribution : Originally described and subsequently recorded from Japan. The species is so far not reported elsewhere except the Indian coast.

In India : Pirotan Island, Gujarat (Gideon *et al.*, 1956 Menon *et al.*, 1964; present record).

Elsewhere : Japan (Ikeda, 1904; Onoda, 1934, 1935).

SUMMARY

The paper deals with a comprehensive account of echiuran fauna of the Gujarat coast. Study reveals the occurrence of 18 species under 9 genera and 3 families, of these 8 species under 4 genera and 2 families constitute new locality records and among them one species is reported for the first time from the Indian coast. All the species have been keyed and described for easy identification. Diagnostic characters are provided for all the families as well as the genera representing in that coast. In addition, the state-wise distribution in India is summarised in a table. A general account of morphology and terminology, material and methods, and collection and preservation is included.

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REFERENCES

- ANNANDALE, N. & KEMP, S.W., 1915. *Mem. Indian Mus.*, **5** : 55-63.
- AWATI, P.R., 1936. *J. Univ. Bombay*, **4** : 96-104, 8 figs.
- AWATI, P.R. & DESHPANDE, D.S., 1936. *J. Univ. Bombay*, **1** : 96-107, 9 figs.
- BISESWAR, R., 1984. *S. Afr. J. Zool.*, **19** (1) : 16-20. 7 figs.
- BISESWAR, R., 1988. *S. Afr. J. Zool.*, **23** (2) : 81-91.
- BISESWAR, R., 1988. *Ann. S. Afr. Mus.*, **98**(2) : 29-75, 23 figs.
- BISESWAR, R. & MOODLEY, L.G., 1989. *S. Afr. J. Zool.*, **24** (4) : 337-339.
- CUENOT, L., 1922. *Fauna de France*, Paris, **4** : 1-30, 14 text-figs.
- DATTAGUPTA, A.K. & MENON, P.K.B., 1961. *J. Bombay nat. Hist. Soc.*, **(3) 48** : 829-830, 1 fig.
- DATTAGUPTA, A.K. & MENON, P.K.B., 1964. *Proc. R. Soc. Edinb.*, **(B) 68** : 267-276.
- DATTAGUPTA, A.K. & MENON, P.K.B., 1965. *Ann. Mag. nat. Hist.*, **(13) 8** : 193-201.
- DATTAGUPTA, A.K. & MENON, P.K.B., 1971. *Rec. zool. Surv. India*, **65 (1-4)** : 173-182, 2 text-figs.
- DATTAGUPTA, A.K. & MENON, P.K.B. & JOHNSON, P. 1963. *Ann. Mag. nat. Hist.*, **(13) 6** : 57-63, 2 text-figs.
- DATTAGUPTA & SINGHAL, 1978. *Zool. Anz.*, **201** : 136-142.
- DATTAGUPTA & SINGHAL, 1966. *Sci. Cult.*, **32** : 509-510.
- FISCHER, W., 1914. *Beitr. Kennt. Meeresfauna*, **1** : 57-84, Fig. 2.
- FISCHER, W., 1922. *Ark. Zool.*, **14 (19)** : 1-39, Pl. 1-3.
- GIDEON, P.W., MENON, P.K.B., RAO, S.R. & JOSE, K.V. 1956. *J. Bombay nat. Hist. Soc.* **54** : 201-202.
- GREEF, R., 1879. *Nova Acta Acad. German*, **40** : 152.
- HALDAR, B.P., 1978. *Bull. zool. Surv. India*. **1 (3)** : 315-316.
- HALDAR, B.P., 1981. *J. Bombay nat. Hist. Soc.*, **78**(1) : 188-189.
- HALDAR, B.P., 1985. *Proc. Symp. Endangered Marine Animals and Marine Parks*. **1** : 401-402.
- HALDAR, B.P., 1995 a. *Zool. Surv. India, Estuarine Ecosystem Series*, **2** : Hugli-Matla Estuary : 31-39.
- HALDAR, B.P., 1995b. *Zool. Surv. India, Wetland Ecosystem series 1 : Fauna of Chilka Lake* : 469-476.
- HALDAR, B.P. & DATTAGUPTA, A.K. 1991. *State Fauna series 2 : Fauna of Lakshudweep*, *Zool. Surv. India* : 185-197, 2 figs.
- HERUBEL, M.A., 1904. *Bull. Mus. Hist. Nat. Paris*, **10** : 476-480.

- HUGHES, R.N. & CRISP, D.J. 1976. *J. Zool., Lond.*, **180** : 233-242.
- IKEDA, I., 1904. *J. Coll. Sci. Imp. Univ. Tokyo*, **20 (4)** : 1-87.
- IKEDA, I., 1924. *Jap. J. Zool.*, **1** : 23-44, Pl, 1, figs. 1-19.
- JAMESON, H.L. 1899. *Zool. Jb. anat.*, **12**: 535-566.
- JOSE, K.V., 1964. *J. Morph.*, **115(1)** : 53-68, 15 figs.
- LANCHESTER, W.F., 1905. *Proc. Zool. Soc. London*, **1** : 35-41, Pl.2.
- MENON, P.K.B. & DATTA GUPTA, A.K., 1962. *Ann. Mag. nat. Hist.*, (13) **5** : 303-309, 3 figs.
- MENON, P.K.B. & DATTA GUPTA, A.K. JOHNSON, P. 1964. *Ann. Mag. nat. Hist.*, (13) **7** : 49-58, 3 figs.
- ONODA, K. 1934. *Annotnes Zool. Jap.*, **14** : 413-424.
- ONODA, K. 1935. *Annotnes Zool. Jap.*, **15** : 141.
- PALLAS, P.S., 1766. *Miscellanea Zoologica*, Hage Comitum : 146-151, 1 pl., 6 figs.
- PRASHAD, B., 1919a. *Mem. Asiat. Soc. Beng.*, **6** : 323-338, pl.11
- PRASHAD, B., 1919b. *Rec. Indian Mus.*, **16** : 399-402.
- PRASHAD, B., 1935. *Rec. Indian Mus.*, **37** : 39-44, pl. 1.
- PRASHAD, B. & AWATI, P.R., 1929. *Rec. Indian Mus.*, **31** : 259-262.
- SATO, H. 1934a. *Zool. Mag. Tokyo*, **46** : 245-252, 9 figs.
- SATO, H. 1934b. *Sci. Rep. Tohoku Imp. Univ.*, (4) **9** : 1-32, 31 figs.
- SATO, H. 1935. *Sci. Rep. Tohoku Imp. Univ.*, (4) **10** : 299-329.
- SATO, H. 1939. *Sci. Rep. Tohoku Imp. Univ.*, (4) : 339-460.
- SHIPLEY, A.E. 1899. *In: A. Willey, Zool. Res.*, **3** : 335-356, pl. 33.
- SHIPLEY, A.E. 1902. *In: J.S. Gardiner, Fauna and Geography of the Maldiv and Laccadive Archipelagoes*, **1** : 127-130, pl.6.
- SLUITER, G.P. 1888. *Naturuk. Tijdschr. Ned. Indie*, **48** : 244-248.
- SLUITER, G.P. 1902. *Siboga Expedition Monographie*, **25** : 1-53, 4pls.
- STEPHEN, A.C., 1952. *Bull. Brit. Mus. (nat. Hist.)*, Zool. **1** : 181-182.
- STEPHEN, A.C. & ROBERTSON, J. 1952. *Proc. R. Soc. Edinb.*, 64 (B) **22** : 426-444, pl. 1.
- STEPHEN, A.C. & EDMONDS, S.J., 1972. *The Phyla Sipuncula and Echiura, British Museum (nat. Hist.)*, London 528.
- SOUTHERN, R. 1913. *Scient. Invest. Fish. Brch. Ire* 1912 **(3)** : 1-46.
- WESENBERG-LUND, E., 1954. *Bull. Mus. natn. Hist. Paris* **(2) 26** : 376-384, 6 figs.
- WESENBERG-LUND, E., 1959a. *Atlantide Rep.* **5** : 177-210, 16 figs.
- WESENBERG-LUND, E., 1959b. *Vidensk. Meddr. dansk. naturh. Foren.*, **121** : 53-73.
- WESENBERG-LUND, E., 1963. *Vidensk. Meddr. dansk. naturh. Foren.*, **125** : 101-146, text-figs. 1-12.

Table showing distribution of echiurans in different Indian coasts

Sl. No.	Name of species	West Bengal	Orissa	Tamil Nadu	Andaman & Nicobar Islands	Kerala	Lakshadweep	Maharashtra	Gujarat	
									Gulf of Cambay	Gulf of Kutch
1.	<i>Anelassorhynchus</i> Annandale <i>A. branchiorhynchus</i> (Annandale & Kemp)	+	+							+
2.	<i>A. lobarhynchus</i> Dattagupta & Menon									+
3.	<i>A. sabinus</i> (Lanchester)			+					+	+
*4.	<i>Thalassema</i> Lamarck <i>T. diaphanes</i> Sluiter			+	+		+			+
**5.	<i>T. thalassemium</i> (Pallas)									+
*6.	<i>Ochetostoma</i> Leuckart & Ruppell <i>O. bombayensis</i> (Prashad & Awati)				+			+		+
*7.	<i>O. erythrogrammon</i> Leuckart & Ruppell				+					+
*8.	<i>O. palense</i> (Ikeda)						+		+	
9.	<i>O. zanzibarensis</i> Stephen & Robertson									+
*10.	<i>Listriolobus</i> Spengel <i>L. brevirostris</i> Chen & Yeh					+				+
*11.	<i>L. capensis</i> (Jose & Stephen)						+			+
12.	<i>Rubricelatus</i> Duttgupta & Menon <i>R. pirotansis</i> (Menon & Dattagupta)								+	+
*13.	<i>Eubonellia</i> Fisher <i>E. valida</i> Fisher						+			+
14.	<i>Achaetobonellia</i> Fisher <i>A. maculata</i> Fisher									+
15.	<i>Acanthobonellia</i> Fisher <i>A. miyajimai</i> (Ikeda)									+
16.	<i>A. pirotanensis</i> Jose				+					+
17.	<i>A. rollandoe</i> Menon, Duttgupta & Johnson									+
18.	<i>Ikedella</i> Monro <i>I. misakiensis</i> (Ikeda)									+

MARINE MOLLUSCA (PART-I : POLYPLACOPHORA, GASTROPODA and SCAPHOPODA)

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INTRODUCTION

Gujarat, the north-western part of Peninsular India (20°1' 24°7' N & 68°4' 74°4'E), has a coastline of 1663 kms, the longest among all the states. A vast expanse of 12,000 sq. kms of Arabian Sea between the Gulf of Kutch and the Gulf of Khambhat belonging to the state offers suitable home to more than 800 species of different animal groups. The wide ranging diversity of a marine animal assemblage attracts the researchers and students of Indian & foreign universities every year to visit this coast. The impression gained is the overwhelming dominance of the molluscan fauna as seen in all levels of zonations.

A considerable amount of earlier works on the molluscan fauna of the east coast of India has already been published by Gravely (1941, 1942), Ray (1948, 1968), Satyamurti (1952), Rajagopal and Mookherjee (1978, 1982), Mookherjee (1985), Subba Rao *et al.*, (1991, 1992). In comparison the marine molluscs of the west coast in general except for some restricted areas or some particular categories have so far received less attention. Hornell (1909, 1916) was the first to make an extensive survey of the marine resources of the Okhamandal coast. Gideon *et al.*, (1957) published report on molluscs of Gulf of Kutch following a preliminary survey of the area. After that a detailed account of marine gastropods of Gulf of Kutch was given by Menon *et al.*, (1961). Informations are also available on nudibranchs of Okhamandal (Eliot, 1909; Burn, 1970, Narayanan, 1971), Opisthobranchiate gastropods (Narayanan, 1969; 1970; Burn & Narayanan, 1970; Suba Rao & Surya Rao 1980, 1981), and shore ecology of okha coast including a list of fauna

(Gopalakrishnan, 1970). Subba Rao (2003) in his book, 'Indian Sea Shells-Part I' gave an exhaustive account of Indian marine molluscs especially the groups Polyplacophore and gastropoda filled the lacunae of Indian work in recent years.

This is the first comprehensive report on the marine molluscs (Polyplacophora, gastropoda and scaphopoda) of Gujarat. The paper is based on the study of a large collection of molluscs collected from the long stretch of the Gujarat coast conducted by different survey parties of Zoological Survey of India during 1953-1994 as H.C. Ray (1953), A. Daniel (1968), A.K. Nagabhusanam (1970), G.C. Rao (1971), K.V. Surya Rao (1972, 1979), K.N. Reddy (1977), B.P. Haldar (1978), N.V. Subba Rao (1992) and H.P. Mookherjee (1994).

Opportunity was taken to reexamine the named collection preset in National Zoological Collection, though the exact locality of collection and the identity of collector(s) could not be ascertained in some cases.

The classification adopted here is according to the one given by Vaught (1989).

LIST OF LOCALITIES SURVEYED DURING 1953-1994

Kutch

Lakhpat, Kori creek
Koteswar, Kori creek
Narayan Sarovar
Jakhau Port
Mandvi beach

* Present address : Retd. Dy. Director, GFI, Shree Ganesh Residency, Official Colony, 2nd Lane, Maharunipeta, Vishakhapatnam 530 002, Andhra Pradesh

Salaya nr. Mandvi
 Rukmavati river mouth, Mandvi
 Mundra mangroves
 Bhadreswar beach
 Tuna creek nr. Kandla
 Kandla, creek nr. New Port, Thermal Power Station
 Karero Port nr. Kandla
 Mithapore nr. Kandla
 Old Kandla Port
 Navlaki Port
 Vasarmadi creek, Navlaki

Jamnagar

Sikka Port
 Danda, 4.8 kms N.E. Sikka Port
 Bedi vill. Bank of Raso river, 8 kms E. of Sikka port
 Deeda Is., 22.5 kms N.E. of Sikka port
 Pirotan Is.,
 Salaya Port
 Naya Bandar, Bedi Port
 Rozy Port
 Sarmat, 17 kms. of Jamnagar

Okha

Okha beach nr. Port rest house
 Okha beach nr. MBRS
 N.W. Port Okha
 S.E. Port Okha
 Adatara nr. Okha
 Mithapur nr. Okha
 Beyt Is.
 Hanumandandi
 Balapur Bay
 Gopi
 Okha Light house
 Shamiani Is.

Dwaraka

Gomti creek
 Light house area
 Dwaraka beach
 Mandhi

Porbandar

Porbandar beach nr. Vill. Guest house, Birla mandir, Subhashnagar, Port area
 Miani creek
 Lamba shore, N. of Miani
 Gosabara creek
 Navibandar N. & S.
 Odedhad
 Madhavpur N. & S.
 Pata
 Mangrol
 Sil

Veraval

Chorwad
 Jaleswar
 Veraval beach, Port
 Bedia
 Somnath
 Off Veraval
 Devke river
 Muldwaraka
 Kotda
 Madhwad

Diu Is.

Vanakbara
 Diu Port
 Fudam
 Gogla
 Jalandar
 Simbor
 Nagoa
 Delvada
 Jaferabad
 Mahua

Bhavnagar

Gopnath
 Kuda
 Gogha
 New Fort

Kavi rivermouth of Mahisagar
Ambata, rivermouth of Narmada

Surat

Dumas

Valsad

Shantinagar vill., 1-1/2 S.W.
Leelapore vill., Hanumanbagra vill.

Daman

Navi Daman
Devake Daman
Jampur Daman
Marwad

Umbargaon

Beaches along the Gujarat coast chiefly fall under the following types. Muddy (backwater, Dumas), with mangrove vegetation (Mundra), sandy without vegetation (Somnath), sandy with mixture of mud (Mandvi), sandy with boulders and stones (Adatara), rocky with stones and fragmentary corals (Dwaraka). These different types of habitats are suitable localities for molluscs. Past records reveal that the Gulf area with its necklace of islands, had much richer in marine fauna. But the tour party of ZSI (1994) was not satisfied about the marine collection and remarked that environmental pollution caused from the drainage of swarages from a few coastal factories may disturbs the ecosystem of the intertidal and off shore fauna. Cutting of mangrove vegetation, once very richly covered the coastal belt for fuel and timber may also threaten the existence of this marine environment.

ABBREVIATIONS USED

A.D., A. Daniel; A.K.N., A.K. Nagabhusnanam; B.P.H., B.P. Haldar; D.R.K., D.R.K., Sastry; E., east; G.C.R., G.C. Rao; H.C.R., H.C., Ray; H.P.M., H.P. Mookherjee; Is., Island; K.N.R., K.N. Reddy; nr., near; K.V.S.R., K.V. Surya Rao; N., north; N.E., north east; N.V.S.R., N.V. Subba Rao; NZC., National Zoological Collection; Opp., opposite; S., South; S.B., S. Barua; S.E., south east; S.W., South west; Stn.,

Station; T.D.S., T.D. Soota; T.K.S., T.K. Samanta; W., West.; vill. Village.

**LIST OF MOLLUSCS
(POLYPLACOPHORA, GASTROPODA &
SCAPHOPODA) FROM GUJARAT**

Class POLYPLACOPHORA

Order NEOLORICATA

1. Family CHITONIDAE

1. *Chiton peregrinus* Thiele
2. Family ISCHNOCHITONIDAE

2. *Ischnochiton bouryi* Dupius

Class GASTROPODA

Order ARCHAEOGASTROPODA

3. Family FISSURELLIDAE

3. *Diodora bombayana* (Sowerby)
4. *D. exquisita* (Reeve)
5. *Diodora fimbriata* (Reeve)
6. *D. funiculata* (Reeve)
7. *D. indusiaca* (Reeve)
8. *D. lima* (Sowerby)
9. *D. subrostrata* (Gray)
10. *D. ticaonica* (Reeve)
11. *Emarginula dilecta* A. Adams
- *12. *E. elongata* (Philippi)
- *13. *Lucapinella canalifera* (G. & H. Nevill)
- *14. *Scutus unguis* (Linnaeus)

4. Family PATELLIDAE

15. *Cellana radiata radiata* (Born)

5. Family TROCHIDAE

16. *Trochus radiatus* Gmelin
17. *Calliostoma scobinatum* (Reeve)
- *18. *C. unica* Dunker
19. *Clanculus ceylonicus* G. & H. Nevill
20. *C. dipictus* A. Adams
- *21. *Clanculus microdon* Adams
22. *Trochus (Belangeria) scabrosus* (Philippi)
23. *Trochus (Infundibiulum) ochroleucus* Gmelin
- *24. *Euchelus indicus* (A. Adams)
25. *Euchelus quadricarinatus* (Bolten)

26. *Monilea (Priotrochus) obscurus* (Wood)
 27. *Osilanus kotschy* (phillipi)
 28. *Monodonta australis* Lamarck
 29. *Umbonium vestiarius* (Linnaeus)
 30. *Thalotia* sp.
6. Family STOMATELLIDAE
31. *Stomatella elegans* Gray
 32. *S. sulcifera* Lamarck
 33. *Stomatia phymotis* Helbling
7. Family TURBINIDAE
34. *Astrea (Astraliium) semicostata* (Kiener)
 *35. *Calcar stellatus* Gmelin
 36. *Liotia reeviana* Hinds
 37. *Lunella coronata* (Gmelin)
 38. *Angaria plicata* (Kiener)
 39. *Turbo burneus* (Roeding)
 40. *Angaria distorta* Linnaeus
 41. *Angaria plicata* (Kiener)
8. Family NERITIDAE
42. *Nerita (Theliostyla) albicilla* Linnaeus
 *43. *Nerita dombeyi* Reeve
 44. *N. insculpta* Recluz
 45. *N. oryzarum* Recluz
 *46. *N. plexa* Chemnitz
 47. *N. textilis* Gmelin
 48. *N. undata* Linnaeus
 49. *Neritina (Dostia) violacea* (Gmelin)
 50. *Clithon oualaniensis* (Lesson)
- Order MESOGASTROPODA
9. Family LITTORINIDAE
51. *Littoraria carinifera* (Menke)
 52. *L. (Littoraria) undulata* Gray
 53. *L. (Littorinopsis) scabra scabra* (Linnaeus)
 54. *Nodilittorina (Nodilittorina) trochoides* (Gray)
 55. *N. (Nodilittorina) vidua* (Gould.)
10. Family PLANAXIDAE
56. *Planaxis savignyi* Deshayes
 57. *Planaxis sulcatus* (Born)
11. Family CERITHIIDAE
58. *Cerithium caeruleum* Sowerby
- *59. *C. scabridum* Philippi
 60. *Clypeomorus moniliferus* (Kiener)
 61. *Rhinoclavis sinensis* (Gmelin)
12. Family POTAMIDIDAE
62. *Cerithidea (Cerithideopsilla) cingulata* (Gmelin)
 63. *Telescopium (Telescopium) telescopium* (Linnaeus)
13. Family TURRITELLIDAE
64. *Turritella duplicata* (Linnaeus)
 65. *Turritella columnaris* Kiener
 *66. *T. cerea* (Reeve)
 67. *T. maculata* Reeve
14. Family VERMETIDAE
68. *Serpulorbis variabilis* Hadfield & Key
15. Family STROMBIDAE
- *69. *Strombus gigas* Linnaeus
 *70. *Strombus ureus* Linnaeus
 71. *Tibia fusus* (Linnaeus)
16. Family VANIKORIDAE
72. *Vanikoro cancellat* (Lamarck)
17. Family CREPIDULIDAE
73. *Crepidula walshi* Herrmannson
 74. *Calyptraea pellucida* (Reeve)
18. Family CAPULIDAE
75. *Capulus irregularis* Smith
 76. *C. scutellatum* (Wood)
19. Family XENOPHORIDAE
77. *Xenophora (Stellaria) solaris* (Linnaeus)
20. Family CYPRAEIDAE
78. *Cypraea annulus* Linnaeus
 79. *C. arabica* Linnaeus
 80. *C. caurica* Linnaeus
 81. *C. cicercula* Linnaeus
 82. *C. gracilis* Gaskoin
 83. *C. lamarckii* Gray
 84. *C. lentiginosa* Gray
 85. *C. moneta* Linnaeus
 86. *C. ocellata* Linnaeus
 87. *C. onyx* Linnaeus

88. *C. pallida* Gray
 89. *C. tigris* Linnaeus
 90. *C. turdus winckworthi* Schilder & Schilder
 91. *C. vitellus* Linnaeus
21. Family OVULIDAE
92. *Phenacovolva brevirostris* Schumacher
22. Family TRIVIDAE
93. *Trivirostra oryza* (Lamarck)
23. Family NATICIDAE
- *94. *Natica abyssicola* E.A. Smith
 95. *N. pulicaria* Philippi
 96. *N. tigrina* (Roeding)
 97. *N. vitellus* (Linnaeus)
 98. *Polinices (Glossaulux) didyma* (Roeding)
 *99. *P. lamarckii* Chemnitz
 100. *S. cuvienianum* (Recluz)
 101. *Sinum halioloideum* (Linnaeus)
24. Family TONNIDAE
102. *Tonna dolium* (Linnaeus)
25. Family FICIDAE
103. *Ficus ficoides* (Lamarck)
 104. *F. variegata* Roeding
26. Family CASSIDAE
105. *Phalium glaucum* (Linnaeus)
27. Family RANELLIDAE
106. *Cymatium parthenopeum* (Von Salis)
 107. *C. pileare* (Linnaeus)
 108. *C. vespereum* (Lamarck)
 109. *Gyrineum natator* (Roeding)
28. Family BURSIDAE
110. *Bursa granularis* (Roeding)
 111. *Bufonaria echinata* (Link)
29. Family EPITONIDAE
112. *Epitonium immaculatum* (Sowerby)
 113. *Gyroscala lamellosa* (Lamarck)
30. Family JANTHINIDAE
114. *Janthina globosa* Swainson
 115. *J. janthina* Linnaeus
31. Family EULIMIDAE
116. *Niso pyramidelloides* G. & H. Nevill
32. Family MURICIDAE
117. *Murex carbonnieri* (Jousseau)
 *118. *M. malabaricus* Smith
 119. *M. ternispina* Lamarck
 120. *Murex trapa* Roding
 121. *M. tribulus* Linnaeus
 122. *Chicoreus brunneus* (Link)
 123. *C. kilburni* Houart & Pain
 124. *C. ramosus* (Linnaeus)
 125. *Cronia (Ergalatax) contracta* (Reeve)
 126. *C. subnodulosa* (Melvill)
 127. *Morula granulata* (Duclos)
 128. *M. marginatra* (Blainville)
 129. *Muricanthus kuesterianus* (Tapparone-Canefri)
 130. *Muricopsis bombayanus* (Melvill)
 131. *Purpura panama* (Roeding)
 132. *P. persica* (Linnaeus)
 133. *Rapana rapiformis* (Born)
 134. *Thais blanfordi* (Melvill)
 *135. *T. echinata* (Blainville)
 136. *T. bufo* Lamarck
 137. *T. lacera* (Born)
 138. *T. rugosa* (Born)
 139. *T. tissoti* (Petit)
33. Family BUCCINIDAE
140. *Babylonia spirata* (Linnaeus)
 141. *Cantharus (Pollia) fumosus* (Dillwyn)
 142. *C. (Pollia) spiralis* (Gray)
 143. *C. (Pollia) undosus* (Linnaeus)
 144. *Engina alveolata* (Kiener)
34. Family COLUMBELLIDAE
145. *Pyrene flava* (Bruguiera)
 146. *Pyrene splendidula* (Sowerby)
 147. *P. scripta* (Lamarck)
 148. *Anachis miser* (Sowerby)
 149. *A. sulcosa* (Sowerby)
 150. *A. terpischore* (Sowerby)
 151. *Mitrella blanda* (Sowerby)
35. Family NASSARIIDAE
152. *Nassarius (Hima) stolatus* (Gmelin)

153. *N. (Niotha) nodiferus* (Powis)
 154. *N. (Niotha) obesus* G. & H. Nevill
 155. *N. (Plicarcularia) pullus* (Linnaeus)
 156. *N. (Telasco) gaudiosus* (Hinds)
 157. *N. (Telasco) luridus* (Gould)
 158. *N. (Zeuxis) foveolatus* (Dunker)
 159. *Bullia (Bullia) melanoides* Deshayes in Belanger
 160. *B. (Bullia) taheitensis* (Bruguiere)
 *161. *Nassa hepatica* (Montagu)
 *162. *N. olivacea* (Bruguiere)
 *163. *N. pseudoconcinna* Smith
 *164. *N. thersites* Bruguiere
36. Family MELONGENIDAE
165. *Pugilina (Hemifusus) carinarium* (Roeding)
 166. *P. (Hemifusus) cochlidium* (Linnaeus)
37. Family VASIDAE
167. *Turbinella pyrum* (Linnaeus)
38. Family OLIVIDAE
- *168. *Oliva lepida* Duclos
 169. *O. oliva* (Linnaeus)
 169A. *O. undata* Lamarck
 *170. *Olivancillaria gibbosa* (Born)
 171. *Agaronia nebulosa* (Lamarck)
 172. *Amalda albifasciata* (Sowerby)
 173. *A. ampla* (Gmelin)
39. Family MITRIDAE
174. *Mitra (Mitra) guttata* Swainson
 *175. *M. mica* Reeve
 176. *M. (Nebularia) aurantia aurantia* (Gmelin)
 177. *M. (Nebularia) aurantia subruppeli* Finlay
 178. *M. (Strigatella) scutulata* (Gmelin)
40. Family COSTELLARIIDAE
179. *Vexillum sculptilis* (Reeve)
41. Family CANCELLARIIDAE
180. *Scalptia scalariformis* (Lamarck)
42. Family CONIDAE
181. *Conus angulatus* (A. Adams)
 182. *C. biliosus* (Roeding)
 183. *C. coronatus* Gmelin
184. *C. flavidus* Lamarck
 185. *C. lentiginosus* Reeve
 186. *C. lividus* Hwass in Bruguiere
 187. *C. monile* Hwass in Bruguiere
 188. *C. Piperatus* Dillwyn
 *189. *C. punctatus* Chemnitz
43. Family TURRIDAE
190. *Gemmula (Unedogemmula) deshayesii* Doumet
 191. *Lophiotoma indica* (Roeding)
 192. *Clavus unizonalis* (Lamarck)
 193. *Inquisitor flavidulus* (Linnaeus)
 194. *Turricula javana* (Linnaeus)
 195. *T. nelliae spuria* (Hedley)
 196. *T. tornata fulminata* (Kiener)
44. Family TEREBRIDAE
197. *Diplomeriza duplicata* (Linnaeus)
 198. *Hastula tenera* (Hinds)
45. Family ARCHITECTONICIDAE
199. *Architectonica laevigata* (Lamarck)
 200. *Heliacus dorsuosus* (Hinds)
- Subclass OPISTHOBRANCHIA
 Order CEPHALASPIDEA
46. Family HYDATINIDAE
201. *Hydatina physis* (Linnaeus)
 202. *H. velum* (Gmelin)
47. Family BULLIDAE
203. *Bulla ampulla* Linnaeus
48. Family HAMINEIDAE
204. *Haminoea elegans* Leach
 *205. *Haminoea galba* (Pease)
 *206. *H. tenera* A. Adams
- Order SACCOGLOSSA
49. Family ELYSIIDAE
- *207. *Elysia grandifolia* Kelaart
- Order APLYSIOMORPHA
50. Family APLYSIIDAE
- *208. *Aplysia benedicti* Eliot
- Order NOTASPIDEA
51. Family PLEUROBRANCHIDAE
- *209. *Pleurobranchus morula* Bergh

- *210. *Berthellina minor* Bergh
 Order NUDIBRANCHIA
 52. Family POLYCERIDAE
- *211. *Plocamopherus ceylonicus* (Kelaart)
 *212. *P. ocellatus* Ruppel & Leuckart
 53. Family CHROMODORIDIDAE
- *213. *Glossodoris petachialis* (Gould)
 *214. *Hypselodoris infucata* (Ruppel & Leuckart)
 54. Family ARCHIDORIDIDAE
- *215. *Archidoris minor* Eliot
 55. Family DISCODORIDIDAE
- *216. *Discodoris boholiesis* Bergh
 *217. *Peltodoris rubescens* Bergh
 *218. *P. pulchra* Eliot
 219. *Thordisa crosslandi* Eliot
 56. Family KENTRODORIDIDAE
- *220. *Kentrodoris funebris* Kelaart
 57. Family PLATYDORIDIDAE
- *221. *Hoplodoris desmoparpha* Bergh
 58. Family PHYLLIDIIDAE
- *222. *Phyllidia zelanica* Kelaart
 59. Family DENDRODORIDIDAE
- *223. *Dendrodoris nigra* Stimpson
 *224. *Doriopsilla miniata* Alder & Han-Cock
 *225. *D. miniata* Var.
 60. Family BORNELLIDAE
226. *Bornella digitata* Adams & Reeve
 61. Family TETHYIDAE
227. *Melibe rangii* Bergh
 62. Family ARMINIDAE
- *228. *Armina (Linguella) cinera* Farran
 *229. *Dermatobranchus semistriatus* Baba
 63. Family ZEPHYRINIDAE
230. *Antiopella indica* Eliot
 64. Family TERGIPEDIDAE
- *231. *Cuthona ceylonica* (Farran)
 65. Family FACELINIDAE
- *232. *Phidiana militaris* (Alder & Hancock)

- *233. *Pteraeolidia semperi* Bergh
 *234. *Sakuraeolis gujaratica* Rudman
 Order
 SYSTELLOMMATOPHORA
66. Family ONCHIDIIDAE
 235. *Onchidium verruculatum* (Cuvier)
 Subclass PULMONATA
 Order
 ARCHAEOPULMONATA
67. Family ELLOBIIDAE
 236. *Ellobium auris-judiae* (Linnaeus)
 237. *Cassidula nucleus* (Gmelin)
 238. *Melampus flavus* (Gmelin)
 239. *Melampus singaporensis* (Pfeiffer)
 Order BASOMMATOPHORA
68. Family SIPHONARIIDAE
 240. *Siphonaria siphon* Sowerby
 Class SCAPHOPODA
 Order DENTALOIDA
69. Family DENTALIIDAE
 241. *Dentalium eburneum* (Linnaeus)
 242. *Denlaliium longitrorsum* Reeve
 243. *Dentalium octangulatum* Donovan

*Indicates species reported in literature only, but not included in the text as we could not examine any material.

Class POLYPLACOPHORA Gray, 1821
 Order NEOLORICATA Bergenhayn, 1955

Chitons with the articulatum projecting beneath the tegmantum, either s sutural laminae only or as sutural laminae and insertion plates on and or more of the eight valves.

Key to families

1. Animal usually broad and oval, girdle narrow, insertion plates with pectinated teeth
 CHITONIDAE
- Animal generally more elongated, girdle broader, insertion plates not pectinated but with distinct slits ISCHNOCHITONIDAE

Family 1. CHITONIDAE

Genus 1. *Chiton* Linnaeus 17581. *Chiton peregrinus* Thiele

1930. *Chiton iatricus* Wincworth, *Proc. Malac. Soc. Lond.*, 19 : 78, pl. 8B.
1951. *Chiton iatricus* : Gideon *et al.*, *J. Bombay nat. Hist. Soc.*
1954. *Chiton iatricus* : Kaas, *Zool. Meded.*, 33 (1) : 1.
1995. *Chiton peregrinus* : Bosch *et al.*, *Sea Shells of Eastern Arabia*, : p. 190, pl. 882.
2003. *Chiton iatricus* : Subba Rao, *Rec. zool. Surv. India Occ paper No.*, 192 : 52, Fig. 19-4.

Material examined : (i) 2 exs., a mile N.W. of Port Okha, 21.i.1953, coll. H.C.R.; (ii) 6 exs., Okha, Coll. T.D.S.; (iii) 5 exs., Adatarra beach, 11.xi.1968, coll. A.D.; (iv) 12 exs., Okha beach, 13.viii.1972, coll. K.V.S.R.; (v) 8 exs., on shore in Beyt Is., opp. To Okha, 23.i.1953, coll. H.C.R.; (vi) 9 exs., Hanumandandi, 12.viii.1972, coll. K.V.S.R.; (vii) 5 exs., Okha beach, 9.iv.1977, coll. K.N.R.; (viii) Mandvi, along Rukmavati river mouth, 25.i.1992, coll. N.V.S.R.; (ix) 11 exs., Okha rocky shore, 4-5.ii.1992, coll. N.V.S.R.; (x) 1 ex., Okha rocky shore at Adatarra, 5.ii.1992, coll. N.V.S.R.; (xi) 1 ex., Dwaraka rocky shore, 6.ii.1992, coll. N.V.S.R.; (xii) 6 exs., Lamba shore, 35 miles from Porbandar, 28.i.1953, coll. H.C.R.; (xiii) 6 exs., Subhashnagar beach, Porbandar, 28.viii.72, coll. K.V.S.R.; (xiv) 13 exs., Porbandar beach, 29.viii.1972, coll. K.V.S.R., (xv) 3 exs., Rocky shore nr. Veraval Rest House, January, 1953, coll. H.C.R.; (xvi) 3 exs., Gopnath, 30.xi.1968, coll. A.D.; (xvii) 2 exs., Jaleswar nr. Veraval, 15.xi.1971, coll. G.C.R. and T.K.S.; (xviii) 13 exs., Jaleswar beach, Veraval, 26.iii.1977, coll. K.N.R.; (xix) 2 exs., Jaleswar Veraval, 21.i.1978, coll. B.P.H. & D.R.K.S.; (xx) 4 exs., Veraval, 24.i.1978, coll. B.P.H. & D.R.K.S.; (xxi) 3 exs., Veraval rocky shore, 10-13.ii.1992, coll. N.V.S.R.; (xxii) 2 exs., Sil, 12.xi.1971, coll. G.C.R. & T.K.S.; (xxiii) 3 exs., Somnath rocky shore, nr. Triveni Sangam, 11.ii.1992, coll. N.V.S.R.; (xxiv) 12 exs., Chorwad, 16.xi.1971, coll. G.C.R. & T.K.S.

Distribution : India : Gujarat (as above).

Elsewhere : Pakistan.

Remarks : In younger ones, the valves distinctly beaked, posterior margin of the intermediate valves with strong ribs. The number of gill plumes varies widely, found in tidal area at low tide. So far this references not recorded from east coast of India and restricted to N.W. Indian Ocean.

Family 2. ISCHNOCHITONIDAE

Genus 2. *Ischnochiton* Gray 18472. *Ischnochiton bouryi* Dupuis

1917. *Ischnochiton bouryi* Dupuis, *Bull. Mus. Hist. Nat. Paris*, 23 (7) : 535.
1976. *Ischnochiton bouryi* : Rajagopal and Subba Rao, *J. Mar. Biol. Ass. India.*, 16 (2) : 404.
2003. *Ischnochiton bouryi* Subba Rao. *Rec. zool. Surv. India Occ Paper No.*, 192 : 55, Fig 19-5.

Material examined : (i) 3 exs., Port Okha, 21.i.1953, coll. H.C.R.; (ii) 2 exs., Okha rocky shore, 4.ii.1992, coll. N.V.S.R.; (iii) 1 ex., Okha rocky shore, 5.ii.1992, coll. N.V.S.R.; (iv) 1 ex., Veraval rocky shore, east of light house, 10.ii.1992, coll. N.V.S.R.; (v) 2 exs., Somnath rocky shore near Triveni Sangam, 11.ii.1992, coll. N.V.S.R.; (vi) 8 exs., Somnath, 25.2.1970, coll. A.K.N.

Distribution : India : Gujarat (as above), Tamil Nadu, Andamans.

Elsewhere : Indonesia, Sri Lanka.

Class GASTROPODA

Order ARCHAEOGASTROPODA

Family 3. FISSURELLIDAE

Key to genera

- Apex perforated, perforation bound by callus *Diodora* Gray
- Apex recurved, slit long and narrow towards anterior margin *Emarginula* Lamarck

Subfamily DIODORINAE Weng, 1938

Genus 3. *Diodora* Gray, 1821

Key to the species of *Diodora*

1. Outline of shell polygonal, very strong ribs with broad interstices bearing weaker ribs 2
 Outline of shell rounded, ribs uniformly developed and close set 3
2. Concentric ribs fine and more in number forming a row of nodule like appearance on radial ribs
D. funiculata
 Concentric ribs strong and less in number giving the frill like appearance *D. fimbriata*
3. Anterior surface of shell much narrow and concave 4
 Anterior surface of shell slightly narrow ... 5
4. Radial ribs stronger than concentric ridges, weaker intermediate ribs in interstices.....
 *D. exquisita*
 - Radial ribs and concentric ridges are strong to form latticed sculpture, weaker intermediate ridges in interstices only seed posteriorly
 *D. ticaonica*
5. Shell much inflated, anterior and posterior surface of shell more convex *D. indusiaca*
 Shell not much elevated, anterior slightly narrower 6
6. Outline of shells broadly ovate, sculpture simple, strong radial ribs decussated by concentric ridges forming nodulated squarish pits *D. lima*
 - Outline of shells elongately ovate, sculpture elaborate, fine network of secondary radial ribs in addition to lattice .. *D. singaporensis*

3. *Diodora singaporensis* (Reeve)

1850. *Fissurella singaporensis* : Reeve, *Conch. Icon.*, 6, Pl. fig.
 1862. *Fissurella bombayana* Sowerby, *Thes. Conchyl.*, 3 : 196, fig. 166.
 1961. *Diodora bombayana* : Menon *et al. J. Bombay nat. Hist. Soc.* 58(2) : 477, Pl. 1, Figs. 182.

1991. *Diodora bombayana* : Subba Rao, *et al., State Fauna Series, Fauna of Orissa*, 1 (pt. 3) : 29.
 2000. *Diodora singaporensis* : Subba Rao & Dey. *Rec. zool. Surv. India, Occ Paper No.*, 187 : 9
 2003. *Diodora singaporensis* : Subba Rao, *Rec. zool. Surv. India. Occ Paper No.*, 192 : 67, pl. 3, fig. 5,6.

Material examined : (i) 1 ex., Mandvi beach nr. Rest House, 25.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Rukmavati river mouth nr. Mandvi, 30.vii.1972, coll. K.V.S.R.; (iii) 6 exs., Kutch, 28.vii.1972, coll. K.V.S.R.; (iv) 1 ex., Adatara, Okha, 10.viii.1972, coll. K.V.S.R., (v) 17 exs., Lamba Shore, 28.i.1953, coll. H.C.R.; (vi) 1 ex., Veraval beach, 25.vii.1972, coll. K.V.S.R., (vii) 1 ex., Veraval, 26.viii.1972, coll. K.V.S.R. (viii) 1 ex., Port area, Veraval, 24.i.1978, coll. B.P.H.; (ix) 5 exs., Shore, about 35 miles from Porbandar, 28.i.1953, coll. H.C.R.; (x) 5 exs., Subhashnagar, Porbandar, 28.viii.1972, coll. K.V.S.R.

Distribution : India : Andhra Pradesh; Gujarat (as above); Lakshadweep, Maharashtra, Orissa, Tamilnadu.

Elsewhere : Iran, Jashak, Myanmar, Pakistan.

Remarks : Shell not much elevated but elongated, anterior slightly narrower, apical hole broader and round, sculptured with widely spaced strong radial ribs, tranversed by widely spaced weaker concentric ridges, intermediate finer riblets also found to form reticulation, inner surface smooth and glossy, outer surface marked with radial brown patches. *D. bombayana* (Sowerby) is synonym of this species.

4. *Diodora exquisita* Reeve

1850. *Fissurella exquisita* Reeve, *Conch. Icon.*, 6, *Fissurella* sp. no. 74, pl. 11, fig. 74.
Material examined : (i) 1 ex., Port Okha, 21.i.1953, coll. H.C.R.

Distribution : Gujarat (as above).

Elsewhere : Strait of Magalhaens (Type loc.).

Remarks : Shell elongately ovate with elevated apex but flattened towards the periphery, surface

sculptured with wide spaced strong radial ribs traversed by close set weak concentric ridges, finer riblets also present in the interspaces of radial ribs near periphery; inner surface smooth with faint dentition at margin. This species is reported for the first time from Gujarat.

5. *Diodora fimbriata* Reeve

1850. *Fissurella fimbriata* Reeve, *Conch. Icon.*, 6, *Fissurella*, sp. no. 104, pl. 14, fig. 104.

Material examined : (i) 1 ex., Kathiawar, January, 1953, Coll. H.C.R.

Distribution : India : Gujarat (as above).

Elsewhere : North east coast of Australia, Jukes.

Remarks : Shell elongately ovate, apex elevated, surface sculptured with widely spaced strong radial ribs and fine riblets in interstices, concentric ridges are strong but a few in number, anterior shorter and narrower than posterior, inner surface glossy with polygonal margin. This species is reported for the first time from Gujarat.

6. *Diodora funiculata* (Reeve)

1850. *Fissurella funiculata* Reeve, *Conch. Icon.*, 6 : *Fissurella*. Sp. No. 65, pl. 9, fig. 65.

1961. *Diadora funiculata* : Menon *et al.*, *J. Bombay nat. Hist.* 58 (2), pl. 1, figs. 3,4.

1995. *Diodora funiculata* : Bosch *et al.*, *Sea Shells of Eastern Australia*, p. 30, pl. 15.

2003. *Diadora funiculata* : Subba Rao, *Rec. zool. Surv. India. Occ. Paper No.*, 192 : 66, pl. 3, figs. 1.

Material examined : (i) 1 ex., Danda, Kutch, 2 miles N. of Sikka Port, 14.i.1953, coll. H.C.R.; (ii) 2 exs., Deeda Is. 13 miles from Sikka Port, 17.i.1953, coll. H.C.R.; (iii) 4 exs., Pirotan Is. 20 miles from Sikka Port, 18.i.1953, coll. H.C.R.; (iv) 2 exs., Port Okha, 22.i.1953, coll. H.C.R., (v) 1 ex., Mandvi, Kutch nr. Rest house, 25.vii.1972, coll. K.V.S.R.; (vi) 2 exs., Rozy Port near Jamnagar, 22.viii.1972, coll. K.V.S.R.; (vii) 3 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (viii) 1 ex., Bhadreswar, 29.vii.1972, coll. K.V.S.R.; (ix)

1 ex., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (x) 1 ex., Jamnagar, Adatara beach, Okha, 5.iv.1977, coll. K.N.R.; (xi) 1 ex., Shamiani Is., Okha, 12.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Kerala, Tamil Nadu.

Elsewhere : Arabia, Pakistan, Persian Gulf, Sri Lanka.

Remarks : Shell moderately elongated with elevated apex nearer to the anterior margin, anterior much narrower than posterior, apical hole small round, surface sculptured with radiating ribs traversed by fine concentric ridges forming rows of nodules. Surface marked with brownish lines radiating from the apex, inner surface smooth, and glossy, shell margin polygonal, and slightly crenulated.

7. *Diodora indusica* (Reeve)

1850. *Fissurella indusiaca* Reeve, *Conch. Icon.*, 6, *Fissurella*. Sp. no. 67, pl. 10, fig. 67.

2003. *Diodora indusica* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.*, 192 : pl. 3, fig. 2

Material examined : (i) 10 exs., Kutch; (ii) 1 ex., Kathiawar, January, 1953, coll. H.C.R.

Distribution : India : Gujarat (as above).

Elsewhere : Pakistan.

Remarks : Shell elongately ovate inflated with apex nearer to the anterior margin, apical hole oblong and larger than that of the preceding species, anterior much shorter than posterior, surface sculptured by radiating ribs transversed by concentric ridges to form lattice, concentric ridges much weaker near the posterior margin, inner surface smooth and faintly indented.

8. *Diodora lima* (Sowerby)

1862. *Fissurella lima* Sowerby, *Thes. Conch.* III : 198.

1952. *Diodora lima* Sctyemerti, *Bull. Madras Govt. Mus. N. Ser.* 1 (2), pt. 6 : 32, pl. 1, Fig. 9.

Material examined : (i) 1 ex., Lamba shore in Porbandar, 28.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above). Tamil Nadu.

Remarks : Shell less elevated, slightly narrower anteriorly, surface sculptured with strong close set radial ribs traversed by concentric ridges forming nodulated squarish pits, surface alternately marked with white and brown patches radiating from the apex, inner surface smooth and slightly crenulated at margin, shell margin broadly ovate.

9. *Diodora subrostrata* (Gray)

1835. *Fissurella subrostrata* Gray in Sowerby. *Conch. Illustr.*, 2 (73), f. 35, *Catal.* (80) : 6.

Material examined : (i) 2 exs., Kutch.

Distribution : India : Gujarat (as above).

Elsewhere : Pakistan.

Remarks : Anterior surface narrower and concave, radial ribs stronger than concentric ones and form nodular rows, inner surface smooth but strongly crenulated at margin.

10. *Diodora ticaonica* (Reeve)

1850. *Fissurella ticaonica* Reeve. *Conch. Icon.*, 6 : *Fissurella*. Sp. no. 1070 pl. 14, fig. 107.

1961. *Diodora ticaonica* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 477, Pl. 1, fig. 5 & 6.

1978. *Diodora ticaonica* : Rajagopal and Mookherji, *Rec. zool. Surv. India. Occ. Paper No.* 12 : 11.

2003. *Diodora ticaonica* : Subba Rao, *Rec. zool. Surv. India. Occ. Paper No.* 192, pl. 3, fig. 7 & 8.

Material examined : (i) 1 ex., Lamba shore in Porbandar, 28.i.1953, H.C.R.

Distribution : India : Gujarat (as above), Tamil Nadu.

Elsewhere : Philippines.

Remarks : Shell narrower and elongated with elevated apex, apical hole oblong, surface concave anteriorly but somewhat convex posteriorly, sculptured by strong radial and concentric ridges forming lattice, interstices with weaker concentric

ridges posteriorly, inner surface smooth and glossy with faint dentition at margin, margin slightly excavated in the middle at the sides.

Subfamily EMARGINULINAE Weng, 1938

Genus 4. *Emarginula* Lamarck, 1801

11. *Emarginula dilecta* A. Adams

1851. *Emarginula dilecta* A. Adams, *Proc. Zool. Soc. London*, 19 : 85.

1863. *Emarginula dilecta* : Adams & Sowerby, *Thesaurus Conchyl.*, p. 211, fig. 5.

Material examined : 1 ex., Littoral zone, Port Okha, 21.i.1953, coll. H.C.R.

Distribution : Gujarat (as above), Maharashtra.

Elsewhere : Myanmar, Sri Lanka.

Remarks : Shell ovate, elevated, spire hook like posteriorly, centrally located; surface latticed, sculptured with 36 radial ribs, ribs nodulose, concentric ribs crested, intersections squamose in appearance, margin rounded with denticles; deep, narrow slit on anterior margin; interior porcellaneous.

This species is recorded for the first time from India.

Family 4. PATELLIDAE Rafinesque, 1815

Subfamily NACELLINAE Weng, 1938

Genus 5. *Cellana* H. Adams, 1869

12. *Cellana radiata radiata* (Born)

1778. *Patella radiata* Born., *Index Rerum Naturalium caesarei Vindobonensis*, pt. 1 : 443, pl. 18, fig. 10.

1961. *Cellana radiata* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 478, pl. 1, fig. 9.

1991. *Cellana radiata radiata* : Subba Rao *et al.*, *Zool. Surv. India : State Fauna Series 1 : Fauna of Orissa* (pt. 3) : 29.

2003. *Cellana radiata* : Subba Rao, *Rec. zool. Surv. India : Occ. Paper No.*, 192 : 72, pl. 4, fig. 8, 9.

Material Examined : (i) 18 exs., beach nr. Rest house, Mandvi, 25.vii.1972, coll. K.V.S.R., (ii) 18 exs., Mandvi beach near light house, Kutch, 28.vii.1972, coll. K.V.S.R., (iii) 7 exs., Rukmavati river, Mandvi, 30.vii.1972, coll. K.V.S.R.; (iv) 2 exs., Mithapur, Okha, 14.viii.1972, coll. K.V.S.R.; (v) 1 ex., Mithapur, near Okha, 24.viii.1972, coll. K.V.S.R.; (vi) 10 exs., Hanumandandi, Beyt Is., 8.iv.1977, coll. K.N.R.; (vii) 2 exs., Okha beach between Port and Light house, 9.iv.1977, coll. K.N.R.; (viii) 5 exs., Shamiani island, Okha, 12.iv.1977, coll. K.N.R.; (ix) 5 exs., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.; (x) 5 exs., Madhi, 1.xi.1971, coll. G.C.R. and T.K.S.; (xi) 5 exs., Miani, 31.x.1971, coll. G.C.R. and T.K.S., (xii) 5 exs., Lamba shore, 35 miles from Porbandar, 28.i.1953, coll. H.C.R.; (xiii) 5 exs., Lamba shore, 35 miles from Porbandar, 28.i.1953, coll. H.C.R.; (xiv) 3 exs., Porbandar, 30.x.1971, coll. G.C.R. and T.K.S.; (xv) 27 exs., Porbandar beach opp. to Circuit house, 24.viii.1972, coll. K.V.S.R.; (xvi) 20 exs. Porbandar beach nr. Port, 29.viii.1972, coll. K.V.S.R.; (xvii) 8 exs., Porbandar beach, 30.viii.1972, coll. K.V.S.R.; (xviii) 11 exs., Madhavpur, N., 6.xi.1971, coll. G.C.R. and T.K.S.; (xix) 3 exs., Madhavpur S., 7.xi.1971, coll. G.C.R. and T.K.S.; (xx) 2 exs., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S.; (xxi) 8 exs., Somnath, rocky shore, 29.iii.1977, coll. K.N.R.; (xxii) 1 ex., Veraval beach, 25.xi.1968, coll. A.D.; (xxiii) 13 exs., Veraval beach, 27.xi.1968, coll. A.D.; (xxiv) 3 exs., Jaleswar beach, Veraval, 21.i.1978, coll. B.P.H. and D.R.K.S.; (xxv) 7 exs., Kotda, 24.xi.1971, coll. G.C.R. and T.K.S.; (xxvi) 2 exs., Pata, 8.xi.1971, G.C.R. and T.K.S.; (xxvii) 3 exs., Sil, 12.xi.1971, coll. G.C.R. and T.K.S.; (xxviii) 1 ex., Gogla, 27.xi.1972, coll. G.C.R. and T.K.S.; (xxix) 8 exs., Madhwad, 25.xi.1971, coll. G.C.R. and T.K.S.; (xxx) 10 exs., Jalandhar, Diu, 27.i.1978, coll. B.P.H. and D.R.K.S.; (xxxi) 1 ex., Odledhad, 3.xi.1971, coll. G.C.R. and T.K.S.; (xxxii) 3 exs., Delvada, 27.xi.1971, Coll. G.C.R. and T.K.S.; (xxxiii) 3 exs., Simbar (Diu), 28.i.1978, coll. B.P.H. and D.R.K.S.; (xxxiv) 8 exs., Port area, Veraval, 24.i.1978, coll. B.P.H. and D.R.K.S.; (xxxv) 2 exs., Navibandar, South, 4.xi.1971, coll. G.C.R. and T.K.S.; (xxxvi) 4 exs., Navibandar, North, 2.xi.1971, coll. G.C.R. and T.K.S.; (xxxvii) 1 ex.,

Vanakbara, 24.xi.1971, coll. G.C.R. and T.K.S.; (xxxviii) 1 ex., Diu creek, 19.ii.1970, coll. A.K.N.; (xxxix) 8 exs., Madhwad, 25.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Andamans, Andhra Pradesh, Kerala, Maharashtra, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : Australia, Myanmar, Mergui Archipelago, Philippines, Queensland, Seychelles, Sri Lanka.

Family 5. TROCHIDAE

Key to the genera

1. Shell small, rounded, dorso-ventrally compressed; surface smooth, glossy, upper surface variously coloured, lower white; umbilicus filled by callous **Umbonium**
— Shell usually large, not compressed; surface either smooth or sculptured; umbilicus may or may not present, not calloused 2
2. Shell pyramidal in shape; aperture quadrangular; base flattended 3
— Shell either conical or turbiniform in shape; aperture nearly circular; base not flattened 5
3. Base excavated in middle; columella straight **Trochus**
4. Whorls straight sided; sculptured with nodulose spiral ribs, nodules prominent below suture; umbilicus narrow and deep **Osilinus**
— Whorls convex; sutured with beaded ridges; umbilicus shallow **Calliostoma**
5. Shell turbiniform; spire elevated; body whorl much longer than spiral whorls 6
— Shell conical; spire elevated; body whorl not large; spiral whorl gradually narrow 7
6. Shell sculptured with beaded spiral ribs; body whorl with prominent spiral ridges in middle; aperture smooth inside **Euchelus**

— Shell sculptured with smooth spiral ribs; Body whorl without ridges; aperture strongly lirate inside *Monodonta*

7. Whorl straight sided with angular shoulders, surface with spiral ridges and strong nodules *Monilia*

— Whorls concave without angular shoulders; surface with coarse beads on spiral rows *Clanculus*

Genus 6. *Trochus* Linnaeus, 1758

13. *Trochus radiatus* Gmelin

1791. *Trochus radiatus* Gmelin, *Syst. Nat.* Ed. 13, 1(6) : 3572, sp. 33.

1961. *Trochus radiatus* Menon *et al.*, *J. Bombay nat. Hist. Soc.*, 58 (2) : 478, pl.2, fig. 11

1978. *Trochus (Infundibulum) radiatus* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No. 12* : 24.

2003. *Trochus (Infundibulum) radiatus* Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 77, pl. 5, fig. 2

Material examined : (i) 8 exs., Umbargaon, 12.ii.1978, coll. B.P.H. and, D.R.K.S.

Distribution : India : Gujarat (as above). Andaman and Nicobar Islands, Lakshadweep, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Indo-pacific.

Remarks : Pilsbry (1889) gave a detailed description of the species, surface with transpiral crimson red irregular bands and angulated base of the conical shell make the species familiar.

14. *Trochus (Belangeria) scabrosus* (Philippi)

1995. *Trochus (Belangeria) scabrosus* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 34, fig. 37.

2003. *Trochus (Belangeria) scabrosus* : Subba Rao *et al.*, *Rec. zool. Surv. India. Occ Paper No. 192* : 78, pl. 5, fig. 8.

Material examined : (i) 3 exs., Mundra, Kutch, 27.vii.1972, coll. K.V.S.R.; (ii) 3 exs., Mithapur

nr. Okha, 14.viii.1972, coll. K.V.S.R.; (iii) 1 ex., Port area, Veraval, 24.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Goa, Maharashtra.

Elsewhere : Pakistan, Persian Gulf.

Remarks : This species is restricted to west coast only. Shell slightly broader than tall, convex sided; beaded spiral rows on whorls, body whorl keeled with round base, columella toothed, irregular brownish zig zag streaks on yellowish surface.

Genus 7. *Clanculus* Montfort, 1810

15. *Clanculus ceylonicus* G. & H. Nevill

1868. *Clanculus ceylonicus* G & H. Nevill, *J. Asiat. Soc. Bengal*, 38 (pt. 2) : 157.

Material examined : (i) 1 ex., Kutch.

Distribution : India : Gujarat (as above), Maharashtra,

Elsewhere : Sri Lanka.

Remarks : Shell small whitish in colour with transpiral reddish brown streaks, sutures shallow, whorls with beaded spiral ridges, columella with a strong tooth.

Subfamily CALLIOSTOMATIDAE

Genus 8. *Calliosoma* Swainson, 1840

16. *Calliostoma scobinatus* (Adams)

1863. *Zizyphinus scobinatus* Adams in Reeve, *Conch. Icon.*, 14 : 5, sp. 29.

1972. *Calliostoma scobinatum* : Subrahmanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 28, fig. 13.

2003. *Zizyphinus scobinatus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 86, pl. 8, fig. 6.

Material examined : (i) 1 ex., Mundra mangroves, Kutch, 27.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Rukmavati river mouth, Mandvi, Kutch, 26.vii.1972, coll. K.V.S.R.; (iii) 4 exs., Salaya nr. Mundra, Kutch, 31.vii.1972, coll. K.V.S.R.; (iv) 1 ex., Marwad, Daman, 13.ii.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Maharashtra.

Remarks : This species is endemic to Maharashtra and Gujarat coast. Shell straight sided, conical, taller than broad, with flattened base and tapering apex, whorls with spiral rows of beads.

Subfamily MARGARITINAE

Genus 9. *Euchelus* Philippi, 1847

17. *Euchelus asperus* (Gmelin)

1791. *Trochus asper* Gmelin, *Syst. Nat.*, ed. 13, 1 (6) : 3583, sp. 105. Type loc. : not known)

1854. *Euchelus indicus* : A. Adams, *Proc. zool. Soc. Lond.*, 1854 : 316.

1961. *Euchelus asper* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 419, pl. 2, fig. 17.

1978. *Euchelus asper* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper* No. 12 : 16.

2003. *E. asperus* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper* No. 192 : 82. Pl. 7, fig. 1, 2.

Material examined : (i) 2 exs., Kutch coast.

Distribution : India : Gujarat (as above), Andamans, Andhra Pradesh, Kerala, Maharashtra, Tamil Nadu.

Elsewhere : Indian Ocean, Moluccas, Sri Lanka.

Remarks : Whorls rounded with strong spiral ridges crossed by grooves, aperture circular, outer lip finely ridged, umbilicus narrow but deep. *Euchelus indicus* & *E. proximus* A. Adams are synonyms of this species.

18. *Euchelus quadricarinatus* (Holten)

1978. *Euchelus asper* var. *tricarinatus* : Rajagopal and Mookherjee *Rec. zool. Surv. India, Occ. Paper* No. 12 : 17.

2003. *Euchelus asper* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper* No. 192 : 83. Pl. 6, fig. 10.

Material examined : (i) 2 exs., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Hanumandandi, Beyt Is., Okha, 8.iv. 1977, coll. K.N.R.; (iii) 1 ex., Port area, Veraval, 24.i.1978, coll. B.P.H. and D.R.K.S.; (iv) 1 ex., Veraval beach, 24.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Goa, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Indian Ocean.

Remarks : Body whorl with three to four prominent spiral ridges, ridges with beads. This species was reported from India earlier as the variety *tricarinatus* Lamarck under *E. asperus* synonym of this species.

Subfamily MONODONTINAE

Genus 10. *Monodonta* Lamarck, 1799

19. *Monodonta australis* Lamarck

1961. *Monodonta australis* Menon *et al.*, *J. Bombay nat. Hist. Soc.*, 58 (2) : 478., pl. 2, fig. 12.

2003. *Monodonta (Monodonta) australis* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper* No. 192 : 84. Pl. 17, fig. 4.

Material examined : (i) 2 exs., Hanumandandi, 28.i.1953, coll. H.C.R.; (ii) 13 exs., Hanumandandi, Beyt Is., nr. Okha; (iii) 7 exs., Mithapur, nr. Okha, 14.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Mithapur beach, S. of Okha, 11.iv.1977, coll. K.N.R.; (v) 1 ex., Porbandar beach, 24.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Dwaraka, January, 1953, coll. H.C.R.; (vii) 13 exs., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.; (viii) 1 ex., Miani, 31.x.1971, coll. G.C.R. and T.K.S.; (ix) 1 ex., Pata, 8.xi.1971, coll. G.C.R. and T.K.S.; (x) 1 ex., Veraval nr. Rest House, 31.i.1953, coll. H.C.R.; (xi) 3 exs., Veraval beach, 29.xi.1968, coll. A.D.; (xii) 1 ex., Jaleswar (Veraval), 15.xi.1971, coll. G.C.R. and T.K.S.; (xiii) 4 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (xiv) 5 exs., Jalander, W. of Fort, Diu, 27.i.1978, coll. B.P.H.; (xv) 1 ex., Nagoa, Diu, 29.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andamans.

Elsewhere : Australia, Bangladesh, New Caledonia, Pakistan, South Africa.

Remarks : Whorls well rounded with shallow spiral grooves, spire often eroded, columella with strong tooth, outer lip liriate, umbilicus absent.

Genus 11. *Thalotia* Gray, 1840

20. *Thalotia* sp.

Material Examined : 2 exs., Gujarat coast.

Remarks : Shell broader than tall, whorls slightly concave and keeled at base, apex pointed, surface sculptured with prominent coarse spiral cords and spiral lines in between, base flat and spirally corded, umbilicus present, columella toothed at base, aperture nacreous, outer lip liriate internally.

Since specific identification of the material could not be done, the same was sent to Dr. David G. Herbert, Chief Curater, Mollusca Section, Natal Museum, South Africa, an expert of in this group. Though Dr. Herbert pointed out to the affinities of the shells towards *Thalotia beluchistana* Melvill, 1897 from Chabar and *Thalotia torresi* Smith, 1884 from the Torres Strait, he was unable to assign the specimens to any particular species. Further investigations are necessary for specific determination.

However, the genus *Thalotia* is now being for the first time reported from Indian water coast and the material will be a new addition to the NZC.

Genus 12. *Monilia* Swainson, 1840

Subgenus *Priotrochus* Fischer in Kiener & Fischer, 1880

21. *Monilea (Priotrochus) obscurus* (Wood)

1828. *Trochus obscurus* Wood, *Index Test. Suppl.*, pl. 5, fig. 25.

1949. *Monilea obscura* : Ray, *Rec. Ind. Mus.*, 46 (1-4) : 92.

1995. *Priotrochus obscurus* : Bosch *et al.*, *Sea Shells of Eastern Arabia*, p. 36, pl. 48.

Material examined : (i) 1 ex., Danda, 2 miles N. of Sikka port, 14.i.1953, coll. H.C.R.; (ii) 1 ex., Pirotan Is., Gulf of Kutch, 20.iv.1977, coll. K.N.R.;

(iii) 1 ex., Shamiani Is., Okha, 12.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Tamil Nadu.

Elsewhere : Indo-Pacific.

Remarks : Shell slightly taller than broad, whorls straight sided with angulate shoulders bearing coarse spiral ridges, large nodules present below sutures. This species varies in shape and colour, reported from Gujarat for the first time.

Subfamily UMBONIINAE

Genus 13. *Umbonium* Link, 1807

22. *Umbonium vestiarius* (Linnaeus)

1758. *Trochus vestiarius* Linnaeus, *Syst. Nat.*, ed. 10 : 756, sp. 571 (type locality : *M. mediterranes*, Aisatico, Chinensis).

1961. *Umbonium vestiarius* Menon *et al.*, *J. Bombay nat. Hist. Soc.*, 58 (2) : 480, pl. 2, fig. 20.

1991. *Umbonium vestiarius* : Subba Rao *et al.*, *Zool. Surv India, State Fauna Series, 1 : Fauna of Orissa* (pt. 3), p. 30.

2003. *Umbonium vestiarius* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No. 192* : 89. Pl. 16, fig. 10j.

Material examined : (i) 73 exs., Bhadreswar, beach, Kutch, 29.vii.1972, coll. K.V.S.R.; (ii) 10 exs., Balapur beach, Beyt Is., Kutch, 15.viii.1972, coll. K.V.S.R.; (iii) 4 exs., Kutch, (iv) 11 exs., Gopi, near Okha, 17.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Kerala, Karaikal, Pondicherry, Goa, Maharashtra, Tamil Nadu, West Bengal.

Elsewhere : Mediterranean, Indo-Pacific.

Family 6. STOMATELLIDAE

Two genera are found from Gujarat representing three species, and all the species are at subtidal on rocky bottoms.

Key to the genera

1. Spire low, conical, surface smooth but not plicate below suture, aperture ovate-quadrated
.....*Stomatella* Lamarck

2. Spire very short, surface plicate below suture with spiral ribs, aperture ovate-triangulara
..... *Stomatia* Helbling

Genus 14. *Stomatella* Lamarck, 1819

23. *Stomatella elegans* Gray

1847. *Stomatella elegans* Gray. In *Appendix to a Narrative of the Voy. H.M.S. 'Fly'* 2 : 359, pl. 2, fig. 1.

1949. *Stomatella (Stomatella) elegans* : Ray, *Rec. India Mus.*, 46 (1-4) : 92.

Material examined : (i) 1 ex., Hanumandandi, Beyt Is., near Okha, 2.i.1953, coll. H.C.R.; (ii) 1 ex., Balapur Bay, Beyt Is. Nr. Okha, 16.ii.1979, coll. K.V.S.R.; (iii) 1 ex., Port Sikka, 18.i.1953, coll. H.C.R.; (iv) 6 exs., Dwaraka, on shore, 24.i.1953, coll. H.C.R.; (v) 1 ex., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (vi) 3 exs., Port Okha, 21.i.1953, coll. H.C.R.; (vii) 1 ex., Adatara beach, nr. Okha, 10.viii.1972, coll. K.V.S.R.; (viii) 4 exs., Okha beach, 13.viii.1972, coll. K.V.S.R.; (ix) 2 exs., Okha beach, opp. to Guest houst, 12.iv.1977, coll. K.N.R.; (x) 4 exs., Lamba shore, 28.i.1953, coll. H.C.R.; (xi) 4 exs., Subhashnagar, Porbandar, 28.viii.1972, coll. K.V.S.R.; (xii) 9 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Tamil Nadu (Coromandel coast).

Elsewhere : Pakistan, Persia, S.W. Pacific.

Remarks : Spire slightly depressed, body whorl inflated with ovatoquadrate large aperture, surface sculptured with rough and fine spiral cords, brown spots found at the penultimate whorl, body whorl with brown patches, columella smooth and concave.

24. *Stomatella sulcifera* Lamarck

1822. *Stomatella sulcifera* Lamarck, *Hist. Nat. Anim. Sans Vert.*, 6 (2) : 210.

2003. *Stomatella sulcifera* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No. 192* : 92, pl. 9, fig. 3.

Material examined : (i) 45 exs., Lamba shore about 35 miles from Porbandar, 28.i.1953, coll. H.C.R.

Distribution : India : Gujarat. Andaman in west coast. Reported for the first time.

Remarks : Spire depressed, shell small, thick narrow and elongate : aperture large and oval with fine spiral straight. This species differs from former in heavy ovate aperture, body whorl with fine striae.

Genus 15. *Stomatia* Helbling, 1779

25. *Stomatia phymotis* Helbling

1779. *Stomatia phymoti* Helbling, *Abh. Privatges. Boehm.*, 4 : 124.

1995. *Stomatia phymotis* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 37, pl. 59.

2003. *Stomatella phymotis* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No. 192* : 93, pl. 9, fig. 14.

Material examined : (i) 1 ex., Pirotan Is., 32 miles from Sikka port, 18.i.1953, coll. H.C.R.

Distribution : India : Gujarat (Reported for the first time).

Elsewhere : Japan to S.W. Pacific (moderately uncommon in W. Pacific).

Remarks : Shell ear-shaped with much depressed spire, aperture oblique, ovate triangular, liriate; surface sculptured with nodulose keel like cords and fine threads, cords connected by coarse and elevated axial ribs; outer sculpture impressing on inner side of aperture, columella smooth and concave.

Family 7. TURBINIDAE

Key to the genera

1. Shell conical, whorls straight; base flattened, Periphery carinate : umbelicus absent
..... *Astrea*
- Shell not conical, whorls rounded : base not flattened and carinate; umbelicus usually present 2
2. Shell generally small upto 15 mm; spire low, sculpture with both arial and spiral ribs; operculum chitinous within, outside calcareous granules *Liotia*

- Shell large, spire high, sculpture with spiral ribs; operculum either calcareous or chitinous 3
- 3. Spire low; surface with rows of nodes or branched spires : umbellicus wide; operculum thia horny *Angaria*
- Spire either high or flattened, surface with spiral ribs. Umbellicus narrow, some times closed; operculum thick, calcareous ... *Turbo*

Subfamily ASTRAEINAE DAVIES, 1933

Genus 16. *Astrea* Roeding, 1798

Subgenus *Astralium* Link, 1807

26. *Astrea (Astralium) semicostata* (Kiener)

1839. *Trochus semicostatus* Kiener, *Cog. Viv.*, : *Trochus*, pl. 38, fig. 1. (type loc. : not known).
1961. *Astrea semicostata* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 480, pl. 3, fig. 23.
1978. *Astrea (Astralium) semicostata* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No.* 12 : 32.
2003. *Astrea semicostata* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* 192, pl. 12, Fig. 1-3.

Material examined : (i) 5 exs., Pirotan Is., 18.i.1953, coll. H.C.R.; (ii) 3 exs., beach nr. Light house, Mandvi, Kutch, 28.vii.1972, coll. K.V.S.R.; (iii) 2 exs., Salaya beach, Kutch, 31.vii.1972, coll. K.V.S.R.; (iv) 1 ex., Bedi Bandar nr. Jamnagar, 21.viii.1972, coll. K.V.S.R.; (v) 2 exs., 1 mile N.W. of Port Okha, 21.i.1953, coll. H.C.R.; (vi) 11 exs., 4.81 miles S.E. of Port Okha, 22.i.1953, coll. H.C.R.; (vii) 3 exs., Okha, 10.xi.1968, coll. A.D.; (viii) 2 exs., Adatara beach, Okha, 10.viii.1972, coll. K.V.S.R.; (ix) 2 exs., Okha beach between Port and Light house, 9.iv.1977, coll. K.N.R.; (x) 12 exs., Mithapur near Okha, 14.viii.1972, coll. K.V.S.R.; (xi) 1 ex., Mithapur, Okha, 11.iv.1977, coll. K.N.R.; (xii) 1 ex., Balapur Bay, Beyt Is., nr. Okha, 7.iv.1977, coll. K.N.R.; (xiii) 2 exs., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (xiv) 2 exs., Hanumandandi, Beyt Is. Okha, 8.iv.1977, coll. K.N.R.; (xv) 1 ex., on shore, nr Dwaraka Rest house, 24.i.1953, coll. H.C.R.; (xvi)

1 ex., Dwaraka, 22.ii.1970, coll. A.K.N.; (xvii) 4 exs., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (xviii) 1 ex., Shamiani Is., Okha, 12.iv.1977, coll. K.N.R.; (xix) 5 exs., Madhi, 1.xi.1971, Coll. G.C.R. and T.K.S.; (xx) 2 ex., Miani, 31.x.1971, coll. G.C.R. and T.K.S.; (xxi) 1 ex., Miani beach, 27.viii.1972, coll. K.V.S.R.; (xxii) 2 exs., Lamba shore, 35 miles from Porbandar, 28.i.1953, coll. H.C.R.; (xxiii) 5 exs., Porbandar, 30.x.1971, coll. G.C.R. and T.K.S.; (xxiv) 2 exs., Subhashnagar, Porbandar, 28.viii.1972, coll. K.V.S.R.; (xxv) 1 ex., Beach opp. to Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R.; (xxvi) 3 exs., Navibandar, S., 4.xi.1971, coll. G.C.R. and T.K.S.; (xxvii) 2 exs., Navibandar, 2.xi.1971, coll. G.C.R. and T.K.S.; (xxviii) 1 ex., Navibandar, 27.xi.1971, coll. G.C.R. and T.K.S.; (xxix) 4 exs., Madhavpur N., 6.xi.1971, coll. G.C.R. & T.K.S.; (xxx) 4 exs., Madhavpur S., 7.xi.1971, coll. G.C.R. & T.K.S.; (xxxi) 5 exs., Mangrol bandar, 11.xi.1971, coll. G.C.R. & T.K.S.; (xxxii) 9 exs., Veraval beach, 25-27.xi.1968, coll. A.D.; (xxxiii) 2 exs., Bedia, nr. Veraval, 19.xi.1971, coll. G.C.R. & T.K.S.; (xxxiv) 2 exs., veraval beach, 20.viii.1972, coll. K.V.S.R.; (xxxv) 8 exs., Jalandar, W. of Diu, 27.i.1978, coll. B.P.H. and D.R.K.S.; (xxxvi) 5 exs., Kotda, 24.xi.1971, coll. (xxxvii) 2 exs., Vankabara, 24.xi.1971, coll. G.C.R. and T.K.S.; (xxxviii) 3 exs., Sil, 12.xi.1971, coll. G.C.R. and T.K.S.; (xxxix) 2 exs., Delvada, 27.xi.1971, coll. G.C.R. and T.K.S.; (xxxx) 1 ex., Odedhad, 3.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Andaman Is., Kerala, Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Indian Ocean.

Subfamily LIOTINAE

Genus 17. *Liotia* Gray, 1847

27. *Liotia reeviana* Hinds

Material examined : (i) 7 exs., Pirotan Is. 18.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above).

Elsewhere : China, Singapore.

Remarks : Shell small with low spire, whorls

and aperture polygonal, surface with raised prominent transpiral ribs and spiral ridges to form latticed sculpture, ribs close set ventrally, umbilicus deep and widely open.

Genus 18. *Turbo* Linnaeus, 1758

28. *Turbo bruneus* (Roeding)

1798. *Lunatica brunea* Roeding, *Mus. Bolt.*, : 102, No. 1315.
(type loc. : Not known).

1961. *Turbo intercoastalis* Menon *et al.* *J. Bombay nat. Hist. Soc.* 58 (2) : 480, M 3, fig 21.

1978. *Turbo (Lunatica) bruneus* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No. 12* : 36.

2003. *Astrea (Marmoration) semicostata* : Subba Rao, *Rec. Zool. Surv. India, Occ. Paper No. 192* : 97, pl. 10, fig. 3.

Material examined : (i) 3 exs., Pirotan Is., 32 kms from Sikka Port, 18.i.1953, coll. H.C.R.; (ii) 1 ex., Beach nr. Light house, Mandvi, Kutch, 28.vii.1972, coll. K.V.S.R.; (iii) 3 exs., Littoral region, 4.8 kms S.W. of Port Okha, 22.i.1953, coll. H.C.R.; (iv) 7 exs., Crevice of rock, Okha, 10.xi.1968, coll. A.D.; (v) 5 exs., Adatara, 11.xi.1968, coll. A.D.; (vi) 1 ex., Adatara beach nr. Okha, 10.viii.1972, coll. K.V.S.R.; (vii) 4 exs., Okha beach, 13.viii.1972, coll. K.V.S.R.; (viii) 6 exs., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (ix) 4 exs., Mithapur, near Okha, 14.viii.1972, coll. K.V.S.R.; (x) 3 exs., Mithapur, 2 km. S. of Okha, 11.iv.1977, coll. K.N.R.; (xi) 2 exs., Okha beach between Port and Light houses, 9.iv.1977, coll. K.N.R.; (xii) 1 ex., Shamiani Is., Okha, 12.ii.1977, coll. K.N.R.; (xiii) 5 exs., Port Okha, 24.i.1978, coll. B.P.H.; (xiv) 2 exs., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (xv) 1 ex., Light house, Dwaraka, 10.iv.1977, coll. K.N.R.; (xvi) 4 exs., Madhi, 1.xi.1971, coll. G.C.R. and T.K.S.; (xvii) 2 exs., Lamba shore, 40 kms from Porbandar, 28.8.1953, coll. H.C.R. and T.K.S.; (xix) 3 exs., Subhashnagar, Porbandar, 28.viii.1972, coll. K.V.S.R.; (xx) 2 exs., Navibandar, 2.xi.1971, coll. G.C.R. and T.K.S.; (xxi) 1 ex., Madhavpur, 7.xi.1971, coll. G.C.R.; (xxii) 4 exs., Mangrol bandar, 11.xi.1971, coll. G.C.R.; (xxiii) 3 exs., Jaleswar, 15.xi.1971, coll. G.C.R. and T.K.S.; (xxiv) 3 exs., Veraval beach, 26. viii.1972, coll. K.V.S.R.;

(xxv) 1 ex., Jaleswar, Veraval, 19.x.1978, coll. B.P.H. and D.R.K.S.; (xxvi) 1 ex., Odehald, 3.xi.1971, coll. G.C.R. and T.K.S.; (xxvii) 1 ex., Pata, 8.xi.1971, coll. G.C.R. and T.K.S.; (xxviii) 1 ex., vanakabora, 24.xi.1971, coll. G.C.R.; (xxix) 1 ex., Simor, Diu, 28.i.1978, coll. B.P.H. and D.R.K.S.; (xxx) 4 exs., Diu, St. xii, 29.i.1978, coll. B.P.H. and D.R.K.S.; (xxxi) 1 ex., Gopnath, 30.xi.1968, coll. A.D.; (xxxii) 2 exs., Jalandar, W. of Port Diu, 22.i.1978, coll. B.P.H. and D.R.K.S.; (xxxiii) 1 ex., Hanumandandi, Beyt Is, Okha, 8.vii.1977, coll. K.N.R.; (xxxiv) 3 exs., Pirotan Is., 20 miles from Sikka Port, 18.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above), Andaman and Nicobar Islands, Goa, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Australia, Annana, Akyab, Gulf of Sian, Gulf of Suez, Indonesia, Loyalty Island, Madagascar, Maldives, Mauritius, Myanmar, New Caledonia, Persian Gulf, Sandwich Islands, Sri Lanka.

Remarks : Shell thick with moderate spire, sutures deep, body whorl large, umbilicus narrow and deep.

29. *Turbo (Lunella) coronata* (Gmelin)

1791. *Turbo coronatus* Gmelin, *Syst. Nat.*, ed. 13.

1961. *Turbo coronatus* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 480, pl. 3, fig. 22.

1995. *Lunella coronata* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 40, p. 89.

Material examined : (i) 4 exs., Rukmavati river mouth, mandvi, Kutch, 30.vii.1972, coll. K.V.S.; (ii) 1 ex., Nagabandar, Bedi, nr. Jamnagar, 20.viii.1972, coll. K.V.S.R.; (iii) 3 exs., Bedi Bandar, nr. Jamnagar, 17.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Okha, 10.xi.1968, coll. A.D.; (v) 1 ex., Adatara, 5 kms. S.E. of Okha, 11.xi.1968, coll. A.D.; (vi) 1 ex., Sikka beach, 19.8.1972, coll. K.V.S.R.; (vii) 1 ex., Port Okha, 2.i.1953, coll. H.C.R.; (viii) 6 exs., Adatara beach, Okha, 10.viii.1972, coll. K.V.S.R.; (ix) 3 exs., Mithapur, nr. Okha, 14.viii.1972, coll. K.V.S.R.; (x) 3 exs., Hanumandandi, 12.viii.1972, coll. K.V.S.R.; (xi) 1

ex., Adatara beach, Okha, 5.iv.1977, coll. K.N.R., (xii) 1 ex., Okha beach, between Port and Light house, 9.iv.1977, coll. K.N.R.; (xiii) 1 ex., Mithapur, S. of Okha, 11.iv.1977, coll. K.N.R.; (xiv) 1 ex., Hanumandandi, Beyt Is., Okha, 8.iv.1979, coll. K.N.R.; (xv) 1 ex., Muldwaraka, 22.ii.1970, coll. A.K.N.; (xvi) 4 exs., Muldwaraka, 22.xi.1971, coll. G.C.R. and T.K.S.; (xvii) 4 exs., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.; (xviii) 1 ex., Madhi, 1.xi.1971, coll. G.C.R. and T.K.S.; (xix) 1 ex., Miani, 31.x.1971, coll. G.C.R.; (xx) 1 ex., Porbandar, 30.x.1971, coll. G.C.R.; (xxi) 6 exs., Porbandar beach opp. to circuit house, 24.viii.1972, coll. K.V.S.R.; (xxii) 14 exs., Porbandar beach, nr. Port, 27.viii.1972, coll. K.V.S.R.; (xxiii) 5 exs., Subhashnagar beach, Porbandar, 28.viii.1972, coll. K.V.S.R., (xxiv) 4 exs., beach opp. to Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R., (xxv) 3 exs., Navibandar, 2-4-9.xi.1971, coll. G.C.R. and T.K.S.; (xxvi) 3 exs., Madhavpur, north, 6.xi.1971, coll. G.C.R. and T.K.S.; (xxvii) 5 exs., Madhavpur, 7.xi.1971 coll. G.C.R. and T.K.S.; (xxviii) 1 ex., Odedhad, 3.xi.1971, coll. G.C.R. and T.K.S.; (xxix) 3 exs., Sil, 12.xi.1971, coll. G.C.R. and T.K.S., (xxx) 2 exs., Mangrol, 16.xi.1971, coll. G.C.R. and T.K.S.; (xxxi) 3 exs., Jaleswar, 15.xi.1971, J.C.R. and T.K.S.; (xxxii) 13 exs., Veraval beach, 27.xi.1968, coll. A.D.; (xxxiii) 2 exs., Bedia, nr. Veraval, 19.xi.1971, coll. G.C.R. and T.K.S., (xxxiv) 1 ex., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (xxxv) 1 ex., Jaleswar, nr. Veraval, 26.iii.1977, coll. K.V.S.R.; (xxxvi) 1 ex., Jaleswar beach, Veraval, 21.i.1978, coll. B.P.H.; (xxxvii) 2 exs., Port oval, Veraval beach 24.i.1978, coll. B.P.H.; (xxxviii) 5 exs., Somnath, 17.xi.1971, coll. G.C.R. and T.K.S.; (xxxix) 2 exs., Delvada, 27.xi.1971, coll. G.C.R. and T.K.S.; (xl) 1 ex., Vanakabara, Diu, 24.xi.1971, G.C.R. and T.K.S.; (xli) 2 exs., Vanakabara, Diu, 26.i.1978, coll. B.P.H. and D.R.K.S.; (xlii) 1 ex., Gogla, 12.ii.1970, coll. A.K.N.; (xliii) 1 ex., Gogla, 27.xi.1971, G.C.R.; (xliv) 3 exs., Simbor (Diu), 28.xi.1971, coll. B.P.H. and D.R.K.S.; (xlv) 3 exs., Simbor (Diu), 28.xi.1978, coll. G.C.R. and T.K.S.; (xlvi) 2 exs., Diu Fort, 6.i.1978, coll. B.P.H.; (xlvii) 4 exs., W. of Gogla, Diu, 29.i.1978, coll. B.P.H. and D.K.R.S.

Distribution : India : Gujarat (as above).

Elsewhere : Arabia, Japan & Korea.

Remarks : This species can easily be differentiated from the preceding one by its small low spire and body whorl with spiral rows of nodules on shoulder. It is widely distributed on Gujarat coast.

This species is not reported from east coast so far.

Subfamily ANGARIINAE

Genus 19. *Angaria* (Bolten) Roeding, 1798

30. *Angaria distorta* (Linnaeus)

1758. *Turbo distorta* Linnaeus, *Syst. Nat.* ed. 10 : 764, sp. 547, (type loc. : not known).

1978. *Angaria distortata* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No. 12* : 20.

2003. *Angaria (Angaria) distortata* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No. 192* : 99, pl. 11, figs. 9, 10.

Material examined : (i) 2 exs., Danda, 2 kms N. of Sikka port, Gulf of Kutch, 14.i.1953, coll. H.C.R.; (ii) 1 ex., Pirotan Is., 32 kms from Sikka Port, 18.i.1953, coll. H.C.R., (iii) 1 ex., Beach nr. Light house, Mandvi, Kutch, 28.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Tamil Nadu, Nicobar Is.

Elsewhere : Australia, Philippines, Singapore, Sri Lanka.

Remarks : This species can easily be identified by its depressed spire of the plicated turbinata shell and wide open umbilicus. Recorded from Gujarat for the first time. *A. plicata* (Kiener 1838) is synonym of this species.

Family 8. NERITIDAE

Key to genera

1. Shell thick, moderate, with spiral ribs, outer lip denticulate *Nerita* Linnaeus, 1758

Shell thin, small without spiral ribs, outer lip smooth 2

2. Shell with a subsutural row of spines or nodules
..... *Clithon* Montfort, 1810

Shell surface smooth without spines
..... *Neritina* Lamarck

Genus 20. *Nerita* Linnaeus, 1758

Subgenus *Theliostyla* Moersch, 1852

31. *Nerita (Theliostyla) albicilla* Linnaeus

1758. *Nerita albicilla* Linnaeus, *Syst. Nat.*, ed. 10 : 778, sp. 640, (type loc. : "ad. Hitoe").

1961. *Nerita albicilla* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 481, pl. 3, fig. 24 & 25.

1978. *Nerita (Theliostyla) albicilla* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No.* 12 : 39.

2003. *Nerita (Theliostyla) albicilla* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* 192 : 105, pl. 14, fig. 1-4, pl. 17, fig. 3.

Material examined : (i) 17 exs., Beach nr. Rest houst, Mandvi, 25.vii.1972, coll. K.V.S.R.; (ii) 9 exs., Rocks near Rukmavati river mouth, Kutch, 30.vii.1972, coll. K.V.S.R.; (iii) 1 ex., Adatara beach nr. Okha, 10.viii.1972, coll. K.V.S.R.; (iv) 3 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (v) 13 exs., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Okha, 13.viii.72, coll. K.V.S.R.; (vii) 4 exs., Mithapur, Okha, 14.viii.1972, coll. K.V.S.R.; (viii) 1 ex., Mithapur, 12 kms. S. of Okha, 11.iv.1977, coll. K.N.R.; (ix) 1 ex., Okha beach, between Port and Light house, 9.iv.1977, coll. K.N.R.; (x) 1 ex., Light house, Dwaraka, 10.iv.1977, coll. K.N.R.; (xi) 6 exs., Miani beach, 27.viii.1972, coll. K.V.S.R.; (xiv) 2 exs., Porbandar beach, 24.viii.1972, coll. K.V.S.R.; (xv) 9 exs., Porbandar beach nr. Port, 29.viii.1972, coll. K.V.S.R.; (xvi) 4 exs.; Subhasnagar beach, Porbandar, 28.viii.1972, coll. K.V.S.R.; (xvii) 2 exs., Beach opp. to Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R.; (xviii) 2 exs., Madhavpur, S., 7.xi.1971, coll. G.C.R.; (xix) 4 exs., Veraval beach, 25.ii.1968, coll. A.K.D.; (xx) 3 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (xxi) 10 exs., Veraval, 24.i.1978, coll. B.P.H. and D.R.K.S.

Distribution : India : Gujarat (as above), common in both coasts of India, Andaman and Nicobar Islands, Lakshdweep.

Elsewhere : Indo-Pacific.

Remarks : Thick globose shell with depressed spire, outer lip weakly dented, columella with heavily granulated callus pad, has 4 weak central teeth, whorls with low spiral ridges and fine growth lines.

32. *Nerita insculpta* Recluz

1841. *Nerita insculpta* Recluz, *Revue Zool. Soc. Cuvier* : 152.

1975. *Nerita (Amphinerita) insculpta* : Subba Rao, *Studies on Indian Neritids*, Ph.D. Thesis, Calcutta University, p. 119.

2003. *Nerita insculpta* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* 192 : 114, pl. 13, fig. 10, 11, pl. 18, fig. 4.

Material examined : (i) 2 exs., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman and Nicobar Islands, Tamil Nadu.

Elsewhere : Sri Lanka, Philippines, Australia, Polynesia.

Remarks : Shell obliquely oveli, strongly arched. Whorls 3, narrow, spirally ribed. Ribs 22-32, aperbire semiluner callus smooth, inner collumeller margin convex or straight with 2-4 feebly developed teeth in the middle.

33. *Nerita oryzarum* Recluz

1952. *Nerita oryzarum* : Subrahmanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 29, fig. 21.

2003. *Nerita oryzarum* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* 192 : 106, pl. 14, fig. 10-13, pl. 17, fig. 6.

Material examined : (i) 2 exs., Jaleswar beach, veraval, 21.i.1978, coll. B.P.H. and D.R.K.S.; (ii) 2 exs., Veraval beach, 24.ii.1979, coll. K.V.S.R.; (iii) 1 ex., Gopnath nr. Bhavnagar, 1.ii.1978, coll. B.P.H. and D.R.K.S.; (iv) 1 ex., Diu Fort, 6.i.1978,

Coll. B.P.H. and D.R.K.S.; (v) 8 exs., Jalandar, W. of Fort, Diu, 21.i.1978, coll. B.P.H. and D.R.K.S.; (vi) 10 exs., Vanakbara, Diu, 26.i.1978, coll. B.P.H. and D.R.K.S.; (vii) 57 exs., Devika, Daman, 10.ii.1978, coll. B.P.H. and D.R.K.S.; (viii) 3 exs., Jampora (Daman), 11.ii.1978, coll. B.P.H. and D.R.K.S.; (ix) 16 exs., Umbargaon, 12.ii.1978, coll. B.P.H. and D.R.K.S.; (x) 20 exs., Marwad, Daman, 13.ii.1978, coll. B.P.H. and D.R.K.S.

Distribution : India : Gujarat (as above), Daman, Diu, Maharashtra.

Remarks : Shell black with white transpiral zig zag patches, spire slightly elevated, columella broad with a few tubercles and ridges, margin of outer lip is ridged internally.

Endemic to west coast (Subba Rao, 2003) Maharashtra. This is first record from Gujarat.

34. *Nerita textilis* Gmelin

1791. *Nerita textilis* Gmelin. *Syst. nat.* ed. 13 : 3683, No. 53, (Refers to *Rumph. Mus.*, t. 22, f. 3) Type loc. : not mentioned

1995. *Nerita textilis* : Bosch *et al.*, *Sea Shells of Eastern Arabia*, p. 44, pl. 106.

2003. *Nerita textilis*: Subba Rao, *Rec. zool. Surv. India, Occ. Paper No. 192* : 108, pl. 15, fig. 7, 8, pl. 17, fig. 2.

Material examined : 1 ex., Veraval beach, 26.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above).

Elsewhere : Arabia, Muscat. East coast of Africa to west coast of India (Subba Rao, 2003).

Remarks : Thick, heavy shell with depressed spire, outer lip strongly ridged inside, columella, with densely granulated callus weakly dented; whorls coarsely wrinkled with spiral cords.

35. *Nerita undata* Linnaeus

1758. *Nerita undata* Linnaeus, *Syst. Nat.*, ed. 10 : 779

1972. *Nerita (Ritena) undata* : Cernohorsky. *Marine shells of the pacific* 2 : 51, pl. 11, figs. 8, 8a.

1992. *Nerita (Nerita) undata* : Subba Rao *et al.*, *Zool. Surv. India State Fauna Series, Fauna of West Bengal*, 3 (pt. 9) : 159, pl. 1, fig. 11.1

Material examined : (i) 14 exs., Rukmavati river, Mandvi, Kutch, 30.vii.1972, coll. K.V.S.R.; (ii) 4 exs., Port Okha, 21.i.1953, coll. H.C.R.; (iii) 28 exs., Adatara, near 5 km. Of S.E. of Okha, 11.xi.1968, coll. A.D.; (iv) 10 exs., Adatara beach, Okha, 5.iv.1977, coll. K.N.R.; (v) 20 exs., Hanumandandi, Beyt Is., Okha, 8.iv.1977, coll. K.N.R.; (vi) 4 exs., Mithapur beach, S. of Okha, 11.iv.1977, coll. K.N.R.; (vii) 32 exs., Shamiani Is., 12.iv.1977, coll. K.N.R., (viii) 5 exs., Dwaraka beach, 17.viii.1972, coll. K.V.S.R.; (ix) 8 exs., Light house, Dwaraka, 10.iv.1977, coll. K.N.R.; (x) 3 exs., on rocks at Gomti creek, Dwaraka, 18.iii.1979, coll. K.V.S.R.; (xi) 17 exs., Porbandar beach, 24.viii.1972, coll. K.V.S.R.; (xii) 3 exs., Porbandar, beach opp to Circuit house, 30.viii.1972, coll. K.V.S.R.; (xiii) 4 exs., Delvada, 27.xi.1971, coll. G.C.R.

Distribution : India : Gujarat (as above), Lakshadweep.

Elsewhere : Indo-pacific.

Remarks : Cernohorsky (1972) discussed its variability and gave number of synonyms of this species and very variable.

Geus 21. *Neritina* Lamarck, 1816

Subgenus *Dostia* Gray, 1847

36. *Neritina (Dostia) violacea* (Gmelin)

1791. *Nerita vioacea* Gmelin, *Syst. Nat.*, ed. 13 : 3686, sp. 68 (type loc. : Not given).

1992. *Neritina (Dostia) violacea* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of West Bengal*, 3 (pt. 9) : 159, pl. 1, fig. 11.

Material examined : (i) 1 ex., Simbor (Din), 28.i.1978, coll. B.P.H. & D.R.K.S.; (ii) 11 exs., Kori creek, Lakhat, 4.vii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above). Andaman & Nicobar Islands, Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Australia, Bangkok, Borneo, Cambodia, Celebes, China, Fiji, Indonesia, Japan, Java, New Celedonia, Myanmar, Merqui

Archipelago, New Caledonia, Philippines, Samoa, Singapore, Sri Lanka, Sumatra, Thailand.

Remarks : Variable in colour, shape and structure (Subba Rao, 1989) occurs in estuaries, found attached to mangrove plants.

Genus 22. *Clithon* De Montfort, 1810

37. *Clithon oualaniensis* (Lesson)

1831. *Neritina oualaniensis* Lesson, *Voy. Coquille, Zool.*, 2 (1) : 379 (type loc. : Oulan, Fiji).

1991. *Clithon oualaniensis* : Subba Rao *et al.*, *Zool. Surv. India.*, State Fauna Series, *Fauna of Orissa*, 1 (pt. 3) : 36.

Material examined : 9 exs., Vanakabara, Diu, 26.i.1978, coll. B.P.H.

Distribution : India : Diu, Andaman and Nicobar Islands, Andhra Pradesh, Karnataka, Kerala, Orissa, Tamil Nadu.

Elsewhere : Java, Indonesia, Margui Archipelago, Polynesia, Sri Lanka, Sumatra, Thailand.

Remarks : This species found near river mouths and back waters on mudflats and fine sandy patches. Gregarius in their habitat. Polymorphic, exhibiting different colour patterns.

This species is reported first time from Gujarat (Diu).

Order MESOGASTROPODA

Family 9. LITTORINIDAE

Key to genera

Rows of nodules absent on the shell sculpture, spire elongated..... *Littoraria*

Rows of nodules present on the shell, spire short *Nodilittorina*

Genus 23. *Littoraria* Griffith & Pidgeon, 1834

38. *Littoraria carinifera* (Menke)

1830. *Phasianella carinifera* Menke, *Synopsis Methodica Molluscosum*, Pyrmont, ed. 2 : 51, 141, (type loc. : not known).

1970. *Littorina carinifera* : Rosewater, *Indo-Pacific Mollusca*. 2 (11) : 464, pls. 325, 355.

Material examined : (i) 2 exs., Mundra mangrove, Kutch, 27.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Mundra mangrove, 11.ii.1979, coll. K.V.S.R.; (iii) 1 ex., Creek W. of Kandla Port, 5.viii.1972, coll. K.V.S.R.; (iv) 6 exs., Bedi Bandar, 17.viii.1972, coll. K.V.S.R.; (v) 1 ex., Nayabandar, Bedi, 20.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Deeda Is., 22.4 kms from Sikka Port, 17.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above), Goa, Maharashtra, Karnataka.

Elsewhere : Indonesia, Malaysia, Myanmar, Pakistan, Philippines, Thailand.

39. *Littoraria (Littoraria) undulata* (Gray)

1839. *Littorina undulata* Gray, *Zool. Capt. Beechey's Voy. In H.M.S. Blossom, Mollusks*, p. 140 (type loc. Okinawa, Ryukyu Islands).

1961. *Littorina undulata* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 481, p. 3, pl. 29

1991. *Littorina (Littoraria) undulata* : Surya Rao & Subba Rao, *Zool. Surv. India, State Fauna Series, Fauna of Lakshadweep*, 2 : 295.

1992. *Littorina undulata* : Subba Rao *et al.*, *Zool. Surv. India State Fauna Series 3 : Fauna of West Bengal*, (pt. 9) : 119, p. 19, pl. 1, 2

Material examined : (i) 60 exs., Mandvi beach, Kutch, 25.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat, Andaman & Nicobar Is., Goa, Kerala, Lakshadweep, Pondicherry, Tamil Nadu, common on east and west coasts

Elsewhere : Indo-Pacific.

Remarks : Rosewater (1970) gave a detailed synonymy of this species. He reported it from rocky shores, commonly clustering in rock crevices.

Subgenus *Littorinopsis* Moersch, 1870

40. *Littoraria (Littorinopsis) scabra scabra* (Linnaeus)

1758. *Helix scabra* Linnaeus, *Syst. Nat.*, ed. 10, 1 : 770 (type loc. : Ambonia, Moluccas).

1970. *Littorina (Littorinopsis) scabra scabra* : Rosewater, *Indo-Pacific Mollusca* 2 (11) : 456, pls. 325, figs. 1-4, pls. 352, 353.
1991. *Littorina (Littorinopsis) Scabra Scabra* : Subba Rao *et al.*, *Fauna of Orissa* (pt. 3), *State Fauna Series*, 1 : 38.
1992. *Littorina (Littorinopsis) Scabra Scabra* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of West Bengal*, 3 (pt. 9) : 120, pl. 19, fig. 8.

Material examined : (i) 26 exs., Rukmavati river mouth, mandvi, Kutch, 26.vii.1972, coll. K.V.S.R.; (ii) 85 exs., Beach near Light house, Mandvi, Kutch, 28.vii.1972, coll. K.V.S.R.; (iii) 2 exs., Mundra mangroves, Kutch, 27.vii.1972, coll. K.V.S.R.; (iv) 39 exs., area behind Power Stn., Kandla, 3.viii.1972, coll. K.V.S.R.; (v) 34 exs., Nayabandar, Bedi, 20.viii.1972, coll. K.V.S.R., (vi) 2 exs., Rozy Port nr. Jamnagar, 22.viii.1972, coll. K.V.S.R.; (vii) 1 ex., Danda, 2 miles N. of Sikka Port, 14.i.1953, coll. H.C.R.; (viii) 2 exs., Port Sikka, Gulf of Kutch, 13.i.1953, coll. Of H.C.R.; (ix) 9 exs., on mangrove plants, kori creek, Lakpat, Kutch, 4.ii.1979, coll. K.V.S.R.; 1 ex., Miani, 27.viii.1972, coll. K.V.S.R.; (xi) 2 exs., Gomti creek, Dwaraka, 18.ii.1979, coll. K.V.S.R., (xii) 4 exs., Marwad, Daman, 13.ii.1978, coll. B.P.H. and D.R.K.S.; (xiii) 5 exs., Umbargaon, 12.ii.1978, coll. B.P.H. and D.R.K.S.

Distribution : India : Gujarat (as above), Andaman Is : Goa, Karnataka, Kerala, Lakshadweep, Maharashtra, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Common throughout Indo-Pacific.

Remarks : Occurs on the tree trunks and branches of mangrove trees, little above high tide limit. Earlier this was reported under the genus *Littorine* Subba Rao (2003).

Genus 24. *Nodilittorina* von Martens, 1897

41. *Nodilittorina (Nodilittorina) trochoides* (Gray, 1839)

1839. *Nodilittorina trochoides* Gray, *The Zoology of Captain Beechey's Voyage – in His Majesty's Ship Blossom, Mollusca*, p. 140. (No locality)

1970. *Nodilittorina (Nodilittorina) pyramidalis pyramidalis* : Rosewater, *Indo-Pacific Moll.*, 2 (11), pl. 370, figs. 1-9.
1982. *Nodilittorina (Nodilittorina) pyramidalis pyramidalis* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No. 28* : 12.
2003. *Nodilittorina (Nodilittorina) trochoides* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 120, pl. 19, figs. 5, 6

Material examined : (i) 1 ex., Hanumandandi, Beyt Is., near Okha, 23.i.1953, coll. H.C.R.; (ii) 5 exs., Okha beach, between Port and light house, 9.iv.1977, coll. K.N.R.; (iii) 94 exs., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.; 65 exs., beach opp. to Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R.; (v) 30 exs., Veraval beach, 27.xi.1968, coll. A.D.; (vi) 56 exs., Veraval beach, 26.viii.72, coll. K.V.S.R.; (vii) 2 exs., Diu Fort E., 11.ii.1970, coll. A.K.N.; (viii) 7 exs., W. of for Diu, 10.xi.1978, coll. B.P.H. and D.R.K.S.

Distribution : India : Gujarat (as above), Andhra Pradesh, Goa, Karnataka, Maharashtra, Orissa, Tamil Nadu.

Elsewhere : China, Malayasia, Myanmar, New Guinea, New South Wales, Pakistan, Philippines, Sri Lanka, Thailand, Vietnam.

Remarks : Occurs in crevices and rocks in the littoral zone. It was reported as *Nodilittorina pyzawuddin* by authors in India and in recorded for the first time from Gujarat. Reid (1992) given its anatomical features and ecology.

Subgenus *Granulittorina* Habe and Kosuge, 1966

42. *Nodilittorina (Nodilittorina) vidua* (Gould, 1859)

1859. *Littorina Vidua* Gould, *Proceedings of the Boston Society of Natural History*, Vol. 7 : p.138
1970. *Nodilittorina (Granulittorina) millegrana* : Rosewater, *Indo-Pac. Molluscs*, 2 (11), pt. 1 : 491-495, pl. 378, figs. 1-14 & pl. 380, figs. 1-14.
1982. *Nodilittorina (Granulittorina) millegrana* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No. 28* : 13.

2003. *Nodilittorina (Nodilittorina) vidua* : Subba Rao, *Rec. zool. Serv. India, Occ Paper No. 192* : 121, pl. 19, fig. 3, 4

Material examined : (i) 2 exs., Mandvi beach nr. Rest house, Kutch, 25.vii.1972, coll. K.V.S.R., (ii) 13 exs., Mandvi beach nr. Light house, Kutch, 28.viii.1972, coll. K.V.S.R.; (iii) 4 exs., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andamans, Goa, Kerala, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Australia, China, Gulf of Aden, Indonesia, Japan, Madagascar, Malaysia, Myanmar, New South Wales, Philippines, Queensland, Red Sea, Sri Lanka, Thailand, Vietnam.

Remarks : This species was earlier recorded as *Nodilittorina millegrana* which is now referred to the present species.

This is recorded for the first time from Gujarat.

Family 10. PLANAXIDAE

Genus 25. *Planaxis* Lamarck, 1822

43. *Planaxis savignyi* Deshayes

Material examined : (i) 1 ex., littoral zone of Okha port, 21.i.1953, coll. H.C.R.; (ii) 3 exs., Adatara beach, 5 kms. S.E. of Okha, 11.xi.1962, coll. A.D.; (iii) 1 ex., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (iv) 40 exs., Sikka Port, 13.i.1953, coll. H.C.R.; (v) 1 ex., Sikka beach, 19.xi.1968, coll. A.D.; (vi) 1 ex., Okha, 21.i.1953, coll. H.C.R., (vii) 2 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (viii) 2 exs., Navibandar, 4.xi.1971, coll. G.C.R., (ix) 1 ex., Jaleswar, Veraval, 21.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), reported first time from India.

Elsewhere : Aden, Annesley, Bay, Persian Gulf.

Remarks : Ovate shell with short and blunt spire, body whorl angulated at the base, spiral grooves present on the whorl interrupted by white patches.

44. *Planaxis sulcatus* (Born)

1780. *Buccinum sulcatum* Born, *Test. Mus. Caes. Vindob.*, : 258, pl. 10, figs. 5, 6 (type loc. : not known).

1995. *Planaxis sulcatus* : Bosch *et al.*, *Sea Shells of Eastern Arabia*, p. 50, pl. 148.

2003. *Planaxis sulcatus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 123, pl. 19, fig. 11

Material examined : (i) 8 exs., Bedi Bandar, 17.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Bedi Bandar, 21.viii.1972, coll. K.V.S.R.; (iii) 10 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Adatara nr. 5 kms. S.E. of Okha, 11.xi.1968, coll. A.D.; (v) 1 ex., Adatara Beach, Okha, 10.viii.1972, coll. K.V.S.R.; (vi) 8 exs., Adatara Beach, Okha, 6.iv.1977, coll. K.N.R.; (vii) 6 exs., Okha, opp. fisheries str., 10.xi.1968, coll. A.D.; (viii) 15 exs., Okha beach, 15.viii.1972, coll. K.V.S.R.; (ix) 1 ex., Salaya, 18.viii.1972, coll. K.V.S.R.; (x) 1 ex., Rozy port nr. Jamnagar, 22.viii.1972, coll. K.V.S.R.; (xi) 8 exs., Okha beach, between port and light house, 9.iv.1979, coll. K.N.R., (xii) 2 exs., Gogha, 15 miles from Bhavnagar, 5.ii.1953, coll. H.C.R.; (xiii) 1 ex., Gopnath nr. Bhavnagar, 1.ii.1978, coll. B.P.H. and D.R.K.S.

Distribution : India : Gujarat (as above), Andamans, Andhra Pradesh, Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Australia, Indian Ocean, Indonesia, Gulf of Suez, Hawaii Is., Mauritius, Myanmar, Philippines, Penang, Singapore, South Africa, Sri Lanka.

Remarks : This species can easily be distinguished from the preceding one by more elongated and acuminate spire.

Family 11. CERITHIIDAE

Subfamily CERITHIINAE

Key to the genera

1. No plaits on columellar callus, siphonal canal not upturned 2
- Columellar callus of the shell with plaits, siphonal canal upturned into anal canal.....
..... *Rhinoclavis*

2. Shell pyramidally turreted, sculptured spirally with tubercles, anterior canal short and not produced *Clypeomorus*

- Shell turreted, sculptured variously, anterior canal narrow and produced *Cerithium*

Genus 26. *Cerithium* Bruguiere, 1789

45. *Cerithium caeruleum* Sowerby

1855. *Cerithium caeruleum* Sowerby, *Thes. Conchyliol.*, p. 866, pl. 179, figs. 61, 62.

1995. *Cerithium caeruleum* : Bosch *et al*, *Sea shells of Eastern Arabia*, p. 51, pl. 158.

Material examined : (i) 1 ex., Hanumandandi, Beyt Is., near Okha, 23.i.1953, coll. H.C.R., (ii) 1 ex., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (iii) 4 exs., Hanumandandi, Beyt Is., 8.iv.1977, coll. K.N.R.; (iv) 1 ex., Okha, 10.xi.1968, coll. A.D.; (v) 3 exs., Okha beach, 13.viii.1972, coll. K.V.S.R.; (vi) 9 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (vii) 4 exs., Subhashnagar beach, Porbandar, 28.viii.1972, coll. K.V.S.R.; (viii) 5 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (ix) 12 exs., Dwaraka, 6.ii.1992, coll. N.V.S.R.

Distribution : India : Gujarat (as above).

Elsewhere : Arabia.

Remarks : Thick shell with fine spiral striae, prominent nodules at periphery of whorls though smaller at subsutural regions, varix present opposite to outer lip, Siphonal Canal short and narrow.

Genus 27. *Clypeomorus* Jousseaume

46. *Clypeomorus batillariaeformis* (Hobe and Kosege)

1966. *Clypeomorus batillariaeformis* Hobe & Kosege, *Venus*, 24 (4) : 328, Pl. 29, fig. 13

1982. *Clypeomorus moniliferus* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper no. 28* : 38.

2003. *Clypeomorus batillariaeformis* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No. 192* : 128, pl. 19, figs. 5, 6

Material examined : (i) 1 ex., Bedi Bandar, 17.viii.1972, Coll. K.V.S.R., (ii) 25 exs., Sikka port,

13.i.1953, coll. H.C.R.; (iii) 1 ex., Danda, 2 miles N. of Sikka Port, 14.i.1953, coll. H.C.R.; (iv) 197 exs., Sikka Port, 19.viii.1972, coll. K.V.S.R.; (v) 31 exs., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (vi) 6 exs., Rozy, nr. Jamnagar, 22.viii.1972, coll. K.V.S.R.; (vii) 1 ex., Salaya, Jamnagar, 18.viii.1972, coll. K.V.S.R.; (viii) 12 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (ix) 1 ex., Mithapur, 1.iv.1977, coll. K.N.R.; (x) 10 exs., Adatara beach, 10.viii.1972, coll. K.V.S.R.; (xi) 6 exs., Okha beach, 13.viii.1972, coll. K.V.S.R., (xii) 1 ex., Dwaraka beach, 11.viii.1972, coll. K.V.S.R.; (xiii) 2 exs., Gomti creek, Dwaraka, 18.ii.1979, coll. K.V.S.R.; (xiv) 13 exs., Miani, 27.viii.1972, coll. K.V.S.R.; (xv) 3 exs., Subhashnagar beach, Porbandar, 28.viii.1972, coll. K.V.S.R.; (xvi) 38 exs., Porbandar, 29.viii.1972, coll. K.V.S.R., (xvii) 1 ex., opp. to Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R.; (xviii) 13 exs., Navibandar, 27.xi.1971, coll. G.C.R. and T.K.S.; (xix) 2 exs., Madhavpur S., 6.xi.1971, coll. G.C.R. and T.K.S.; (xx) 1 ex., Madhavpur S., 7.xi.1971, coll. G.C.R. and T.K.S.; (xxi) 2 exs., Pata, 8.xi.1971, coll. G.C.R. and T.K.S.; (xxii) 1 ex., Mangrol, coll. G.C.R. and T.K.S., (xxiii) 4 exs., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S., (xxiv) 1 ex., Veraval, 26.viii.1972, coll. K.V.S.R. (xxv) 2 exs., Delvada, 27.xi.1971, coll. G.C.R. and T.K.S., (xxvi) 14 exs., Gopnath, 30.xi.1968, coll. A.D.; (xxvii) 135 exs., Gopnath, 1.ii.1978, coll. B.P.H.; (xxviii) 1 ex., Sil, 12.xi.1971, coll. G.C.R. and T.K.S.; (xxix) 5 exs., Killa, 24.xi.1971, coll. G.C.R. and T.K.S., (xxx) 4 exs., Gogha, 5.ii.1953, coll. H.C.R., (xxxi) 17 exs., Marwad, Daman, 13.ii.1978, coll. B.P.H. and D.R.K.S.

Distribution : India : Gujarat (as above), Arabian Sea coast, Maharashtra, Tamil Nadu, Indian Ocean.

Elsewhere : Indo-Pacific.

Remarks : This species collected in large numbers shows variation in colour, form and sculpture.

Genus 28. *Rhinoclavis* Swainson, 1840

47. *Rhinoclavis sinensis* (Gmelin)

1791. *Murex sinensis* Gmelin (not *Cerithium Sinensis* Philippi, 1848). *Syst. Nat.* ed. 13, 1(6) : 3542, sp. 54, (type loc. In *Mari Senegalium allunata*)

1961. *Rhinoclavis sinensis* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58** (2) : 483, pl. 4, fig. 38.

1995. *Rhinoclavis sinensis* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 54, pl. 175.

2003. *Rhinoclavis (Rhinoclavis) sinensis* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* **192** : 131, pl. 21, fig. 8

Material examined : (i) 4 exs., Port Okha, in the littoral area about a mole N and of port, 21.i.1953, coll. H.C.R.; (ii) 1 ex., Okha beach between port and light house, 9.iv.1977, coll. K.N.R.; (iii) 6 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (iv) 4 exs., Mithapur beach, 11.iv.1977, coll. K.N.R.; (v) 1 ex., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S.; (vi) 1 ex., Veraval Jaleshwar beach, 26 III 1977 coll. K.N.R.

Distribution : India : Gujarat (as above), Andaman Is., Andhra Pradesh, Goa, Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Indo-Pacific.

Remarks : Elongated shell with strong spiral cords, spinose nodules present at subsutural regions, aperture with deep posterior canal and reflexed siphonal canal, columella folded. Tryon (1887) and Houbrick (1978) gave complete description of this species. This species reported carbon under *Obeliscus*.

Family 12. POTAMIDIDAE

Subfamily POTAMIDINAE

Genus 29. *Cerithidea* Swainson, 1840

Subgenus *Cerithidlopsilla* Thiele, 1929

48. *Cerithidea (Cerithidlopsilla) cingulata* (Gmelin)

1791. *Murex cingulatus* Gmelin, *Syst. Nat.* ed. 13, 1 (6) : 3561, sp. 138.

1961. *Cerithidea fluriatilis* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58**(2) : 483, pl. 4, fig. 37.

1995. *Cerithidea cingulata* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 56, pl. 184.

2003. *Rhinoclavis (Rhinoclavis) sinensis* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* **192** : 136, pl. 22, fig.

2

Material examined : (i) 4 exs., Mandvi beach, 25.vii.1972, coll. K.V.S.R.; (ii) 4 exs., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (iii) 26 exs., Kandla, 27.viii.1972, coll. K.V.S.R.; (iv) 3 exs., Mundra mangroves, 27.viii.1972, coll. K.V.S.R.; (v) 13 exs., Kori creek, Lakhpat, Kutch, 4.ii.1979, coll. K.V.S.R.; (vi) 2 exs., backwater at Narayan Sarobar, Kutch, 7.ii.1979, coll. K.V.S.R.; (vii) 2 exs., Danda, 2 kms. N. of Sikka Port, 4.i.1953, coll. H.C.R.; (viii) 14 exs., Salaya, Jamnagar, 18.viii.1972, coll. K.V.S.R.; (ix) 8 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (x) 13 exs., Adatara beach, nr. Okha, 10.viii.1972, coll. K.V.S.R.; (xi) 11 exs., Balapur beach, Beyt Is., 15.viii.1972, coll. K.V.S.R.; (xii) 13 exs., Miani, 27.viii.1972, coll. K.V.S.R.; (xiii) 8 exs., Subhashnagar beach, Porbandar, 28.viii.1972, coll. K.V.S.R.; (xiv) 5 exs., Navibandar, 27.ix.1971, coll. G.C.R. and T.K.S.; (xv) 7 exs., Somnath beach, 20.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, Pondicherry, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Indo-Pacific.

Remarks : *Cerithidea fluriatilis* is synonym of this species. A common estuarine & backwater species. Gregarious is neither found in large number. Commercially used in manufacturing of lime in east coast.

Genus 30. *Telescopium* Montfort, 1810

49. *Telescopium telescopium* (Linnaeus)

1758. *Trochus telescopium* Linnaeus, *Syst. Nat.* ed. 10 : 760, sp. 521 (type loc. : not given).

1961. *Telescopium telescopium* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58**(2) : 482, pl. 4, fig. 35, 36

1995. *Telescopium telescopium* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 56, pl. 186.

2003. *Telescopium telescopium* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* **192** : 136, pl. 22, fig. 3

Material examined : (i) 6 exs., Mundra

mangroves, 27.vii.1972, coll. K.V.S.R.; (ii) 3 exs., Rukmavati river mouth, 8.vii.1972, coll. K.V.S.R.; (iii) 6 exs., Deeda Is., 17.i.1953, coll. H.C.R.; (iv) 1 ex., Tuna creek, 4.viii.1972, coll. K.V.S.R.; (v) 1 ex., Karero Port, 6.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Creek W. of New Kandla, coll. K.V.S.R., (vii) 1 ex., Jakhau Port, 8.ii.1979, coll. K.V.S.R.; (viii) 2 exs., Bhadreswar, 29.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Maharashtra, Kerala, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : North Australia, Indonesia, Madagascar, Malay Peninsula, Myanmar, Philippines, Singapore.

Remarks : Most common species found in mangrove areas; Von Benthem Jutting (1956) gave a detailed synonymy of it. Large quantities of this species collected for manufacture of lime in West Bengal.

Family 13. TURRITELLIDAE

Subfamily TURRITELLINAE

Genus 31. *Turritella* Lamarck, 1799

50. *Turritella duplicata* (Linnaeus)

1758. *Turbo duplicatus* Linnaeus, *Syst. Nat.* ed. 12 : 1239.

1961. *Turbo acutangula* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 481, pl. 3, fig. 30.

1991. *Turritella acutangula* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series 1 : Fauna of Orissa* (pt. 3) : 40.

2003. *Turbo duplicata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 161, pl. 23, fig. 7-9

Material examined : (i) 1 ex., Nayabandar, Bedi, 20.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Sikka Port, 13.i.1953, coll. H.C.R., (iii) 6 exs., Balapur Bay, Beyt Is., 13.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Karaikal and Pondicherry, Maharashtra, Orissa, Tamil Nadu.

Elsewhere : Indonesia, Madagascar, Myanmar, Philippines, Sri Lanka.

Remarks : The species is recorded as *Turritella acutangula* by earlier author is

synonyms of this species, Subba Rao (2003) give detail description of this species.

51. *Turritella columnaris* Kiener

1843-44. *Turritella columnaris* Kiener, *Icon. Cog. Viva.* 10. pl. 7, fig. 1 (type loc. : not known).

1961. *Turritella columnaris* : Menon *et al.*, *J. Bombay nat. Hist Soc.*, p. 481, pl. 3, fig. 31.

1991. *Turritella columnaris* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series 1 : Fauna of Orissa* (pt. 3) : 45.

2003. *Turbo duplicatus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 140, pl. 23, fig. 2, 3

Material examined : (i) 4 exs., Port Okha, 2.i.1953, coll. H.C.R.; (ii) 7 exs., Hanumand- andi, Beyt Is., 23.i.1953, coll. H.C.R.; (iii) 4 exs., Adatara beach, 10.viii.1972, coll. K.V.S.

Distribution : India : Gujarat (as above), Maharashtra, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : California, Mergui Archipelago, Myanmar, Pakistan, Sri Lanka.

Remarks : This species is recognised by proceeding by it's flattened whorls and whorls are more than thirty in number, earlier whorls are mildly keeled.

52. *Turritella maculata* Reeve

1849. *Turritella maculata* Reeve, *Conch. Icon.*, 5, *Turritella* sp. no. 33.

1995. *Turritella maculata* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 58, pl. 192.

Material examined : (i) 7 exs., Mandvi beach, 25.vii.1872, coll. K.V.S.R.; (ii) 4 exs., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (iii) 17 exs., Mandvi beach, 28.vii.1972, coll. K.V.S.R.; (iv) 1 ex., Salya, 31.vii.1972, coll. K.V.S.R.; (v) 4 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (vii) 1 ex., Okha beach, 13.viii.1972, coll. K.V.S.R.; (viii) 12 exs., 24.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), reported from India for the first time.

Elsewhere : Aden, Arabia.

Remarks : Shell thin elongated and turreted, greyish in colour with brown mottlings and stripes, whorls not much inflated but with two strong keels and spiral ridges and threads; aperture squarish.

Family 14. VERMETIDAE

Genus 32 *Serpylorbis* Sacco, 1827

53. *Serpylorbis variabilis* Hadfield & Kay

1995. *Serpylorbis variabilis* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 58, fig. 196.

Material examined : (i) 1 ex., Nayabandar, Bedi, 20.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Mithapur, 14.viii.1972, coll. K.V.S.R.; (iii) 2 exs., Danda on coast, 2 miles from Sikka Port, 14.i.1953, coll. H.C.R.; (iv) 1 ex., Adatara beach, 10.viii.1972, coll. K.V.S.R., (v) 1 ex., Okha beach, 13.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Subhashnagar, Porbandar, 28.viii.1972. coll. K.V.S.R.

Distribution : India : Gujarat (as above), reported for the first time from India.

Elsewhere : Arabia.

Remarks : Hollow tubular shell is thick and coiled, axial ribs are strong and crossed by spiral ribs, aperture brownish white without operculum. These irregular shells are found attached on hard surface and on empty bivalve shell.

Family 15. STROMBIDAE

Genus 33. *Tibia* Roeding, 1798

54. *Tibia fusus* (Linnaeus)

1758. *Murex fusus* Linnaeus, *Syst. Nat.* ed. 10 : 752, No. 478.

1822. *Rostellaria curvirostris* Lamarck, *Hist. Nat. Anim. Sans. Vert.*, 7 : 192.

1949. *Tibia curvirostris* : Ray, *Rec. Indian Mus.*, 46 (1-4) : 98

1977. *Tibia fusus* Suba Rao, *J. mar. biol. soc. India*, 19(1) : 27, pl. III, fig. B.E.

2003. *Tibia fusus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 151, pl. 25, fig. 4

Material examined : (i) 56 exs., Muldwaraka, E. 21-22.ii.1970, coll. A.K.N.; (ii) 2 exs., Odedhad, 3.xi.1971, coll. G.C.R. and T.K.S.; (iii) 2 exs., Madhi, 25.xi.1971, coll. G.C.R. and T.K.S.; (iv) 1 ex., Jakhau, Kutch, 8.ii.1979, coll. K.V.S.R.; (v) 1 ex., Porbandar, January, 1953, coll. H.C.R.; (vi) 2 exs., Lamba shore, 28.i.1953, coll. H.C.R.; (vii) 2 exs., Chorwad, 23.i.1978, coll. B.P.H.; (viii) 6 exs., Veraval, 26.xi.1968, coll. A.D.; (ix) 2 ex., off Somnath, 26.ii.1970, coll. A.K.N.; (x) 1 ex., Vanakababara, Diu, 24.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Maharashtra, Tamil Nadu.

Elsewhere : Aden, Arabian Sea, Gulf of Oman, Moluccas, Persian Gulf, Red Sea.

Remarks : Thick brown heavy shell with acuminate spire, spire longer than body whorl (excluding siphonal canal), white columella continues upwards, outer lip with 4-6 blunt processes. Subba Rao (1977) discussed about identity of this species and *T. curvirostris* Lamarck treated as synonym under the present species. It prefers muddy bottom.

Family 16. VANIKORIDAE

Genus 34. *Vanikoro* Quoy & Gaimard, 1832

55. *Vanikoro cancellata* (Lamarck)

1822. *Sigaretus cancellatus* Lamarck, *Hist. Nat. Anim. Sans. Vert.*, 6 (2) : 208.

1995. *Vanikoro cancellata* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 67. pl. 222.

2003. *Vanikoro cancellata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 156, pl. 29, figs. 5, 6

Material examined : (i) 1 ex., Lamba shore, 28.i.1953, coll. H.C.R.; (ii) 1 ex., Veraval beach, 26.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman and Nicobar Is., Lakshadweep, Orissa, Tamil Nadu.

Elsewhere : Aden, China, Maldivees, Mauritius, Pakistan, Persian Gulf, Seychelles, Tanzania, Zanzibar.

Remarks : Occurrence of this species in Eastern Arabia listed by Melvill and Standen (1901) is doubtful (Bosch *et al.*, 1995).

Family 17. CREPIDULIDAE

Genus 35. *Crepidula* Lamarck, 1799

56. *Crepidula walshi* Herrmannson

1858. *Crepidula walshi* Herrmannsen in Reeve. *Conch. Icon.*, 11, *Crepuula*, sp. 17, pl 3, figs. 17a & 17b.

1991. *Crepidula walshi* : Subba Rao *et al.*, *Zool Surv. India, State Fauna Series 1 : Fauna of Orissa (Pt. 3)* : 49.

2003. *Crepidula walshi* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 159, pl. 28, figs. 9, 10

Material examined : (i) 12 exs., Kutch, (ii) 9 exs., Jakhau Port, 28 kms. W. of Naliya, Kutch, 18.ii.1979, coll. K.V.S.R.; (iii) 5 exs., Muldwaraka E., 22.ii.1970, coll. A.K.N.

Distribution : India : Gujarat (as above), Andaman Is., Maharashtra, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : China, Malaysia, Myanmar, Singapore, Sri Lanka; Indo-Western Pacific.

Remarks : Shell thin with irregular shape and outline, apex at posterior side, concentric striae and growth ridges present on outer surface, a broad shelf found internally below the apex.

Genus 36. *Calyptraea* Lamarck, 1799

57. *Calyptraea pellucida* (Reeve, 1859)

1995. *Calyptraea pellucida* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 68, pl. 227.

Material examined : (i) 3 exs., Balapur Bay, Beyt. Is. 13.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Maharashtra, Tamil Nadu,

Elsewhere : Arabian Sea, New South Wales, Pakistan.

Remarks : Shell thin, more or less circular in outline, apex subcentral, concentric striae and growth ridges present on outer surface, a thin shelf found internally below the apex.

Family 18. CAPULIDAE

Genus 37. *Capulus* Monotfort, 1810

58. *Capulus irregularis* E.A. Smith, 1895

1895. *Capulus irregularis* Smith, E.A. *Ann. Mag. nat. Hist. Lond.* (6)15 : p. pl.

2003. *Capulus irregularis* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 151, pl. 25, fig. 4

Material examined : (i) 14 exs., 21°22'15" E, 44 fms, nr. Saurashtra, Arabian Sea, coll. Marine Survey; (ii) 1 ex., Okha, opp. Guest house (beach wash), 12.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Lakshadweep.

Remarks : Shell thin capshaped apex coiled and extends beyond the posterior margin, shape irregular assuming the shape of attachment site resulting in distortion.

59. *Capulus scutellatum* (Wood)

1952. *Capulus violaceus* : Subramanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 37 : fig. 56.

Material examined : (i) 6 exs., Salaya beach, nr. Mandvi, 31.vii.1977, coll. K.V.S.R.; (ii) 1 ex., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (iii) 1 ex., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Tamil Nadu.

Elsewhere : China, Pakistan.

Remarks : Shell thin capshaped but slightly incurved posteriorly, apex central interior polished with an internal septum.

Family 19. XENOPHORIDAE

Genus 38. *Xenophora* Fischer, 1807

Subgenus *Stellaria* Schmidt in Moeller, 1832

60. *Xenophora (Stellaria) solaris* (Linnaeus)

1767. *Trochus solaris* Linnaeus, *Syst. Nat.*, ed. 12 : 1229, sp. 593 (type loc. : "India Oriental").

1991. *Xenophora solaris* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa*, 1 (3) : 51, pl. vi, figs. 6, 7

1995. *Xenophora (Stellaria) solaris* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 71, fig. 239.

Material examined : (i) 1 ex., Port Okha, 19.i.1953, coll. H.C.R.; (ii) 1 ex., Muldwaraka, E., 21.ii.1970, coll. A.K.N.; (iii) 1 ex., Veraval, trawl ground, 26.xi.1968, coll. A.D.

Distribution : India : Gujarat (as above), Goa, Kerala, Maharashtra, Nicobar Is., Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Gulf of Oman, Singapore, Sri Lanka.

Remarks : Shell thin orbicular, spire depressed, with flat base, spiny hollow processes projected on spire whorls, umbilicus broad and deep. Generally, these shells found by other shells and stones on its surface, known as carrier shells.

Family 20. CYPRAEIDAE

Genus 39. *Cypraea* Linnaeus, 1758

61. *Cypraea annulus* Linnaeus

1758. *Cypraea annulus* Linnaeus, *Syst. Nat.*, ed. 10 : 723.

1995. *Cypraea annulus* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 72, pl. 242.

2003. *Cypraea annulus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 173, figs. 28-45, pl. 31, fig. 9

Material examined : (i) 1 ex., Kathiawar, January, 1953, coll. H.C.R.; (ii) 1 ex., Danda, 3.2 kms N. of Sikka Port, January, 1953, coll. H.C.R.; (iii) 1 ex., Mandvi beach, 25.vii.1972, coll. K.V.S.R.; (iv) 1 ex., Salaya beach, Kutch, 31.vii.1972, coll. K.V.S.R.; (v) 2 exs., Tuna creeks nr. Kandla, 4.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Lakshadweep, Andaman & Nicobar Is., Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Indo-Pacific.

Remarks : Shell pale yellowish or bluish with

a central hump encircled by an orange line; margins thickened with short teeth.

62. *Cypraea arabica* Linnaeus

1758. *Cypraea arabica* Linnaeus, *Syst. Nat.* ed. 10 : 718.

1961. *Cypraea arabica* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 485, pl. 5, figs. 50, 51

1991. *Mauritia arabica* : Surya Rao & Subba Rao, *State Fauna Series 2 : Fauna of Lakshadweep*, p. 305.

2003. *Cypraea (Mauritia) arabica* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 172, pl. 34, figs. 1, 2

Material examined : (i) 1 ex., Kotda, 24.xi.1897, coll. G.C.R. and T.K.S.; (ii) 2 exs., Mithapur, 14.viii.1972, coll. K.V.S.R., (iii) 1 ex., Muldwaraka, 21.xi.1971, coll. G.C.R. and T.K.S.; (iv) 1 ex., Dwaraka beach, 24.i.1953, coll. H.C.R.; (v) 1 ex., Subhashnagar nr. Porbandar, 28.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Andhra Pradesh, Lakshadweep, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Aden, Pakistan, Persian Gulf, Red Sea to Polynesia, Sri Lanka.

Remarks : Gopalkrishnan (1970) reported this species from Dwaraka and Okha found at the base of rocks and coral reefs.

63. *Cypraea caurica* Linnaeus

1758. *Cypraea caurica* Linnaeus, *Syst. Nat.*, ed. 10 : 723.

1995. *Cypraea caurica* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 73, pl. 246.

2003. *Cypraea (Erronee) caurica* : Subba Rao, *Rec. zool. Surv. India, Occ Paper 192* : 167, pl. 32, figs. 13, 14

Material examined : (i) 1 ex., Mithapur nr. Okha, 14.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep, Pondicherry.

Elsewhere : Indo-Pacific, Australia, Gulf of Oman, Kenya, Mauritius, New Caledonia, Sri Lanka.

Remarks : Varies greatly in size, shape and colour pattern, dorsum of shell round with spots and blotches, three darker bands present, aperture wider anteriorly, margins purplish brown.

64. *Cypraea cicercula* Linnaeus

1758. *Cypraea cicercula* Linnaeus, *Syst. Nat.* ed. 10 : 725.

1995. *Cypraea cicercula* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 73, pl. 248.

2000. *Cypraea cicercula* Subba Rao & Dey. *Rec. zool. Surv. India, Occ. Paper No.*, 187 : 69

Material examined : (i) 1 ex., Mithapur, 14.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep.

Elsewhere : Tropical Indo-Pacific.

Remarks : Thin globose shell with a dorsal depression posteriorly, aperture narrow with extended teeth.

65. *Cypraea gracilis* Gaskoin

1849. *Cypraea gracilis* Gaskoin, *Proc. zool. Soc. Lond.*, p. 93.

1995. *Cypraea gracilis* : Bosch *et al.*, *Sea shells of Eastern Arabia* p. 74, pl. 257.

Material examined : (i) 1 ex., Port Okha, Kathiawar.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep, Tamil Nadu.

Elsewhere : Aden, Australia, Japan, Mauritius, New South Wales, Persian Gulf, Sri Lanka, Western Pacific.

Remarks : There is a great variation in size, colour and strength of dorsal spots and colour of terminals and no variations are recognized (Jerry, G. Walls, 1975).

66. *Cypraea lamarckii* Gray

1825. *Cypraea lamarckii* Gray, *Zool. J.*, 1 : 506

1995. *Cypraea lamarckii* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 76, pl. 262.

2000. *Cypraea lamarckii* : Subba Rao & Dey. *Rec. zool. Surv. India, Occ. Paper No.* 187 : 71.

Material examined : (i) 2 exs., Hanumandandi, Beyt Is., coll. H.C.R.; (ii) 1 ex., Gochla, 12.ii.1970, coll. A.K.N.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra, Pondicherry.

Elsewhere : Malaysia, Mozambique, South Africa.

Remarks : Pear shaped shell with greenish dorsum marked by numerous white dots, irregular brown spots are present on margins, base white, anterior extremity slightly upturned. This species was reported by Apte (1998) from Okha.

67. *Cypraea lentiginosa* Gray

1825. *Cypraea lentiginosa* Gray, *Zool. J.*, 1 : 506

1995. *Cypraea lentiginosa* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 76, pl. 263.

2003. *Cypraea (Cratiadusta) lentiginosa* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* 192 : 170

Material examined : (i) 6 exs., Gulf of Kutch; (ii) 2 exs., Deeda Is., 14 miles from debris left on shore, Gulf of Kutch nr. Sikka Port, 16.i.193, coll. H.C.R.; (iii) 6 exs., littoral zone, Gulf of Kutch, 13.i.1953, coll. H.C.R.; (iv) 4 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (v) 1 ex., Pirotan Is., 20.iv.1977, coll. K.N.R.; (vi) 1 ex., Bedi, 19.xi.1971, coll. G.C.R. and T.K.S.; (vii) 5 exs., Balapore Bay, Beyt Is., 7.iv.1977, coll. K.N.R.; (viii) 1 ex., Porbandar, Jan., 1953, coll. H.C.R.; (ix) 2 exs., Lamba shore, about 35 miles from Porbandar, 28.i.1953, coll. H.C.R.; (x) 1 ex., Porbandar beach, 29.viii.1972, coll. K.V.S.R.; (xi) 2 exs., SubhashNagar, nr. Porbandar, 28.viii.1972, coll. K.V.S.R.; (xii) 1 ex., Jaleswar, Veraval, 26.iii.1977, coll. K.N.R.

Distribution : India : Gujarat, Maharashtra, Tamil Nadu.

Elsewhere : Arabia, Pakistan, Persian Gulf, Sri Lanka.

Remarks : Ovate shell with slightly humped grayish dorsum covered by brown bands and spots. This species looks like *C. pallida* but slightly larger with more brown markings on the surface.

68. *Cypraea moneta* Linnaeus

1758. *Cypraea moneta* Linnaeus, *Syst. Nat.*, ed. 10 : 723.

1991. *Monetaria (Monetaria) moneta* : Subba Rao & Subba Rao, *J. mar. biol. soc. India*, 19(1) : 306

1995. *Cypraea moneta* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 78, pl. 269.

2003. *Cypraea (Monetaria) moneta* : Subba Rao, *Rec. zool. Surv. India, Occ Paper* 192 : 173, fig. 28-6, pl. 31, fig. 10, pl. 34, figs. 3, 4

Material examined : (i) 1 ex., Miani beach, 27.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Fiji Is., Maldives Is., New Caledonia, Persian Gulf, Sri Lanka, South Africa.

Subba Rao & Dey (2000) reported the species from Andaman & Nicobars.

69. *Cypraea ocellata* Linnaeus

1758. *Cypraea ocellata* Linnaeus, *Syst. Nat.*, ed. 10 : 724.

1961. *Cypraea ocellata* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 485, figs. 48, 49

1995. *Cypraea ocellata* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 78, pl. 271.

2003. *Cypraea (Erronee) ocellata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* 192 : 169, pl. 33, figs. 1, 2

Material examined : (i) 1 ex., Madhavpur, N. 11.viii.1972, coll. G.C.R. and T.K.S.; (ii) 1 ex., Mandvi beach, 28.vii.1972, coll. K.V.S.R.; (iii) 2 exs., Adatara beach, nr. Okha, 10.viii.197w, coll.

K.V.S.R.; (iv) 7 exs., Mithapur, nr. Okha, 14.viii.1972, coll. K.V.S.R.; (v) 18 exs., Dwaraka nr. Rest House, coll. H.C.R.; (vi) 13 exs., Beyt Is., Gulf of Kutch, coll. H.C.R.; (viii) 10 exs., on shore, Port Okha, 22.i.193, coll. H.C.R.; (ix) 1 ex., Hanuman-dandi, 23.i.1953, coll. H.C.R.; (x) 1 ex., Dwaraka, 10.iv.1977, coll. K.N.R.; (xi) 35 exs., on shore, at about 35 miles from Porbandar, coll. H.C.R.; (xii) 1 ex., Navibandar, 27.xi.1971, coll. G.C.R. and T.K.S.; (xiii) 1 ex., Madhavpur, n., 11.viii.1982, coll. G.C.R. and T.K.S.; (xiv) 1 ex., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S.; (xv) 4 exs., Holiday Camp, Chorwad, 23.i.1978, coll. B.P.H.; (xvi) 1 ex., Sil, 12.xi.1972, coll. G.C.R. and T.K.S.; (xvii) 1 ex., Kotda, 24.xi.1971, coll. G.C.R. and T.K.S.; (xviii) 1 ex., Delvada 27.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Andhra Pradesh, Lakshadweep, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Gulf of Aden, Indonesia, Mauritius, New Caledonia, Pakistan, Persian Gulf, Sri Lanka.

Remarks : Slightly humped shell, brown in colour with small white and a few dark spots, margins angulated and wrinkled, teeth extended.

70. *Cypraea onyx* Linnaeus

1758. *Cypraea onyx* Linnaeus, *Syst. Nat.*, ed. 10 : 722.

1952. *Cypraea onyx* : Subramanyam *et al.*, *J. Univ. Bombay* 21 (3) : 41

Material examined : (i) 1 ex., Pirotan Is., nr. Sikka Port, coll. H.C.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Kerala, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : China, Indonesia, Japan, Mauritius, Persian Gulf, Seychelles, Sri Lanka, Zanzibar.

71. *Cypraea pallida* Gray

1824. *Cypraea pallida* Gray. *Zool. J.*, 1 : 387.

1952. *Cypraea pallida* : Subramanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 40

2003. *Cypraea (Cratiadusta) pallida* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 170, pl. 33, figs. 5, 6

Material examined : (i) 2 exs., Jakhan Portarea, 28 kms. W. of Naliya, kutch, 8.ii.1979, coll. K.V.S.R.; (ii) 8 exs., Porbandar, 28.i.1953, coll. H.C.R.; (iii) 2 exs., Veraval, 31.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Tamil Nadu, Maharashtra, Pondicherry, Andamans, Subba Rao (2000).

Elsewhere : Australia, China, Japan, New Caledonia, Persian Gulf.

Remarks : Light coloured shell, dorsum with irregular longitudinal markings.

72. *Cypraea tigris* Linnaeus

1758. *Cypraea tigris* Linnaeus, *Syst. Nat.*, ed. 10 : 721.

1991. *Cypraea tigris* : Subba Rao & Subba Rao, *Zool. Surv. India, State Fauna Series, Fauna of Lakshadweep* 1 (3) : 301

1995. *Cypraea tigris* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 80, pl. 279.

2003. *Cypraea (Cypraea) tigris* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 167, pl. 31, fig. 5 and pl. 32, fig. 1, 2

Material examined : (i) 2 exs., Sikka Port, coll. H.C.R.

Distribution : India : Gujarat (as above), Andaman and Nicobar Islands, Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Arabia, Kenya, Maldives, Mauritius, Singapore.

Remarks : Thick shell with white round dorsum marked by brown spots and blotches, labial teeth short whereas columellar teeth fine and long occurs in sandy bed among shallow water coral reefs. This species is used in shell craft industry especially in South India. It is reported for the first time from Gujarat.

73. *Cypraea turdus winckworthi* Schilder & Schilder

1938. *Cypraea turdus winckworthi* Schilder & Schilder

1995. *Cypraea turdus winckworthi* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 81, pl. 280.

Material examined : (i) 17 exs., on shore, about 3 miles S.W. of Port Okha, 22.i.1953, coll. H.C.R.; (ii) 3 exs., Adatara beach nr. Okha, 10.viii.1972, coll. K.V.S.R.; (iii) 4 exs., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Hanumandandi Beyt Is., 8.iv.1977, coll. K.N.R.; (v) 1 ex., in front of Rest house, Dwaraka, Jan., 1953, coll. H.C.R.; (vi) 1 ex., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (vii) 1 ex., Porbandar, 30.viii.1972, coll. K.V.S.R.; (viii) 1 ex., Holiday Camp, Chorwad, 23.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), subspecies *winckworthi* is reported for the first time from India.

Elsewhere : Arabia.

Remarks : Round heavy shell with whitish dorsum marked by irregular brown spots, base flat with deep-set short and coarse teeth. Apte (1998) reported species *turdus* from Okha. So far this species is not recorded from the east coast.

74. *Cypraea vitellus* Linnaeus

1758. *Cypraea vitellus* Linnaeus, *Syst. Nat.* ed. 10 : 721.

1995. *Cypraea vitellus* Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 81, pl. 281.

2003. *Cypraea (Lyncina) vitellus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 171, pl. 31, fig. 11, pl. 33, figs. 13, 14

Material examined : (i) 1 ex., Veraval beach, 27.xi.1968, coll. A.D.

Distribution : India : Gujarat (as above), Andaman and Nicobar Is., Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Indo-pacific. Earlier it is reported from Okha by Apte (1998).

Remarks : Thick heavy shell with swollen grayish dorsum marked by white spots, base rounded with deepset coarse teeth.

Family 21. OVULIDAE

Subfamily OVULINAE

Genus 40. *Phenacovolva* Iredale, 1930

75. *Phenacovolva brevirostris*
(Schumacher, 1817)

1967. *Volva brevirostris* : Cernohorsky, *Marine shells of the Pacific*, p. 107, pl. 21, fig. 123.

Material examined : (i) 1 ex., Veraval, nr. Rest house, 31.i.1953, coll. H.C.R.; (ii) 6 exs., Veraval beach 26.viii.1972, coll. K.V.S.R.; (iii) 1 ex., Subhashnagar nr. Porbandar, 28.viii. 1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above),

Elsewhere : From South Africa to Japan and Fiji Is.

Remarks : Spindle shaped shell with well produced two extremities forming long and slender canals, outer tip thickened and curved anteriorly, transverse striations present except in the calloused, columellar region, pinkish in colour with narrow central white band on dorsum.

Cernohorsky (1967) synonymised *Volva rosea* Adams, 1854 with this species. This is reported from India for the first time.

Family 22. TRIVIIDAE

Genus 41. *Trivirostra* Jousseume, 1884

76. *Trivirostra oryza* (Lamarck)

1811. *Oliva oryza* Lamarck, *Anim. Mus. Hist. Nat. Paris*, 16 : 127.

1967. *Trivirostra oryza* : Cernohorsky, *Proc. Ser. Shells*, 1 : III, pl. 22, fig. 133.

1995. *Trivirostra oryza* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 83, pl. 300.

2003. *Trivirostra oryza* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 176, pl. 28, figs. 1-3, pl. 35, figs. 4, 5

Material examined : (i) 1 ex., beach opp. to Circuit house, Porbandar, 24.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Tamil Nadu.

Elsewhere : Arabia, Christmas Is., Persian Gulf.

Remarks : Elongately globose shell with transverse ridges covering the entire shell surface, aperture narrow and curved posteriorly.

Family 23. NATICIDAE

Key to the genera of family NATICIDAE

1. Shell either globular or ovate; aperture semilunar or ovate; umbilicus either partly or completely closed with callus 2
- Shell auriform; operculum corneous; aperture large; umbilicus absent *Sinum*
2. Shell rounded; spire elevated brightly coloured; operculum calcareous; umbilicus opened; shell generally coloured *Natica*
- Shell elongately ovate; spire exerted; operculum corneous, smooth; umbilicus partly closed; shell white, heavy *Polinices*

Genus 42. *Natica* Scopoli, 1777

77. *Natica pulicaria* Philippi

1852. *Natica pulicaria* Philippi, *Conchyl. Cab.*, 2 abth. 1. *Natica* : 90-91, pl. 13, fig. 9 (type loc. : Not known).

1995. *Natica pulicaria* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 86, pl. 320.

Material examined : (i) 4 exs., Lamba shore, above 35 miles from Porbandar, 28.i.1953, coll. H.C.R.; (ii) 4 exs., Subhashnagar nr. Porbandar, 28.viii.1972, coll. K.V. S.R.; (iii) 4 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Port area, Veraval, 24.i.1978, coll. B.P.H.; (v) Dwaraka beach, 11.viii.1972, coll. K.V.S.R.; (vi) 2 exs., Miani beach, 27.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Aden, Mauritius, Pakistan, Philippines, Sri Lanka, Zanzibar.

Remarks : This species is found on coral reefs and rocky beach of intertidal zone (Mookherjee, 1985). Globose, umbilicate, smooth shell marked by reddish dots and blotches, narrow bands on the lower part are also seen; columellar callous thick at the upper part.

78. *Natica tigrina* (Roeding)

1798. *Cochlis tigrina* Roeding, *Museum Boltenianum*, p. 147, sp. 1843 (type loc. : not given).

1961. *Natica tigrina* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 484, pl. 5, figs. 41, & 42

1992. *Natica tigrina* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of West Bengal*, 3 (pt. 9) : 181, pl. 6, figs. 1 & 2.

2003. *Natica tigrina* : Subba Rao, *Rec. zool. Surv. India, Occ Paper 192* : 186, pl. 37, figs. 7, 8

Material examined : (i) 4 exs., Rukmavati river mouth, Mandvi, Kutch, 30.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Kori creek, Lakhpat, Kutch, 4.ii.1979, coll. K.V.S.R.; (iii) 2 exs., Veraval, 26.viii.1972, coll. K.V.S.R.; (iv) 4 exs., 20 miles of Sikka Port, 18.i.1953, coll. H.C.R.; (v) 1 ex., Pirotan Is. 19.iv.1977, coll. K.N.R.; (vi) 1 ex., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (vii) 1 ex., mud flats, Beyt Dwaraka Is., n.e. of Okha, 12.xi.1968, coll. A.D.; (viii) 1 ex., Bala- pur bay, Beyt Is., 15.viii.1972, coll. K.V.S.R.; (ix) 3 exs., creek W. of New Kandla Port, 5.viii. 1972, coll. K.V.S.R.; (x) 7 exs., Old Kandla Port, 28.iv.1977, coll. K.N.R.; (xi) 1 ex., Salaya beach, Jamnagar, 18.viii.1972, coll. K.V.S.R.; (xii) 14 exs., Bhadreswar, 29.vii.1972, coll. K.V.S.R. (xiii) 3 exs., Miani, 27.viii.1972, coll. K.V.S.R.; (xiv) 2 exs., Jampur Daman, 11.ii. 1978, coll. B.P.H.; (xv) 5 exs., Umbergaon, 12.ii.1978, coll. K.V.S.R.; (xvi) 5 exs., Navibandar, Daman, 9.ii.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman Is, Kerala, Maharashtra, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : China, Indonesia, Hong Kong, Japan, Malaysia, Myanmar, Philippines, Persian Gulf, Singapore, Sri Lanka.

Remarks : Shell globose, white with regular spiral lines of purple brown spots, aperture ovate, collumellar callous thick at the base.

Natica merbosa Lamarck and *N. picta* recorded as synonym under this species.

79. *Natica vitellus* (Linnaeus)

1758. *Nerita vitellus* Linnaeus, *Syst. Nat.*, ed. 10 : 776 (type loc. O. Asiae).

1995. *Natica vitellus* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 87, p. 322.

2003. *Natica vitellus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 186, pl. 37, figs. 5, 6

Material examined : (i) 1 ex., Muldwaraka E., 22.ii.1979, coll. A.K.N.

Distribution : India : Gujarat (as above), Andhra Pradesh, Kerala, Lakshadweep, Maharashtra, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Fiji Is., Hong Kong, Japan, Mauritius, New Caledonia, Queensland, Pakistan, Persian Gulf, Singapore, N. to S. along W. coast of Viti.

Remarks : Thick globose shell with broad brown bands, umbilicus obscured by white polished columellar callus.

Natica rufa is synonym of this species inhabits sandy beach near low tide.

Genus 43. *Polinices* Montfort, 1810

Subgenus *Gloussaulax* Pilsbry, 1929

80. *Polinices (Gloussaulax) didyma* (Roeding)

1798. *Albula didyma* Roeding, *Museum Boltenianum*, p. 20, sp. 145 (refers Chemnitz, 1781, pl. 186 figs. 1856. 1857 (type loc. Not known Tranquebar, Chemnitz.)

1961. *Natica didyma* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58(2) : 484, pl. 5, figs. 43, 44

1995. *Neverita (Gloussaulax) didyma* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 86, pl. 515.

2003. *Polinices didyma* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 89, pl. 40, fig. 3

Material examined : (i) 1 ex., Pirotan Is, 20 miles from Sikka Port, 18.i.1953, coll. H.C.R.; (ii) 1 ex., Muldwaraka, 21.xi.1971, coll. G.C.R. and T.K.S.; (iii) 1 ex., Bedia, Veraval, 19.xi. 1971, coll. G.C.R. and T.K.S.; (iv) 6 exs., Tuna creek, 4.viii.1972, coll. K.V.S.R.; (v) 13 exs., Bhadrewar, Kutch, 29.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is, Maharashtra, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Indo-Pacific.

Remarks : Large globose shell with low spire, aperture semiovate, umbilical opening obscured by dark brown columellar callus deeply grooved in the middle.

Natica ohemaitz Reculz, *Neverita bicolor* Phillipi and *Natica lamerckenian* Reev., are synonym under this order.

Genus 44. *Sinum* Roeding, 1798

81. *Sinum haliotoideum* (Linnaeus)

1758. *Sinum haliotoideum* Linnaeus, *Syst. Nat.* 10 :

1843. *Sigaretus planatus* Recluz, *Illustr. Conchyl.*, 3 : 1, 6.

1843. *Sigaretus planulatus* Reculz, *Illustr. Conchyl.* 3, pl. 3, fig. 4.

1952. *Sinum planulatum* : Subramanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 39.

1976. *Sinum planatum* : Kilburn, *Ann. Natal. Mus.*, 22 (3) : 874, fig. 23, 24.

2003. *Sinum haliotoideum* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* 192 : 192, pl. 38, fig. 15, 16, pl. 39, fig. 9, 10

Material examined : (i) 1 ex., Simbor, Diu, 28.i.1978, coll. B.P.H. and D.R.K.S.

Distribution : India : Diu, Maharashtra, Tamil Nadu, Andhra Pradesh.

Elsewhere : Japan and Queensland to Mocambique and Natal.

Remarks : Shell much depressed with flattened spire, columellar margin much curved resulting in

wide aperture, umbilicus absent, Kilburn (1976) gave a detailed synonymy of this species and justified the name of this species. Suba Rao (2003) states that *Sigaretus plenatus* Reculz & *S. planulatus* Reculz are synonyms of this species.

Family 24. TONNIDAE

Genus 45. *Tonna* Bruennich, 1772

82. *Tonna dolium* (Linnaeus)

1758. *Buccinum dolium* Linnaeus, *Syst. Nat.*, ed. 10 : 735 (type loc. M. Siculo).

1995. *Tonna dolium* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 89, pl. 334.

2003. *Tonna dolium* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper* 192 : 195, pl. 41, fig. 9

Material examined : (i) 1 ex., Balapur beach, Beyt Is., 15.viii.1972, coll. K.V.S.R.; (ii) 2 exs., Jakhan Port, Naliya, kutch, 8.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Indo-Pacific. There are no earlier reports of this species from Gujarat.

Remarks : Ovately globose shell sculptured with cords and threads, cords ornamented with reddish brown quadrate markings. This species is mostly caught by fishermen nets. *Dolium macerbatum* Lamarck synonym under this species.

Family 25. FICIDAE

Genus 46. *Ficus* Roeding, 1798

83. *Ficus ficoides* (Lamarck)

1822. *Pyrula ficoides* Lamarck, *Hist. Nat. Anim. Sans Vert.*, 7 : 142 (type loc. 'I' Ocean des grandes Indes?).

1985. *Ficus ficoides* : Mookherjee, *Rec. Zool. Surv. India, Occ. Paper No.* 75 : 73, pl. 13, fig. 51.

2003. *Ficus ficoides* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* 192 : 198, pl. 43, fig. 5, 6.

Material examined : (i) 1 ex., Veraval trawl ground, 26.xi.1968, coll. A.D.

Distribution : India : Gujarat (as above), Andhra Pradesh, Kerala, Orissa, Tamil Nadu.

Elsewhere : Australia, Borneo, China, Persian Gulf, Sulu Sea.

Remarks : The juvenile specimen not so much bulbous at shoulder region and shows reticulate sculpture formed by regular primary and intermediate ridges overrided by longitudinal ridges.

84. *Ficus variegata* Roeding

1798. *Ficus variegata* Roeding, *Museum Boltenianum* : 148, sp. 1852 (type loc. Not known).

1991. *Ficus variegata* : Subba Rao *et al.* *Zool. Surv. India, State Series, Fauna of Orissa*, 1 (pt. 3) : 59.

Material examined : (i) Jakhau Port, about 28 kms. W. of Naliya, Kutch, 8.ii.1979, Coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Kerala, Maharashtra, Orissa, Pondicherry and Karaikal, Tamil Nadu, West Bengal.

Elsewhere : China, Japan, Indonesia, Iran, Malagasay, Mauritius, Myanmar, Persian Gulf, Philippines, Red Sea, South Africa, Sri Lanka.

Remarks : Pyriform, thin, bulbous shell sculptured with regular spiral ridges with intermediate ones and longitudinal lirae, surface of the shell marked by irregular brown blotches.

Family 26. CASSIDAE

Subfamily PHALIINAE

Genus 47. *Phalium* Link, 1807

85. *Phalium glaucum* (Linnaeus)

1758. *Buccinus glauca* Linnaeus, *Syst. Nat.* ed. 10 : 737

1995. *Phalium glaucum* : Bosch *et al.* *Sea shells of Eastern Arabia*, p. 93, fig. 341.

2003. *Phalium glaucum* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 202, pl. 44, fig. 3, 4 & pl. 45, fig. 4.

Material examined : (i) 1 ex., Jakhau Port, about 28 kms. W. of Naliya, Kutch, 8.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andamans, Pondicherry, Tamil Nadu, Indian Seas.

Elsewhere : Amboina, Moluccas, Singapore.

Remarks : Shell large, ovate and heavy with varices, whorls angularly shouldered with nodules near the sutures, outer lip reflected with a series of teeth throughout inner side and three elongated teeth on outer side near the anterior canal. Occurs in off shore, caught by nets.

Family 27. RANELLIDAE

SubFamily CYMATIINAE

Genus 48. *Cymatium* Roeding, 1798

86. *Cymatium parthenopeum* (Von Salis)

1991. *Cymatium parthenopeum* : Subba Rao *et al.*, *Zool Surv. India, State Fauna Ser. 2* : 314.

1995. *Cymatium parthenopeum* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 98, pl. 355.

Material examined : (i) 1 ex., Lamba shore, 56 kms from Porbandar, 28.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above), Lakshadweep.

Elsewhere : Australia, Cape Verde, Durban, Kermadec Is., Madiebea, New Holland, New Zealand, Port Jackson. All tropical and warm seas (Abbott and Dance, 1982).

Remarks : Thick ovate elongate brownish shell, varices coloured with white and chocolate brown blotches alternately, whorls rounded with broad spiral ribs crossed by narrow longitudinal ridges forming nodules, sutures deep, siphonal canal short, broad and recurved, outer lip with paired teeth, columella lirated. Found at a depth of 35 fathom in shallow and intertidal region (? , 1972)

87. *Cymatium pileare* (Linnaeus)

1758. *Murex pileare* Linnaeus, *Syst. Nat.*, ed. 10 : 749, sp. 458

1991. *Cymatium pileare* : Subba Rao, *Zool. Surv. India, State Fauna Series 2 : Fauna of Lakshadweep* : 310

1995. *Cymatium pileare* Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 99, pl. 356.

2003. *Cymatium (M) pileare* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 207, pl. 47, fig. 3.

Material examined : (i) 1 ex., Port Okha, 22.i.1953, coll. H.C.R.; (ii) 1 ex., Dwaraka beach nr. Rest house, 24.i.1953, coll. H.C.R.; (iii) 1 ex., Kotda, 24.xi.1971, coll. G.C.R. and T.K.S., (iv) 2 exs., Porbandar beach, 30.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : From Red Sea to Polynesia, the Hawaiian Is. And the Caribbean region (Cernohorsky, 1967).

Remarks : Shell strong, elongated with nodulose spiral ribs, varices white and brown.

88. *Cymatium vespaceum* (Lamarck)

1843. *Triton vespaceus* Lamarck, *Hist. Nat. Anim. Sans. Vert.* (Deshayes ed.), 9 : 636 (type loc. Not known).

1844. *Triton thersites* Reeve, *Conch. Icon.*, 2, *Triton*, sp. no. 48.

1985. *Cymatium (Gutturium) vespaceum* : Mookherjee, *Rec. zool. Surv. India, Occ. Paper No. 75* : 76, pl. 13, fig. 53a & 53b.

2003. *Cymatium (M) vespaceum* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 208, pl. 47, fig. 4.

Material examined : (i) 1 ex., Muldwaraka, e., 21.ii.1978, coll. A.K.N.

Distribution : India : Gujarat (as above), Lakshadweep. Tamil Nadu.

Elsewhere : Australia, Mauritius, Pakistan, Persian Gulf, Sri Lanka, Viti Is., West Indies, Indo-Pacific.

Remarks : Thick fusiform shells with four varices, siphonal canal long and upwardly turned.

Genus 49. *Gyrineum* Link, 1807

89. *Gyrineum natator* (Roeding)

1798. *Tritonium natator* Roeding, *Museum Boltenianum*, p. 127, sp. 1836.

1992. *Gyrineum natator* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of West Bengal 3* (pt. 9) : 185, pl. 6, fig. 5.

2003. *Gyrineum (G) natator* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 209, pl. 48, fig. 2.

Material examined : (i) 3 exs., Pirotan Is., 18.i.1953, coll. H.C.R., (ii) 1 ex., Sikka Port, 13.i.1953, coll. H.C.R.; (iii) 13 exs., Sikka beach, 17.viii.1972, coll. K.V.S.R.; (iv) 2 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (v) 5 exs., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (vi) 3 exs., Muldwaraka E., 22.ii.1970, coll. A.K.N.; (vii) 4 exs., Madhi, 1.xi.1971, coll. G.C.R. and T.K.S.; (viii) 3 exs., Miani, 31.x.1971, coll. G.C.R. and T.K.S.; (ix) 5 exs., Porbandar, 30.x.1971, coll. G.C.R. and T.K.S.; (x) 3 exs., Porbandar, off Circuit house, 5 x 24.viii.1972, coll. K.V.S.R.; (xi) 11 exs., Navibandar, 4 x 27.xi.1971, coll. G.C.R. and T.K.S.; (xii) 3 exs., Madhavpur, 6 x 7.xi.1971, coll. G.C.R. and T.K.S.; (xiii) 4 exs., Mangrol, 11.xi.1971, coll. G.C.R. and T.K.S.; (xiv) 1 ex., Chorwad, 23.i.1978, coll. B.P.H.; (xv) 1 ex., Veraval, 25.xi.1968, coll. A.D., (xvi) 2 exs., Veraval, 26.viii.1972, coll. K.V.S.R.; (xvii) 1 ex., Veraval, 21.i.1978, coll. B.P.H.; (xviii) 1 ex., Somnath, 17.xi.1971, coll. G.C.R. and T.K.S.; (xix) 1 ex., Delvada, 27.xi.1971, coll. G.C.R. and T.K.S.; (xx) 2 exs., Odedhad, 3.xi.1971, coll. G.C.R. and T.K.S.; (xxi) 3 exs., Kotda, 24.xi.1971, coll. G.C.R. and T.K.S.; (xxii) 4 exs., Gogha and Bhavnagar, 12.xii.1971, coll. G.C.R. and T.K.S.; (xxiii) 3 exs., W. of Gogha, 29.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Andhra Pradesh, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Ranges from Polynesia to Indian Ocean (Cernohorsky, 1972).

Remarks : Dorsoventrally compressed shell with conical spire, body whorl with spiral rows of small and large nodules, a pair of varices present

to form a continuous ridges, aperture ovate with denticulate outer lip. This species closely resembles *Bursa granularis*, but differs in the absence of deep posterior canal. Some times misidentified as *Bursa granularis*.

Family 28. BURSIDAE

Genus 50. *Bursa* Roeding, 1798

90. *Bursa granularis* (Roeding)

1798. *Tritonium granulare* Roeding, *Museum Boltenianum*, p. 127, sp. 1641, (type loc. : not given).

1961. *Bursa granularis* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58**(2) : 485

1991. *Bursa granularis* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa* **1** (pt. 3) : 60.

Material examined : (i) 2 exs., Lamba shore, 56 kms from Porbandar, 28.i.1953, coll. H.C.R.; (ii) 1 ex., Diu creek, 19.ii.1970 coll. A.K.N.

Distribution : India : Gujarat (as above), Lakshadweep, Maharashtra, Orissa, Tamil Nadu.

Elsewhere : Maldives, Sri Lanka.

Remarks : Presence of posterior canal differentiates this species from *Gyrineum natator* (Roeding).

Genus 51. *Bufonaria* Schumacher, 1817

91. *Bufonaria echinata* (Link)

1807. *Bufonaria echinata* Link. *Museum Boltenianum*, p. 127, sp.

1995. *Bufonaria (Bufonaria) echinata* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 101, pl. 369.

Material examined : (i) 1 ex., Muldwaraka, e., 21.ii.1970, coll. A.K.N.; (ii) 1 ex., Muldwaraka, 21.xi.1971, coll. G.C.R. and T.K.S.; (iii) 6 exs., off Veraval, 26.xi.1968, coll. A.D.; (iv) 1 ex., Gogha, nr. Bhavnagar, 12.xii.1971, coll. G.C.R. and T.K.S.; (v) 1 ex., old Kandla Port, 28.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Kerala, Maharashtra, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : Arabia.

Remarks : Shell oblong ovate with elongated spire, elongated spines present on varices which are not continuous. This species was reported earlier from Gujarat as *Bursa spinosa* (Lamarck) by Menon *et al.* (1961) is synonym of this species.

Family 29. EPITONIIDAE

Subfamily EPITONIINAE

Genus 52. *Epitonium* Roeding, 1798

92. *Epitonium immaculatum* (Sowerby)

1844. *Scalaria immaculata* Sowerby, *Proc. Zool. Soc. London* 1844, pt. **12** : 26 (type loc. Catuanam, Luzon, Philippines), *Thes. Conchyl.*, **1** (4) : 93, pl. 33, fig. 58.

1991. *Epitonium immaculatum* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa* **1** (pt. 3) : 46, pl. IV, fig. 4.

Material examined : (i) 1 ex., Mandvi beach, nr., rest house, Kutch, 25.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Bhadreswar, Kutch, 29.vii.1972 coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Orissa, Tamil Nadu.

Elsewhere : Philippines.

Remarks : Shell white, subumbilicated with minute spiral striations, varices thin and irregular.

Genus *Gyroscala* de Boury, 1887

93. *Gyroscala lamellosa* (Lamarck)

1822. *Scalaria lamellosa* Lamarck in Deshayes *Hist. Nat. Anim. Sans Vert.*, **9** : 73 (type loc. Mediterranean).

1995. *Gyroscala lamellosa* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 110, pl. 437.

2003. *Gyroscala lamellosa* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* **192** : 219, pl. 49, figs. 5, 6

Material examined : (i) 1 ex., Veraval beach, 26.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Pondicherry, Tamil Nadu.

Elsewhere : Arabia, Hawaii Is., Indonesia, Mauritius, Mediterranean, Pakistan, South Africa.

Remarks : Shell non-umbilicated, body whorl with a single spiral rib, varices broad and connected at suture.

Family 30. JANTHINIDAE

Genus 53. *Janthina* Roeding, 1798

94. *Janthina globosa* Swainson

1822. *Janthina globosa* Swainson, *Zool. Illustr.*, 1 ser, 2 : 85 (type loc. : not given).

1982. *Janthina globosa* : Rajagopal and Mookherjee, *Rec. zool. Surv., India, Occ. Paper No. 28* : 49.

Material examined : (i) 5 exs., Subhashnagar, Porbandar, 20.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Tamil Nadu. Elsewhere : Worldwide in distribution (Cernohorsky, 1972).

Remarks : Shell globose, thin fragile, body whorl without angulated periphery, aperture large drawn out anteriorly. colour light violet.

95. *Janthina Janthina* (Linnaeus)

1758. *Helix janthina* Linnaeus, *Syst. Nat.*, ed. 10 : 772.

1982. *Janthina gloseola* : Rajagopal and Mookherjee, *Rec. Zool. Surv., India, Occ. Paper No. 18* : 48

Material examined : (i) 2 exs., Mandvi, 25.vii.1972, coll. K.V.S.R.; (ii) 34 exs., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (iii) 2 exs., Lamba shore, 135 miles from Porbandar, Kathiawar, 28.i.1953, coll. H.C.R.; (iv) 16 exs., beach opp. to Circuit House, Porbandar, 24.viii.1972, coll. K.V.S.R.; (v) 3 exs., Subhashnagar, Porbandar, 28.viii.1972, K.V.S.R.; (vi) 8 exs., Veraval, 26.viii.1972, coll. K.V.S.R.; (vii) 12 exs., Somnath beach, 25.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Nicobar Is., Tamil Nadu.

Elsewhere : Sri Lanka.

Remarks : Shell ovately conical with large squarose aperture, spire slightly elevated. Whorls

moderately convex and angulated at periphery, light violet above angle and deep violet in colour in lower half. Rajagopal and Mookherjee (1982 reported this species from coromandel Coast as *J. roseola* Reeve, is synonym of this species.

Family 31. EULIMIDAE

Genus 54. *Niso* Risso, 1826

96. *Niso Pyramidelloides* Nevill, G. & H.

1871. *Niso pyramidelloides* Nevill, G. & H., *J. Asiat. Soc. Beng.*, 40 (2) : 5, pl. 1, Fig. 14, (type loc. : Sands at 'Pooree' Bay of Bengal).

1991. *Niso pyramidelloidea* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa 1* (pt. 3) : 48.

Material examined : (i) 1 ex., Bhadreswar, Kutch, 29.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Orissa, Tamil Nadu.

Elsewhere : Malacca, Malaysia, Myanmar.

Remarks : Shell with a brown band on each whorl and shell surface smooth except a ridge on the body whorl are differentiating character of this species. Other synonyms of this species have been given by Ray (1968). Subba Rao *et al.*, (1991) designated lectotype & paralectotypes.

Order NEOGASTROPODA

Family 32. MURICIDAE

Key to genera

1. Shell bullbous/pyriform in shape; body whorl with spiral groove ending with labial spine at apertural margin; umbilicus wide, deep with imbricately scaled **Rapana**
- Shell variously shape; no spiral groove; umbilicus if present not wide as above or absent..... 2
2. Shell ornamented with varices either simple or spinose or foliated 3
- Shell without varices 7
3. Varices simple, rounded; whorls culptured with scabrous spiral ribs **Cronia**

- Varices either spinose or frondose 4
- 4. Varices with long tubular spines; siphonal canal long ornamented with spines **Murex**
- Varices ornamented with foliaces or simple short spines; siphonal canal short..... 5
- 5. Whorls with 3 varices each, ornamented with frondose spines **Chicoreus**
- Whorls with more than 3 varices each..... 6
- 6. Body whorl large, globose; spire low; varices with prominent short spines at its shoulder ..
..... **Muricanthus**
- Body whorls not large, spire elevated, fuciform; varices ornamented with spine like projections
..... **Muricopsis**
- 7. Aperture large, broadly ovate, whorls rounded
..... **Purpura**
- Aperture narrow; whorls angulate 8
- 8. Shell spindle shape; ornamented with tubercles
..... **Morula**
- Shell rhomboid in shape; ornamented with spinose or scaly tubercles **Thais**

Subfamily MURICINAE

Genus 55. **Murex** Linnaeus, 1758

97. **Murex carbonnieri** (Jousseaume)

- 1881. *Acupurpura carbonnieri* Jousseaume, *Le naturliste*, **44** : 345 (type loc. : Aden, Red Sea).
- 1993. *Murex carbonnieri* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 33, pl. 4, figs. 1, 2, 3.
- 2003. *Murex carbonnieri* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 228, pl. 53, figs. 4, 5.

Material examined : (i) 1 ex., Sikka nr. Jamnagar, 19.i.1953, coll. H.C.R.; (ii) 1 ex., Port Okha, Kathiawar, 22.i.1953, coll. Coll. H.C.R.; (iii) 2 exs., S. of Light house, Okha, 12.iv.1977, coll. K.N.R.; (iv) 8 exs., Madhi, S.E. of Dwaraka, coll. G.C.R.; (v) 1 ex., Veraval, 26.xi.1968, coll. A.D.; (vi) 2 exs., Jaleswar, 21.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman Is., Andhra Pradesh, Karnataka, Kerala, Maharashtra, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : Bangladesh, Indonesia, Madagascar, Maldives, Mauritius, Pakistan, Persian Gulf, Philippines, Tanzania, Zanzibar, Indo-West Pacific.

Remarks : Shell closely similar to *Murex tribulus* but differs in having primary spiral corals with elongated reddish brown spots between lighter nodes. Aperture with brown spots on notches.

98. **Murex ternispina** Lamarck

- 1822. *Murex ternispina* Lamarck, *Hist. Nat. Anim. Sans. Vert.*, **7** : 158 (type loc. : Indian Ocean).
- 1993. *Murex ternispina* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 41, pl. 5, figs. 6, 7, 8.
- 2003. *Murex carbonnieri* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 229, pl. 54, figs. 3, 4

Material examined : (i) 1 ex., Bhadreswar, Kutch, 29.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman Is., Orissa.

Elsewhere : Australia, Hong Kong, Indonesia, Japan, Myanmar, New Guinea, Papua, Philippines, Singapore, Solomons, Sri Lanka.

Remarks : Shell sculptured with prominent spiral cords and axial ribs, ribs tuberculate and discontinuous. This species was identified as other species by earlier workers but Ponder and Vokes (1988) validated this species.

99. **Murex tribulus** Linnaeus

- 1758. *Murex tribulus* Linnaeus, *Syst. Nat.*, ed. **10** : 746 (type loc. : O. Asiae).
- 1993. *Murex tribulus* : Subba Rao and Surya Rao, *Rec. Zool. Surv. India, Occ. Paper No. 153* : 43, pl. 6, figs. 1, 2, 3, text fig. 18.
- 2003. *Murex tribulus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 230, pl. 53, figs. 10.

Material examined : (i) 1 ex., Port Okha,

Kathiawar, 22.i.1953, coll. H.C.R.; (ii) 8 exs., Madhi, S.E. of Dwaraka, 1.xi.1971, coll. G.C.R.

Distribution : India : Gujarat (as above) , common on east & West coasts of India.

Elsewhere : Indo-west Pacific.

Remarks : Polymorphism of this species is described by Radwin & D'Attilio (1976). *Murex trapa* Roeding, distributed on east coast, closely resembles with *M. tribulus* except in having less spines on the canal, acute spire and prominent labial teeth.

Genus 56. *Chicoreus* Montfort, 1810

100. *Chicoreus brunneus* (Link)

1807. *Purpura brunnea* Link. *Beschreibung der Naturalien Sammlung der Universitat Zu Rostoc* : 121 (Type loc. : Unknown).

1961. *Murex adustus* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 486, pl. 7, fig. 57.

1993. *Chicoreus brunneus* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper 153* : 17, pl. 1, figs. 5, 6, text figs, 4, 9.

2003. *Chicoreus brunneus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper 192* : 225, pl. 52, fig. 2.

Material examined : (i) 2 exs., Pirotan Is., Gulf of Kutch, 19.iv.1977, coll. K.N.R.; (ii) 1 ex., Sikka beach, nr. Jamnagar, 19.viii.1972, coll. K.V.S.R.; (iii) 1 ex., Subhashnagar, Porbandar, 28.viii.1972, coll. K.V.S.R.; (iv) 6 exs., Veraval beach, 25.xi.1968, coll. A.D.; (v) 3 ex., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (vi) 2 exs., Veraval, 24.ii.1979, coll. K.V.S.R.; (vii) 2 exs., Diu fort, E, 11.ii.1970, coll. A.K.N.; (viii) 3 exs., Vanakbara, Diu, 24.xi.1971, coll. G.C.R.

Distribution : India : Gujarat (as above), Andaman and Nicobar Is., Andhra Pradesh, Maharashtra, Tamil Nadu.

Elsewhere : Indo-Pacific.

Remarks : Rhomboid shell with elevated spire, body whorl with frilled varices, a prominent knob like tubercle present between varices, anal sulcus narrow. This species is reported earlier as *Murex*

adustus Lamarck is synonym of this species. Shells collected off Vishakhapatnam are sold in the beach are noticed.

101. *Chicoreus kilburni* Houart & Pain

1982. *Chicoreus (Chicoreus) kilburni* Houart & Pain, *Information de la Soc. Belge, de Malacologie*, 10 (1-4) : 5, pl. 3, figs. 1-4.

1993. *Chicoreus kilburni* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper 153* : 22, pl. 2, figs 4, 5, text figs. 7-8.

2003. *Chicoreus kilburni* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 225, pl. 52, fig. 3

Material examined : (i) 2 exs., Porbandar, 30.x.1971, coll. G.C.R.; (ii) 1 ex., Navibandar, 2.xi.1971, (iii) 5 exs., Veraval beach, 24-26-28.ii.1979, coll. K.V.S.R.; (iv) 1 ex., Somnath, 19.xi.1971, coll. K.V.S.R.; (v) 1 ex., Jaleswar, 21.i.1978, coll. B.P.H.; (vi) 2 exs., Kotda, 24.xi.1971, coll. G.C.R.; (vii) 1 ex., Madhvad, 25.xi.1971, coll. G.C.R.; (viii) 3 exs., Jalandar, Due, 27.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra.

Elsewhere : Cocos, Durban Bay, Mozambique.

Remarks : Subramanyam *et al.*, (1952) reported this species as *Murex maurus* from Bombay.

102. *Chicoreus ramosus* (Linnaeus)

1758. *Murex ramosus* Linnaeus, *Syst. Nat.*, ed. 10 : 747 (type loc. "Persica Jamaica").

1993. *Chicoreus ramosus* : Subba Rao & Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 25, pl. 2, figs. 9, 10; pl. 3 figs. 1, 2; text. Figs. 10, 13.

2003. *Chicoreus ramosus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 226, pl. 52, fig. 6.

Material examined : (i) 1 ex., Sikka beach, 19.i.1953, coll. H.C.R.; (ii) 1 ex., Port Okha, 2.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Andhra Pradesh, Lakshadweep, Pondicherry, Tamil Nadu.

Elsewhere : Indo-west Pacific.

Remarks : Shell fusiform with low spire, body whorl with three varices bearing foliaceous spines, aperture large, outer lip with labial tooth. This species sold in the market as curios and used in lamp shades. Declared as an endangered species.

Genus 59. *Muricanthus* Swainson, 1840

103. *Muricanthus kuesterianus*
(Tapparone-Canefri)

1875. *Murex kuesterianus* Tapparone Canefri, *Ann. Mus. Cly. Stor. Nat.*

1961. *Murex virginieus* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 486, pl. 7, fig. 56

1993. *Murex kuesterianus* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 47, pl. 6, figs. 6, 7.

Material examined : (i) 7 exs., Port Okha, 2 & 22.i.1953, coll. H.C.R.; (ii) 3 exs., Adatara, 10.viii.1972, coll. K.V.S.R.; (iii) 1 ex., Beyt Is., Gulf of Kutch, 12.viii.1972, coll. K.V.S.R.; (iv) 2 exs., Sikka beach, nr. Jamnagar, 19.viii.1972, coll. K.V.S.R.; (v) 2 exs., Nayabandar, Bedi, nr. Jamnagar, 20.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra.

Elsewhere : Gulf of Oman and adjacent region.

Remarks : This species is restricted only on west coast of India. But it closely agrees with *Muricanthus virgineus* (Roeding), distributed on east coast, except in having canal with single spine, varices more than four in number and no knob in between varices. Subramaneum *et al.* (1952) reported as *M. virginus* which is a synonym if this left.

Subfamily MARICOPSINAE

Genus 60. *Muricopsis* Bucquoy, Dautzenbert & Dollfus, 1882

104. *Muricopsis bombayanus* (Melvill)

1893. *Murex (Ocinebra) bombayanus* Melvill, *Mem. Proc. Manchr. Lit. Phil. Soc.*, (4) 7 : 52, pl. 1, fig. 1 (type loc. Bombay).

1993. *Muricopsis bombayanus* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 60 : 60 pl. 8, fig. 4.

2003. *Muricopsis bombayanus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 233, pl. 55, fig. 2

Material examined : (i) 1 ex., Muldwaraka E., Amreli, 22.ii.1970, coll. A.K.N., (ii) 4 exs., Madhabpur, n., 6.xi.1971, coll. G.C.R. and T.K.S.; (iii) 1 ex., Veraval beach, 26.viii.1972, coll. K.V.S.R., (iv) 1 ex., beach opposite to Circuit house, Porbandar, 24.viii.1972, coll. K.V.S.R., (v) 3 exs., Chorwad, 16.xi.1971, coll. G.C.R. & T.K.S.; (vi) 1 ex., Delvada, 21.xi.1971, coll. G.C.R. & T.K.S.; (vii) 3 exs., Kotda, 24.xi.1971 coll. G.C.R. & T.K.S.

Distribution : India : Gujarat (as above), Goa, Maharashtra.

Elsewhere : Pakistan, Persian Gulf.

Remarks : This species is common in west coast. Shell spirally ridged and transpirally ribbed with long and sharp nodules.

Subfamily RAPARINAE

Genus 62. *Rapana* Schumacher, 1817

105. *Rapana rapiformis* (Born)

1778. *Murex rapiformis* var. a Born, *Index rerum naturalium Musci, Caesarei vindobonensis* pt. 1 : (type loc. Not known).

1993. *Rapana rapiformis* : Subba Rao & Surya Rao, *Rec. Zool. Surv. India, Occ. Paper No. 153* : 79, pl. 9, fig. 8, pl. 10, fig. 1, text fig. 20.

2003. *Purpura persica* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 236, pl. 56, fig. 3

Material examined : (i) 1 ex., Okha beach, 13.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Lakshadweep, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : Aden, China, Hong Kong, Japan, Pakistan, Persian Gulf, Philippines, Sri Lanka.

Remarks : Oysters and barnacles are found attached on both the inner and outer surfaces of

the body whorl. *Rapan bulbosa* reported by Satyamurti (1952) in synonym under this species.

Genus 57. *Cronia* H. & A. Adams, 1853

Subgenus *Ergalatax* Iredale, 1931

106. *Cronia (Ergalatax) contracta* (Reeve)

1846. *Buccinum contractum* Reeve, *Conch. Icon.*, 3, *Buccinum* sp. 53 pl. 8, fig. 53 (type loc. Samar Island, Philippines).

1961. *Drupe heptagonalis* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 487, pl. 8, fig. 62

1961. *Drupe margaritirole* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 487, pl. 8, fig. 61

1993. *Cronia (Ergalatax) contracta* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No.* 153 : 83, pl. 10, figs. 2, 3, 4.

2003. *Cronia contracta* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* 192 : 236, pl. 56, fig. 4

Material examined : (i) 7 exs., port Sikka, 13.i.1953, coll. H.C.R.; (ii) 2 exs., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (iii) 5 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (iv) 5 exs., Pirotan Is., 20.iv.1977, coll. K.N.R.; (v) 1 ex., Porbandar, 28.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Navibandar, 4.viii.1971, coll. G.C.R.; (vii) 1 ex., Somnath, 17.xi.1971, coll. G.C.R.; (viii) 1 ex., Miani, 31.x.1971, coll. G.C.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep, Maharashtra, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : Indo-Pacific.

Remarks : This species is variable in its spire, number of axial ridges & colour (Subba Rao & Surya Rao, 1993) and was reported under several names.

106a. *Cronia subnodulosa* (Melvill)

1846. *Ricinula (Sistrum) subnodulosa* Melvill. *Mem. Manchr. lit. phil. Soc.*, (4) 7 : 54, pl.1, fig. 6.

1993. *Cronia (Ergalatax) contracta* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No.* 153 : 88, pl. 10, figs. 9.

Material examined : (i) 2 exs., Chorwad, Gujarat, coll. K.V.S.R.(ii) 3exs. Navibandar. coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andamans, Andhra Pradesh, Diu, Karnataka, Maharashtra.

Elsewhere : Indo-Pacific.

Remarks : Though very close to *C. nodulosa*, this species differs from it in having a longer spire and in bisected nodules and also by possessing a white band in aperture.

Genus 58. *Morula* Schumacher, 1817

107. *Morula granulata* (Duclos)

1832. *Purpura granulata* Duclos, *Ann. Sci. Nat.*, 2 : Fig. 9 (type loc. Not known).

1961. *Drupe tutuberculata* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 486, pl. 8, fig. 60

1993. *Morula granulata* : Subba Rao and Surya Rao, *Rec. zool. Surv. India. Occ. Paper No.* 158 : 95, pl. 11, figs. 3, 4.

2003. *Cronia contracta* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No.* 192 : 239, pl. 56, figs. 8, 9

Material examined : (i) 3 exs., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (ii) 1 ex., Adatara nr. Okha, 10.viii.1972, coll. K.V.S.R.; (iii) 2 exs., Dwaraka, 11.viii.1972, coll. K.V.S.R., (iv) 1 ex., Dwaraka, 10.iv.1977, coll. K.N.R., (v) 8 exs., Okha beach, 12.viii.1972, coll. K.V.S.R.; (vi) 7 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (vii) 2 exs., Lamba shore, 28.i.1953, coll. H.C.R.; (viii) 2 exs., Miani, 31.x.1971, coll. G.C.R.; (ix) 1 ex., Porbandar, 30.x.1971, coll. G.C.R.; (x) 6 exs., Subhashnagar, nr. Porbandar, 28.viii. 1972, coll. K.V.S.R.; (xi) 2 ex., Porbandar, 30.viii.1972, coll. K.V.S.R., (xii) 2 exs., Madhavpur, 6.xi.1971, coll. G.C.R.; (xiii) 2 exs., Navibandar, 4-27.xi.1971, coll. G.C.R.; (xiv) 1 ex., Chorwad, 16.i.1971, coll. G.C.R.; (xv) 1 ex., Chorwad, 23.i.1978, coll. B.P.H.; (xvi) 2 exs., Veraval, 25.xi.1968, coll. A.D.; (xvii) 1 ex., Somnath, 17.xi.1971, coll. G.C.R.; (xviii) 2 exs., Delvada, 27.xi.1971, coll. G.C.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., common both on east and west coast (rocky shore).

Elsewhere : Throughout tropical Indo-Pacific.

Remarks : Synonyms of this well distributed species are given by Cernohorsky (1972) and Ray (1977). This species was reported earlier as *Thais tuberculata* is synonym.

108. *Morula marginatra* (Blainville)

1832. *Purpura marginatra* Blainville, *Nouv. Ann. Mus. Hist. Nat. Paris.* 1 : 218, pl. 10, fig. 1 (type loc. Ticopia, Solomon Island).

1993. *Morula marginatra* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 97, pl. 11, figs. 7, 8.

2003. *Morula marginatra* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 240, pl. 54, fig. 8

Material examined : (i) 16 exs., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (ii) 11 exs., off Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R., (iii) 6 exs., Veraval beach, 26.viii. 1972, coll. K.V.S.R.; (iv) 10 exs., W. Goghla, Diu, 29.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Andhra Pradesh, Goa, Kerala, Lakshadweep, Maharashtra, Orissa.

Elsewhere : Australia, Central Polynesia, Durban, Mauritius, Philippines, Queensland, Singapore.

Remarks : This species is closely resembles, preceding one, but differs in having deep pits and broader aperture.

Subfamily THAIDINAE

Genus 61. *Purpura* Bruguiere, 1789

109. *Purpura panama* (Roeding)

1798. *Thais panama* Roeding, *Museum Boltenianum*, : 54 (refers Chemnitz, Vol. 10, pl. 154, figs. 1467, 1468 (type loc. Tranquebar).

1961. *Thais rudolphi* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* 58 (2) : 486, pl. 7, fig. 58

1998. *Purpura panama* Subba Rao and Surya Rao, *Rec. zool. Surv. India Occ. Paper No. 153* : 104, pl. 12, figs. 8, 9, text fig. 24.

2003. *Purpura panama* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 242, pl. 58, fig. 2

Material examined : (i) 1 ex., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (ii) 6 exs., Okha beach, 13.viii.1972, coll. K.V.S.R.; (iii) 2 exs., Okha, S. of Light house, 12.iv.177, coll. K.N.R.; (iv) 7 exs., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (v) 2 exs., Dwaraka, 10.iv.1977, coll. K.N.R.; (vi) 3 exs., beach opp. Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R.; (vii) 2 exs., between Saurashtra Chemicals and Birla Sagar, Porbandar, 22.ii.1979, coll. K.V.S.R.; (viii) 5 exs., Navibandar, 4.xi.1971, coll. G.C.R.; (ix) 3 exs., Jaleswar nr. Veraval, coll. B.P.H. and D.R.K.S.; (x) 1 ex., Muldwaraka, E., 22.ii.1970, coll. A.K.N.; (xi) 2 exs., sil, 2.xi.1971.

Distribution : India : Gujarat (as above), Andhra Pradesh, Diu, Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Pakistan, Sri Lanka.

Remarks : Shell sculptured with five broad spiral ribs each followed by two to five narrow ribs, first host are broad with raw raised fabercles dark chest not brown alternate with white.

110. *Purpura persica* (Linnaeus)

1758. *Buccinum persicum* Linnaeus, *Syst. Nat. ed. 10* : 738 (type loc. O'Asiatica).

1993. *Purpura persica* : Subba Rao & Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 106, pl. 12, figs. 5, 6, 7.

2003. *Purpura persica* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 242, pl. 58, fig. 3

Material examined : (i) 1 ex., beach opp. Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is.

Elsewhere : Mauritius, Philippines, ranges westwards from New Hebrides.

Remarks : This species closely, resembles with preceding one can easily be distinguished from by its globose body whorl with low spire and large aperture.

Genus 63. *Thais* Roeding, 1798111. *Thais blanfordi* (Melvill)

1893. *Purpura (Stramonita) blanfordi* Melvill, *Mem. Proc. Manchr. Lit. Phil. Soc.*, (4) 7 : 53, pl. 1, fig. 3 (type loc. Bombay and Ratnagiri).

1993. *Thais blanfordi* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 109, pl. 13, fig. 2, 3, text fig. 25.

2003. *Thais blanfordi* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 242, pl. 59, fig. 2

Material examined : (i) 12 exs., Mandvi beach, nr. Rest house, 25.vii.1972, coll. K.V.S.R.; (ii) 2 exs., Rukmavati river mouth, Mandvi, Kutch, 26.vii.1972, coll. K.V.S.R.; (iii) 1 ex., Goghla, Diu, 29.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman Is., Karnataka, Kerala, Maharashtra.

Elsewhere : Pakistan, Persian Gulf, Singapore, Sri Lanka.

Remarks : Shell fusiform, angulated whorls sculptured with round spiral cords, aperture lirated, eight arranged in pairs.

112. *Thais Bufo* (Lamarck)

1822. *Purpura bufo* Lamarck, *Hist. Nat. Anim. Sans Vert.*, ed. 2, 10 : 99, fig. 13.

1993. *Mancinella bufo* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 90 pl. 11, figs. 1, 2, text fig. 22.

2003. *Thais bufo* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 238, pl. 56, fig. 10

Material examined : (i) 6 exs., Rukmavati river mouth, Mandvi, Kutch, 26.vii.1972, coll. K.V.S.R.; (ii) 17 exs., Porbandar beach, 24, 29.viii.1972, coll. K.V.S.R.; (iii) 2 exs., Porbandar, 22.ii.1979, coll. K.V.S.R.; (iv) 1 ex., Navibandar, 4.xi.1971, coll. G.C.R., (v) 1 ex., Veraval, 31.i.1953, coll. H.C.R., (vi) 2 exs., Veraval, 27.xi.1968, coll. A.D.; (vii) 3 exs., Veraval, 26.viii.1972, coll. K.V.S.R.; (viii) 1 ex., Somnath, 25.8.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Common on both coasts except West Bengal.

Elsewhere : Indo-Pacific.

Remarks : This species resembles closely, to *Purpura panama*, occurs in same habitat. Differs in having short spire, monk globose body tubercles. Reported under *Mancinella* genus.

113. *Thais lacera* (Born)

1778. *Murex lacera* Born, *Index rerum naturalium Musel Caesarei Vindobonensis* : 308.

1993. *Thais lacera* : Subba Rao and Surya Rao, *Rec. zool. Surv. India, Occ. Paper No. 153* : 113, pl. 13, figs. 4, 5, 6.

2003. *Thais lacera* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 244, pl. 58, fig. 5

Material examined : (i) 10 exs., Port Sikka, 13.i.1953, coll. H.C.R., (ii) 2 exs., Pirotan Is., 18.i.1953, coll. H.C.R.; (iii) 7 exs., Rukmavati river mouth, 26.vii.1972, coll. K.V.S.R.; (iv) 11 exs., Creek, New Kandla, 3, 5.viii.1972, coll. K.V.S.R.; (v) 37 exs., Old Kandla Port, 28.iv.1977, coll. K.N.R.; (vi) 1 ex., Balapur beach, Beyt Is., 5.viii.1972, coll. K.V.S.R.; (vii) 9 exs., Salaya Port, nr. Jamnagar, 18.viii.1972, coll. K.V.S.R., (viii) 14 exs., Sikka beach, nr. Jamnagar, 19.viii.1972, coll. K.V.S.R.; (ix) 4 exs., Bedi bandar, nr. Jamnagar, 21.viii.1972, coll. K.V.S.R.; (x) 1 ex., Jaleswar, 15.xi.1971, coll. G.C.R.; (xi) 1 ex., Kotda, 21.i.1971, coll. G.C.R.; (xii) 16 exs., Miani, nr. Porbandar, 27.viii.1972, coll. K.V.S.R.; (xiii) 1 ex., Gopnath, 30.xi.1968, coll. A.D.

Distribution : India : Gujarat (as above), common on both coasts in river mouths and Backwaters.

Elsewhere : Israel, Myanmar, Pakistan, Persian Gulf.

Remarks : Subba Rao and Surya Rao (1993) discussed the synonyms of this variable species in detail.

114. *Thais rugosa* (Born)

1778. *Murex rugosus* Born, *Index rerum naturalium Musci Caesarei Vindobonensis* : 303.

1788. *Murex sacellum* Chemnitz, *Conch. Cab.*, **10** : 267, pl. 163, figs. 1561, 1562 (type loc. Nicobar islands).
 1961. *Thais rugosa* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58** (2) : 486, pl. 7, fig. 59
 1993. *Thais rugosa* : Subba Rao & Surya Rao, *Rec. zool. Surv. India, Occ. Paper No.* **153** : 115, pl. 14, figs. 3, 4.
 2003. *Thais rugosa* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* **192** : 244, pl. 59, fig. 5

Material examined : (i) 3 exs., Okha, 11.viii.1972, coll. K.V.S.R.; (ii) 2 exs., Dwaraka, 22.i.1970, coll. A.K.N.; (iii) 1 ex., Dwaraka, 13.viii.1972, coll. K.V.S.R.; (iv) 2 exs., Porbandar, (v) 2 exs., Navibandar, 4.xi.1971, coll. G.C.R.; (vi) 1 ex., Veraval, 31.iii.1953, coll. H.C.R.; (vii) 1 ex., Veraval, 25.xi.1968, coll. A.D.; (viii) 7 exs., Veraval, 15-27.xi.1971, coll. G.C.R.; (ix) 1 ex., Veraval, 1972, coll. K.V.S.R.; (x) 2 exs., Vanakbara, Diu, 24.xi.1971, coll. G.C.R.

Distribution : India : Gujarat (as above), common on east and west coasts.

Elsewhere : Java, Mergui Archipelago, Moluccas, Myanmar, Pakistan, Philippines, Singapore, Sri Lanka.

Remarks : Shells sculptured with four prominent ridges below shoulder ornamented with compressed scales, partly raised upwards, shoulder ones are larger, interstices with scabrous threads. This species is reported as *T. sacellum* by earlier workers is synonym.

115. *Thais tissoti* (Petit)

1852. *Purpura tissoti* Petit, *J. Conch. Paris*, **3** : 163, pl. 7, fig. 4 (type loc : Bombay, India).
 1993. *Thais tissoti* : Subba Rao and Surya Rao, *Rec. Zool. Surv. India, Occ. Paper No.* **153** : 116, pl. 14, fig. 5, text fig. 27.
 2003. *Thais tissoti* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* **192** : 245, pl. 58, fig. 6

Material examined : (i) 1 ex., Port Sikka, 13.i.1953, coll. H.C.R.; (ii) 15 exs., Old Kandla Port, 28.iv.1977, coll. K.N.R.; (iii) 1 ex., Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.; (iv) 10 exs., Porbandar, 24.viii.1972, coll.

K.V.S.R.; (v) 1 ex., Veraval, 26.viii.1972, coll. K.V.S.R.; (vi) 4 exs., Miani, 27.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Daman, Goa, Karnatak, Kerala, Maharashtra, Orissa, Tamil Nadu.

Elsewhere : Myanmar, Pakistan, Persian Gulf, Sri Lanka.

Remarks : Thick spindle shaped shell sculptured with four spiral ridges and bisulcate deep grooves in between, ridges mildly tuberculated and gradually become weak.

Family 33. BUCCINIDAE

Key to the genera of family BUCCINIDAE

1. Shell ovate, smooth, suture channelled, sloping inwards, columella calloused ***Babylonia***
 — Shell spindle shape; sculptured; suture simple not channelled columella not calloused 2
2. Shell sculptured with ridges either axial or spiral or both ***Cantharus***
 — Shell sculptured with tuberculated axial ribs ***Engina***

Subfamily BUCCININAE

Genus 64. *Babu* F. Schultze, 1838

116. *Babylonia spirata* (Linnaeus)

1758. *Buccinum spiratum* Linnaeus, *syst. Nat.* ed. **10** : 739, No. 405 (type loc. : M. Mediterranes).
 1961. *Babylonia spirata* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58** (2) : 487, pl. 8, fig. 65
 1995. *Babylonia spirata* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 126, pl. 512.
 2003. *Thais tissoti* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* **192** : 251, pl. 60, figs. 1, 2, text fig. 32

Material examined : (i) 5 exs., Mandvi beach nr. Rest house, kutch, coll. K.V.S.R., (ii) 7 exs., Rukmavati river mouth, Mandvi, Kutch, 26.viii.1952, coll. K.V.S.R.; (iii) 1 ex., Salaya beach nr. Mandvi, Kutch, 31.vii.1972, coll. K.V.S.R.; (iv)

5 exs., Mandvi beach, nr. Rest house, Kutch, 25.iv.1977. coll. K.V.S.R.; (v) 2 exs., Hanumandandi, Beyt Is., Okha, 23-25.i.1953, coll. H.C.R.; (vi) 1 ex., Port Sikka, 19.i.1953, coll. H.C.R.; (vii) 2 exs., Veraval trawl ground, 26.xi.1968, coll. A.D.; (viii) 3 exs., Vankabara, 24.xi.1971, coll. G.C.R.; (ix) Madhwad, 25.xi.1971, coll. G.C.R.; (x) 2 exs., Gogha, 27.xi.1971, coll. G.C.R.; (xi) 2 exs., Bhadreswar, 29.vii.1972, coll. K.V.S., (xii) 1 ex., Balapur Bay, 13.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Andamans, Andhra Pradesh, Kerala, Maharashtra, Orissa, Pondicherry, Tamil Nadu. Elsewhere : Indo-Pacific.

Remarks : This species can easily be identified by deep surface channeled sutures, deep umbilicus and brown white shell with orange crescents.

SubFamily PISANIINAE

Genus 65. *Cantharus* (Bolten) Roeding, 1798

Subgenus *Pollia* Gray in Sowerby 1834

117. *Cantharus (Pollia) fumosus* (Dillwyn)

1817. *Buccinum fumosum* Dillwyn, *Descr. Cat. Shells 2* : 629 (ref. Chemnitz, vol. 4, pl. 123, upp. Figs. 1145-46) (type loc. Not given).

1995. *Cantharus fumosus* : Bosch *et al.*, *sea shells of Eastern Arabia*, p. 127, pl. 516.

2003. *Cantharus fumosus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 256, pl. 65, fig. 5

Material examined : (i) 3 exs., Muldwaraka E., 21-22.ii.1971, coll. A.K.N.; (ii) 1 ex., Kotda, 24.xi.1971, coll. G.C.R.; (iii) 2 exs., Navibandar, 27.xi.1971, coll. G.C.R.; (iv) 2 exs., Mundra mangroves, Kutch, 27.vii.1972, coll. K.V.S.R.; (v) 1 ex., Jaleswar, Veraval, 21.i.1978, coll. B.P.H.; (vi) 1 ex., Veraval, 26.viii.1972, coll. K.V.S.R.; (vii) 1 ex., Sika beach, 19.viii.1972, coll. K.V.S.R.; (viii) 1 ex., Mithapore nr. Okha, 14.viii.1972, coll. K.V.S.R.; (ix) 2 exs., Lamba shore, 38 miles of Porbandar, 28.i.1953, coll. H.C.R.; (x) 2 exs., Subhashnagar nr. Porbandar, 28.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra.

Elsewhere : Australia, Ethiopia, Hong Kong, Japan, New Guinea, Philippines, Red Sea, Singapore. Throughout tropical Pacific but less common.

Remarks : This species looks like *C. undosus* but the former is with well developed axial ribs on later whorls. "It is suspected that *C. fumosus* is only an individual or developmental form of *C. undosus*" (Cernohorsky, 1971).

118. *Cantharus (pollia) spiralis* (Gray)

1839. *Buccinum spiralis* Gray. *Zoology of Beecheys Voyage* : 111 (type loc. Mauritius)

1995. *Cantharus spiralis* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 127, pl. 519.

2003. *Cantharus spiralis* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 256, pl. 61, fig. 3

Material examined : (i) 2 exs., Madhi, 1.xi.1971, coll. G.C.R. and T.K.S.; (ii) 1 ex., Madhavpur, 9.xi.1971, coll. G.C.R. and T.K.S.; (iii) 2 exs., Navibandar, s., 4.xi.1971, coll. G.C.R. and T.K.S.; (iv) 1 ex., Muldwaraka, 21.xi.1971, coll. G.C.R. and T.K.S.; (v) 1 ex., Rukmavati river mouth, Mandvi, Kutch, 30.vii.1972, coll. K.V.S.R.; (vi) 1 ex., Mundra Mangrove, 27.vii.1972, coll. K.V.S.R.; (vii) 1 ex., Jaleswar, 15.xi.1971, coll. G.C.R. and T.K.S.; (viii) 1 ex., Lamba shore, 56 kms of Porbandar, 28.i.1953, coll. H.C.R.; (ix) 2 exs., Porbandar, 30.x.1971, coll. G.C.R. and T.K.S.; (x) 3 exs., Subhashnagar, Porbandar, 28.viii.1972, coll. K.V.S.R.; (xi) 5 exs., beach nr. Circuit house, Porbandar, 24.viii.1972, coll. K.V.S.R.; (xii) 1 ex., Veravl beach, 26.viii.1972, coll. K.V.S.R.; (xiii) 2 exs., Kotda, 24.xi.1971, coll. G.C.R. and T.K.S.; (xiv) 3 exs., Gogha, 12.xii.1971, coll. G.C.R. and T.K.S.; (xv) 2 exs., Miani, 31.x.1971, coll. G.C.R. and T.K.S.; (xvi) 2 exs., Creek w. of Kandla port, 5.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra. Pondicherry.

Elsewhere : Pakistan, Singapore.

Remarks : Thick shell with strong spiral ridges three in each whorl and seven on body whorl, ridges elevated along transpiral ribs.

119. *Cantharus (Pollia) undosus* (Linnaeus)

1758. *Buccinum undosus* Linnaeus, *Syst. Nat.* ed. 10 : 740, sp. 409 (type loc. Asia).

1971. *Cantharus (Pollia) undosus* : Cernohorsky, *Rec. Auckland Inst. Mus.* 8 : 155, figs. 36, 62, 66.

2003. *Cantharus undosus* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 256, pl. 61, fig. 4

Material examined : (i) 12 exs., Dwaraka, Port Okha, 24.i.1953, coll. H.C.R.; (ii) 2 exs., Okha, 10.xi.1968, coll. A.D.; (iii) 2 exs., Adatara nr. Okha, 10.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Dwaraka, 16.iv.1977, coll. K.N.R.; (v) 8 exs., Okha beach, 13.viii.1972, coll. K.V.S.R.; (vi) 2 exs., Mithapur nr. Okha, 14.viii.1972, coll. K.V.S.R.; (vii) 1 ex., Pirotan Is., 20.iv.1977, coll. K.N.R.; (viii) 1 ex., Veraval, 20.vii.1972, coll. K.V.S.R.; (ix) 1 ex., Jaleswar, Veraval, 26.iii.1977, coll. K.N.R.; (x) 1 ex., Jaleswar, Veraval, 21.i.1978, coll. B.P.H.; (xi) 2 exs., Navibandar, 4 & 27.xi.1971, coll. G.C.R. and T.K.S.; (xii) 1 ex., Kotda, 24.xi.1971, coll. G.C.R. and T.K.S.; (xiii) 17 exs., Sikka beach, 19. viii.1972. coll. K.V.S.R.; (xiv) 1 ex., Miani, 31.x.1971, coll. G.C.R. and T.K.S.; (xv) 1 ex., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S.; (xvi) 1 ex., Vanakabara, 24.xi.1971, coll. G.C.R. and T.K.S.; (xvii) 1 ex., Gogha, nr. Bhavanagar, 12.xii.1971, coll. G.C.R. and T.K.S.; (xviii) 1 ex., Balapur Bay, 7.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Andaman Is., Andhra Pradesh, Lakshadweep, Maharashtra, Tamil Nadu, common along west coast.

Elsewhere : Arabia, Malay Archipelago, Mauritius, Pakistan, Persian Gulf, Philippines, Polynesia. Common throughout Pacific (cernohorsky 1972).

Remarks : Heavy shell with conical spire, sutures weakly channelled, axial ribs not present.

Subfamily PISANIINAE

Genus 66. *Engina* Gray, 1839

120. *Engina alveolata* (Kiener)

1836. *Purpura alveolata* Kiener, *Spec. gen. Econ. Cog.* 8 : 42, pl. 9, fig. 23 (type loc. Not given).

1975. *Engina alveolata* : Cernohorsky, *Rec. Auckland. Inst. Mus.*, 12 : 178, figs. 10.

2003. *Engina alveolata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 257, pl. 60, figs. 10, 11

Material examined : (i) 2 exs., Adatara beach nr. Okha, 10.viii.1972, coll. K.V.S.R.; (ii) 2 exs., Veraval, beach, 26.viii.1972, coll. K.V.S.R.; (iii) 1 ex., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Andamans.

Elsewhere : Common throughout tropical Pacific (Cernohorsky, 1972), New Caledonia, Philippines, Singapore, Queensland to Western Australia.

Remarks : Shell ornamented with double rows of black nodules and intermediate rows of orange nodules, columella calloused and denticulated throughout, aperture narrow, with denticulate outer lip colour grayish with white band encircled at middle of body. This species is variable in colour and a series of synonyms has been cited by Cernohorsky (1975).

Family 34. COLUMBELLIDAE

Subfamily PYRENINAE

Genus 67. *Pyrene* Roeding, 1798

121. *Pyrene flava* (Bruguiere)

1961. *Pyrene flava* : Menon *et al.*, *Sea shells of Eastern Arabia*, p. 487, pl. 8, fig. 64

1995. *Pyrene flava* : Bosch *et al.*, *Sea shells of Arabia*. p. 130, pl. 539.

2003. *Engina alveolata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 262, pl. 62, figs. 6, 7

Material examined : (i) 1 ex., mandvi beach, 28.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Pirotan Is., 20.iv.1977, coll. K.N.R.; (iii) 1

ex., Rozy Port, 22.viii.1972, coll. K.V.S.R.; (iv) 2 exs., Hanumandandi, 12.viii.1972, coll. K.V.S.R.; (v) 1 ex., Hanumandandi, 8.iv.1977, coll. K.N.R.; (vi) 8 exs. Sikka Beach, 19.viii.1972, coll. K.V.S.R., (vii) 11 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (viii) 6 exs., Adatara beach, 10.viii.1972, coll. K.V.S.R.; (ix) 10 exs., Okha beach, 19.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above) Tamil Nadu Andamans.

Elsewhere : Mauritius, Pakistan, Philippines, Singapore.

Remarks : Biconical shell sculptured with fine axial and spiral striations and grooves, aperture long with denticulate outer lip, colour variable. Cernohorsky (1972) gave the synonyms of this species. This species is reported under *P. flavida* Lamarck which is synonym of this species.

122. *Pyrene splendidula* (Sowerby)

1844. *Columbella splendidula* Sowerby, *Thes. Conchyl.*, 1 (4), ante 2 Ap., : 120.

Material examined : (i) 5 exs., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above).

Elsewhere : Philippines, Singapore.

Remarks : Small shell with canaliculated sutures, whorls smooth except a few spiral cords at the basal region of body whorl, outer lip thickened and denticulated, columella with outer denticles, creamy white in colour ornamented with irregular orange patches.

123. *Pyrene scripta* (Lamarck)

1832. *Columbella versicolor* Sowerby, *Proc. Com. Sci. zool.*, 1 : 119.

1961. *Pyrene versicolor* : Menon et al., *J. Bombay nat. Hist. Soc.* 58 (2) : 486, pl. 7, fig. 59

1982. *Pyrene versicolor* : Abbott and Dance. *Compendium of Sea shells*, p.161, fig.

2003. *Pyrene scripta* : Subba Rao, *Rec. zool. Surv. India, Occ Paper* 192 : 262, pl. 62, figs. 2, 3

Material examined : (i) 13 exs., Pirotan Is., 18.i.1953, coll. H.C.R.; (ii) 2 exs., Pirotan Is., 20.iv.1977, coll. K.N.R.; (iii) 4 exs., Rozy Port nr. Bedi, Jamnagar, 22.viii.1972, coll. K.V.S.R.; (iv) 6 exs., Danda, 2 miles N. of Sikka port, 14.i.1953, coll. H.C.R.; (v) 1 ex., Port Sikka, 13.i.1953, coll. H.C.R.; (vi) 3 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (vii) 2 exs., Deeda Is., 14 miles from Sikka Port, 17.i.1953, coll. H.C.R.; (viii) 2 exs., Mithapur, 14.viii.1972, coll. K.V.S.R., (ix) 1 ex., 3 miles s.e. of Port Okha, coll. H.C.R.; (x) 1 ex., Adatara beach, 10.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar is., Tamil Nadu.

Elsewhere : Indo-Pacific, Japan, Singapore, New South Wales to north Western Australia.

Remarks : Small shell with angulated shoulder, body whorl spirally corded; outer lip angulated, thickened and contracted with denticles, columella with an inner split tooth and outer denticles, cream coloured shell with dark brown and orange streaks and spots. This species is reported under *P. versi* colour (Sowerby) is synonyms under this species. In South India this species collected large numbers and used in shell craft industries as garlands. Usually occurs name coral reefs.

Genus 68. *Anachis* H. & A. Adams, 1853

124. *Anachis miser* (Sowerby)

1844. *Columbella miser* Sowerby in Leathes MS. *Thes. Conchyl.* 1 (4) :

1972. *Anachis miser* : Cernohorsky, *Marine shells of the Pacific*, 2 : 135, pl. 1, fig. 6.

Material examined : (i) 3 exs., Mithapore, nr. Okha, 14.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above).

Elsewhere : Throughout tropical Pacific.

Remarks : Small acuminate shell sculptured with strong angulated axial ribs, ribs obsolete on dorsal side of body whorl, basal region with a few spiral cords, aperture narrow with dentated outer

lip, columella with obsolete denticles, spiral rows of dark brown irregular blotches found on the white coloured shell.

125. *Anachis sulcosa* (Sowerby)

1832. *Columbella sulcosa* Sowerby, *Proc. Comm. Sci. Zool.*, (19) : 118.

Material examined : (i) 18 exs., Marwad, Daman, 13.ii.1978, coll. B.P.H. and D.R.K.

Distribution : India : Gujarat (as above).

Remarks : Very small slender shell with acuminate spire, sculptured with closed axial ribs, ribs strong but become obsolete on the basal part of body whorl where a few spiral cords are present.

126. *Anachis terpischore* (Sowerby)

1844. *Columbella terpischore* Sowerby in Leathes MS, *Thes. Conchyl.* 1 (4) : 126.

1952. *Pyrene terpischore* : Subramanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 47, fig. 113.

Material examined : (i) 1 ex., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Mithapur, 14.viii.1972, coll. K.V.S.R.; (iii) 1 ex., 3 miles S.E. of Port Okha, 22.i.1953, coll. H.C.R.; (iv) 1 ex., Adatara beach, 10.viii.1972, coll. K.V.S.R.; (v) 1 ex., Okha beach, 13.viii.1972, coll. K.V.S.R.; (vi) 19 exs., Beach opp. to Circuit house, Porbandar, 30.viii.1972, coll. K.V.S.R.; (vii) 1 ex., Chorwad 16.xi.1971, coll. G.C.R. and T.K.S.; (viii) 7 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (ix) 4 exs., Jaleswar, Veraval, 26.iii.1977, coll. K.N.R.; (x) 1 ex., Port area, Veraval, 24.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andhra Pradesh, Maharashtra.

Elsewhere : Iran, Pakistan, Philippines.

Remarks : Small fusiform shell sculptured with strong prominent axial ribs which become obsolete in the narrow basal region of body whorl, a few spiral cords present in basal region, whitish in colour with brown markings.

Genus 69. *Mitrella* Risse, 1826

127. *Mitrella blanda* (Sowerby)

1844. *Columbella blanda* Sowerby, *Thes. Conchyl.*, 1 (4) :

1995. *Mitrella blanda* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 130, fig. 536.

2003. *Mitrella blanda* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 261, pl. 62, figs. 8, 9

Material examined : (i) 82 exs., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (ii) 27 exs., Bhadreswar beach 29.vii.1972, coll. K.V.S.R.; (iii) 16 exs., Kararo Port, ca 9 kms n. of Kandla, 6.viii.1972, coll. K.V.S.R.; (iv) 24 exs., Kutch; (v) 4 exs., Pirotan Is., 18.i.1953, coll. H.C.R.; (vi) 2 exs., Pirotan Is., 19.iv.1977, coll. K.N.R.; (vii) 29 exs., 2 miles from Sikka Port, 13.i.1953, coll. H.C.R.; (viii) 5 exs., Sikka Beach, 19.viii.1972, coll. K.V.S.R.; (ix) 1 ex., Mithapur, 14.viii.1972, coll. K.V.S.R.; (x) 4 exs., Mud flats, Beyt Dwaraka, 12.xi.1968, coll. A.D.; (xi) 11 exs., Balapur Bay, Beyt, 15.viii.1972, coll. K.V.S.R.; (xii) 5 exs., Balapur Bay, Beyt. 13.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above).

Elsewhere : Arabia, Iran, Pakistan.

Remarks : Shell fusiform with acute spire, whorls smooth but with fine spiral grooves at the base, whitish in colour, zig zag brown axial streaks found throughout the shell. On dorsal side & body whorl near suture at middle, a dark brown colour marking is distinct.

Family 35. NASSARIIDAE

Subfamily NASSARIINAE

Genus 70. *Nassarius* Dumeril, 1806

Subgenus *Hima* Leach in Gray, 1852

128. *Nassarius (hima) stolatus* (Gmelin)

1790. *Buccinum stolatum* Gmelin, *Syst. Nat.*, ed. 13 : 3496.

1991. *Nassarius (Hima) Stolatus* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series : Fauna of Orissa 1* (pt. 3) : 71.

2003. *Nassarius (Hima) Stolatus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper. 192* : 267, pl. 65, figs. 8, 9

Material examined : (i) 1 ex., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R., (ii) 6 exs., Bhadreswar, kutch, 29.vii.1972, coll. K.V.S.R., (iii) 4 exs., Sikka beach, 19.viii.1972, coll. K.V.S.E.; (iv) 5 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (v) 2 exs., Mud flat, Beyt Dwaraka, 12.xi.1968, coll. A.D.; (vi) 1 ex., Balapur Bay, 13.iv.1977, coll. K.N.R.; (vii) 3 exs., Okha, Opp. to Fisheries, 10.xi.1968, coll. A.D.

Distribution : India : Gujarat (as above), Andhra Pradesh, Maharashtra, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Gulf of Aden, Indonesia, Japan, Mauritius, Myanmar, Persian Gulf, Philippines, Red Sea, Singapore, Sri Lanka. Commonly found on sandy beaches near river mouth.

Subgenus *Niotha* H. & A. Adams, 1853

129. *Nassarius (niotha) nodiferus* (Powys)

1835. *Nassa nodifera* Powys, *Proc. Zool. Soc. London*, 3 (30) : 95 (Type loc. Gallapagos & Panama, 6-10 fathoms).

1972. *Nassarius (Niotha) nodiferus* : Cernohorsky, *Rec. Auckland Ins. Mus.*, 9 : 153, figs. 69, 70.

2003. *Mitrella blanda* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 269, pl. 64, fig. 4

Material examined : (i) 1 ex., Mundra Mangroves, 27.vii.1872, coll. K.V.S.R., (ii) 1 ex., Kutch, (iii) 2 exs., Pirotan Is., 18.i.1953, coll. H.C.R.; (iv) 8 exs., Pirotan Is., 19 & 20.iv.1977, coll. K.N.R.; (v) 13 exs., Nayabandar, Bedi, 20.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Bedi bandar, 21.viii.1972, coll. K.V.S.R.; (vii) 1 ex., Salaya, 18.viii.1972, coll. K.V.S.R., (viii) 5 exs., Port Sikka, 23.i.1953, coll. H.C.R.; (ix) 9 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R.; (x) 4 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (xi) 1 ex., Miani, 31.x.1971, G.C.R. and T.K.S.; (xii) 1 ex., Porbandar, 30.x.1971, coll. G.C.R. and T.K.S.; (xiii) 2 exs., Navi Bandar, s., 4.xi.1971, coll. G.C.R. and T.K.S.; (xiv) exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (xv) 2 exs., Gogha, 29.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra.

Elsewhere : Hong Kong, Indonesia, Philippines, Singapore.

Remarks : This species has not been recognized as a member of West American fauna and hence the type locality is erroneous (Cernohorsky, 1972).

130. *Nassarius (Niotha) obesus* G. & H. Nevill

1875. *Nassa obesa* G. & H. Nevill, *J. Asiat. Soc. Bengal*, 44 (2) : 95 (type loc. Kutch).

1995. *Nassarius (Niotha) obesus* : Bosch *et al. Sea shells of Arabia*, p. 133, pl. 157.

Material examined : (i) 1 ex., Kutch.

Distribution : India : Gujarat (as above), Maharashtra, Pondicherry.

Elsewhere : Arabia, Iran, Gulf of Oman, Malaysia, Pakistan, Persian Gulf, Singapore, Sri Lanka.

Remarks : A detail description was given by G. & H. Nevill (1875) and a variety was found by them from Penanang and Ceylone (Sri Lanka), which approaches nearer to *N. algida* Reeve.

Subgenus *Plicarcularia* Thiele, 1929

131. *Nassarius (Plicarcularia) pullus* (Linnaeus)

1758. *Buccinum pullus* Linnaeus, *Syst. Nat.* ed. 10 737, no. 396 (type loc. Asiatic Ocean, Bruguere, 1769).

1991. *Nassarius (Plicarcularia) pullus* : Subba Rao *et al., zool Surv. India, State Fauna Series : Fauna of Orissa* 1 (pt. 3) : 73.

2003. *Nassarius (Plicarcularia) pullus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 270, pl. 65, fig. 1, 2

Material examined : (i) 3 exs., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (ii) 3 exs., Pirotan Is., 13.i.1953, coll. H.C.R.; (iii) 2 exs., Pirotan Is., 19 & 20.iv.1977, coll. K.N.R.; (iv) 16 exs., Bhadreswar, Kutch, 29.vii.1972, coll. K.V.S.R.; (v) 4 exs., Sikka Port, 19.viii.1972, coll. K.V.S.R.; (vi) 3 exs., Salaya, 18.viii.1972, coll. K.V.S.R.; (vii) 6 exs., Balapur, 15.viii.1972, coll. K.V.S.R.; (viii) 9 exs., Balapur Bay, 7.iv.1977, coll. K.N.R.; (ix) 3 exs., Hanumandandi, 8.iv.1977, coll. K.N.R.; (x) 3 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman Is., Maharashtra, Orissa, Pondicherry, Tamil Nadu.

Elsewhere : Australia, Madagascar, Mauritius, Philippines, Singapore, Moderately common in tropical western Pacific (Cernohorsky, 1972).

Remarks : This species can easily be identified by its humped dorsum, large columellar callus and slender axial ribs divided into rows of nodules at the sutures. *Nassarius theristes* (Brunnier) and *Nassarius gracilia* (Pseese) are synonyms of this species.

Subgenus *Telasco* H. & A. Adams, 1853

132. *Nassarius (Telasco) gaudiosus* (Hinds)

1844. *Nassa gaudiosus* Hinds, *Zool. Voy. "Sulphur"* p. 36, pl. 9, figs. 16, 17 (type loc. Unknown).

1972. *Nassarius (Telasco) gaudiosus* : Cernohorsky, *Rec. Auckland Inst. Mus.*, 9 : 161, figs. 97, 100-104.

2003. *Nassarius (Telasco) gaudiosus* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 127

Material examined : (i) 1 ex., Porbandar beach, 24.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Jaleswar, Veraval, 26.iii.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is.

Elsewhere : Australia, Fiji Is., Hawaiian Is., Indonesia, Japan, Mauritius, Philippines, Tahiti.

Remarks : The species is variable in colour, creamy white, grey to dark brown ornamented with orange brown spiral lines, spiral bands or chevron shaped spots arranged in horizontal bands (Cernohorsky, 1972).

133. *Nassarius (Telasco) luridus* (Gould)

1849. *Nassa lurida* Gould, *Proc. Bost. Soc. Nat. Hist.*, 33 : 153 (type loc. Tutuila, Samoa, Is.).

1972. *Nassarius (Telasco) luridus* : Cernohorsky, *Rec. Auckland Inst. Mus.*, 9 : 163, figs. 98, 105-107.

2003. *Nassarius (Telasco) luridus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 127

Material examined : (i) 1 ex., Pirotan Is., 13.i.1953, coll. H.C.R.; (ii) 1 ex., Pirotan Is. 20.iv.1977, coll. K.N.R.; (iii) 1 ex., Naya bandar, Bedi, 20.viii.1972, coll. K.V.S.R., (iv) exs., Deeda

Is., 17.i.1953, coll. H.C.R.; (v) 5 exs., Sikka beach, 19.viii.1972, coll. K.V.S.R., (vi) 1 ex., Hanumandandi, 23.i.1953, coll. H.C.R.; (vii) 1 ex., Adatara, 5.iv.1977, coll. K.N.R.; (viii) 1 ex., Muldwaraka e., 22.ii.1970, coll. A.K.N., (ix) 3 exs., Veraval beach, 26.viii.1972. coll. K.V.S.R., (x) 1 ex., Port area, Veraval, 24.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is.

Elsewhere : Australia, Fiji, Philippines, several Pacific Is., (Cernohorsky, 1972).

Remarks : Shell similar in size and colour with shell of the preceeding species except being more inflated with thicker columellar callus and entirely denticulated columella.

Subgenus *Zeuxis* H. & A. Adams, 1853

134. *Nassarius (Zeuxis) foveolatus* (Dunker)

1847. *Buccinum foveolatus* Dunker, *Zeit. f. Malako zool.*, 4 : 63 (type loc. Oriental India).

1991. *Nassarius (Zeuxis) foveolatus* : Subba Rao *et al.* *Zool Surv. India, State Fauna Series : Fauna of Orissa 1* (pt. 3) : 74.

Material examined : (i) 1 ex., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (ii) 2 exs., Nayabandar, Bedi, 20.vii.1972, Coll. K.V.S.R.; (iii) 8 exs., Balapur Bay, 13.iv.1977, coll. K.N.R.; (iv) 2 exs., Somnath beach, 20.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Kerala, Maharashtra, Orissa, Tamil nadu, West Bengal.

Elsewhere : China, Hong Kong, Malaysia, Mauritius, Myanmar, Sri Lanka.

Subfamily DORSANIINAE

Genus 71. *Bullia* Gray in Griffith & Pidgeon, 1843

135. *Bullia (Bullia) melanoides* Deshayes in Belanger

1832. *Bullia melanoides* Deshayes in Belanger,

1995. *Bullia (Bullia) melanoides* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 134, pl. 568.

2003. *Bullia (Bullia) melanoides* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 264, pl. 63, fig. 3

Material examined : (i) 1 ex., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (ii) 1 ex., beach nr. Light house, Mandvi, 28.vii.1972, coll. K.V.S.R.; (iii) 2 exs., Salaya beach, 31.vii.1972, coll. K.V.S.; (iv) 2 exs., Bhadreswar, 29.vii.1972, coll. K.V.S.R.; (v) 34 exs., Muldwaraka, 21.xi.1971, coll. G.C.R. and T.K.S.; (vi) 6 exs., Navibandar, 27.xi.1971, coll. G.C.R. and T.K.S.; (vii) 1 ex., Madhavpur, s., 7.xi.1971, coll. G.C.R. and T.K.S., (viii) 6 exs., Jaleswar, Veraval, 15.xi.1971, coll. G.C.R. and T.K.S.; (ix) 3 exs., Veraval, 19.xi.1971, coll. G.C.R. and T.K.S.; (x) 9 exs., Somnath, 17.xi.1971, coll. G.C.R. and T.K.S.; (xi) 1 ex., Somnath, 25.viii.1972, coll. K.V.S.R. (xii) 46 exs., Sandy beach, Somnath, 29.iii.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Karnataka, Kerala, Tamil Nadu.

Elsewhere : Arabia, Iran, Pakistan.

Remarks : Shell acuminate elongated, axial ribs become obsolete but spiral threads are prominent at base. This species is restricted to sandy shore, exposed during receding waves on the shore.

136. *Bullia (Bullia) otahaitensis* (Bruguiere)

1995. *Bullia (Bullia) otahaitensis* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 135, pl. 569.

Material examined : (i) 1 ex., Jaleswar, Veraval, 15.xi.1971, coll. G.C.R. and T.K.S.; (ii) 1 ex., Somnath, 17.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above).

Elsewhere : Arabia.

Remarks : Shell with elongated spire, whorls rounded with flattened spiral ribs crossed by irregular fine threads, outer lip corrugated. *Bullia tahitiensis* (Gmelin) is synonym to this species (Bosch *et al.*, 1995).

Family 36. MELONGENIDAE

Genus 72. *Pugilina* Schumacher, 1817

Subgenus *Hemifusus* Swainson, 1840

137. *Pugilina (Hemifusus) carnarium* (Roeding)

2003. *Pugilina (Hemifusus) carnarium* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 264, pl. 63, fig. 3

Material examined : (i) 1 ex., Jamnagar, 18.viii.1972, coll. K.V.S.R., (ii) 3 exs., Port Okha, 2.i.1953, coll. H.C.R.; (iii) 1 ex., Porbandar, Jan., 1953, coll. H.C.R.; (iv) 1 ex., Gogla, 27.xi.1971, coll. G.C.R. and T.K.S.

Distribution India : Gujarat (as above).

Remarks : Large heavy shell with short spire, whorls angulate, shoulders strongly coronated, body whorl two rows of coronations, base with spiral cords, columella calloused and smooth.

138. *Pugilina (Hemifusus) cochlidium* (Linnaeus)

1758. *Murex cochlidium* Linnaeus, *Syst. Nat.*, ed. 10 : 753, sp. 482 (type loc. Not given).

1991. *Pugilina cochlidium* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series : Fauna of Orissa 1* (pt. 3) : 68.

2003. *Pugilina (Hemifusus) cochlidium* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 264, pl. 63, fig. 3

Material examined : (i) 2 exs., Salaya, 18.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Jakhau Port, 8.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Andhra Pradesh, Maharashtra, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Australia, China, Indonesia, Malaysia, Persian Gulf, Philippines, Sri Lanka, Singapore.

Remarks : This species can easily be distinguished from the preceding one by its globose bodywhorl with single row of coronation, elongated spire and narrower aperture.

Family 37. VASIDAE

Subfamily TURBINELLINAE

Genus 73. *Turbinella* Lamarck, 1799

139. *Turbinella pyrum* (Linnaeus)

1952. *Xancus pyrum* : Subrahmanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 48, fig. 123.

Material examined : (i) 2 exs., Mithapur, 14.viii.1972, coll. K.V.S.R., (ii) 2 exs., Kutch; (iii) 3 exs., Salaya, 18.viii.1972, coll. K.V.S.; (iv) 2 exs., Port Okha, 22.i.1953, coll. H.C.R.; (v) 2 exs., Porbandar, Jan., 1953, coll. H.C.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra, Tamil Nadu.

Elsewhere : Philippines, Sri Lanka.

Remarks : Subba Rao (2003) gave details of this and its commercial use.

Family 38. OLIVIDAE

Subfamily OLIVINAE

Genus 74. *Oliva* Bruguiere, 1789

140. *Oliva oliva* (Linnaeus)

1758. *Voluta oliva* Linnaeus, *Syst. Nat.*, ed. 10 : 729, sp. 350 (type loc. M. Indico).

1991. *Oliva oliva* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa*, 1 (Pt. 3) : 77.

2003. *Oliva oliva* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ. Paper No. 192* : 291, pl. 71, fig. 2, pl. 74, fig. 4

Material examined : (i) 1 ex., Gogha, E., 12.ii.1970, coll. A.K.N.; (ii) 20 exs., Muldwaraka, 21.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Andhra Pradesh, Lakshadweep, Pondicherry, Maharashtra, Orissa, Tamil nady.

Elsewhere : Tropical Indo-Pacific, Queensland.

Remarks : Shell inflated, with short spire, columella not concavely depressed, sturo coneliculato aperture narrow elongated and extended almost upto the length of body whorl.

Colour variation of this species resulted a series of synonyms (Cernohorsky, 1967). *Oliva ispidula* reported are synonym of this specimen.

141. *Oliva undata* Lamarck

1845. *Oliva undata* Lamarck, *Hist. Nat. Anim. Sans. Vert.* (Deshayes ed.) 10

Material examined : (i) 28 exs., Kutch.

Distribution : India : Gujarat (as above),

Elsewhere : Sri Lanka.

Remarks : Shell heavy, gibbous with depressed spire, columella white and plicate, anterior end of columella with a claw like callus, posterior with a few grooves and a prominent plate like oblique fold, ornamented with brown zigzag lines and zones on creamy white body whorl. It is recorded from India for the first time.

Subfamily AGARONIINAE

Genus 75. *Agaronia* Gray, 1839

142. *Agaronia nebulosa* (Lamarck)

1845. *Oliva nebulosa* Lamarck, *Hist. Nat. Anim. Sans. Vert.* (Deshayes ed.) 10 : 628.

1991. *Agaronia nebulosa* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa* 1 (pt. 3) : 77, 78.

2003. *Agaronia nebulosa* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ. Paper No. 192* : 293, pl. 72, fig. 5

Material examined : (i) 1 ex., Pirotan Is., Gulf of Kutch, 20.iv.1977, coll. K.V.S.R.; (ii) 10 exs., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (iii) 6 exs., Mithapur, nr. Okha, 14.viii.1972, coll. K.V.S.R.; (iv) 2 exs., Port Okha, 21.i.1953, coll. H.C.R.; (v) 1 ex., Okha beach, 13.viii.1972, coll. K.V.S.R.; (vi) 2 exs., Muldwaraka, 21.xi.1971, coll. G.C.R. and T.K.S., (vii) 9 exs., Navibandar, 27.xi.1971, coll. G.C.R. and T.K.S.; (viii) 34 exs., Umbargaon, 12.ii.1978, coll. B.P.H. and D.R.K.

Distribution : India : Gujarat (as above), Goa, Maharashtra, Orissa, Tamil Nadu.

Elsewhere : Indian Ocean, Indonesia, Pakistan, Sri Lanka.

Remarks : Shell less inflated and slender with acuminate spire, columella mostly straight, aperture not extended upto the length of body whorl. Lower half of body whorl with a band. This species is very common in Gujarat coast.

Subfamily ANCILLINAE

Genus 76. *Amalda* H. & A. Adams, 1853

143. *Amalda albifasciata* (Sowerby)

Material examined : (i) 4 exs., Tuna creek, Kutch, 4.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above).

Remarks : Two are juveniles and the rest two shells are moderate, elongate ovate; sutures covered with callous, columella highly twisted, aperture broad, colour dirty white.

144. *Amalda ampla* (Gmelin)

1791. *Voluta ampla* Gmelin, *Syst. Nat.*, ed. 13 : 3467 (type loc. Not known).

1992. *Amalda ampla* : Subba Rao *et al.*, *zool. Surv. India, State Fauna Series, Fauna of Orissa 1* (pt. 3) : 78.

2003. *Amalda ampla* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 298, pl. 71, figs. 4, 5; pl. 72, fig. 6, 7

Material examined : (i) 5 exs., Balapur Bay, Beyt Is., 3.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Orissa, Tamil Nadu, West Bengal.

Elsewhere : Red Sea, Sri Lanka.

Remarks : It is common on the east coast but reported from the West Coast for the first time.

Family 39. MITRIDAE

Subfamily MITRINAE

Genus 77. *Mitra* Lamarck, 1798 Subgenus s.s.

145. *Mitra (Mitra) guttata* Swainson

1824. *Mitra guttata* Swainson, *Quat. J. Sci. Art.*, 17 (33) : 35, (type loc. Not known).

1984. *Mitra (Mitra) guttata* : Subba Rao and Dey, *Rec. zool. Surv. India, Occ. Paper No. 61* : 7, pl. 1, fig. 4.

2003. *Mitra (Mitra) guttata* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 301, pl. 74, fig. 3

Material examined : (i) 1 ex., Porbandar, Kathiawar, January, 1953, coll. H.C.R.; (ii) 2 exs., beach opp. to Circuit house, Porbandar, 24.viii.1972, coll. K.V.S.R., (iii) 3 exs., Subhashnagar, nr. Porbandar, coll. K.V.S.R.; (iv) 1 ex., Porbandar beach, 29.viii.1972, coll. K.V.S.R.; (v) 1 ex., Navibandar s., 4.xi.1971, coll. G.C.R. and T.K.S.; (vi) 1 ex., Jaleswar, nr. Veraval, 15.xi.1971, coll. G.C.R. and T.K.S., (vii) 1 ex., Jaleswar, nr. Veraval, 21.i.1978, coll. B.P.H., (viii) 8 exs., Veraval beach, 26.8.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra, Pondicherry.

Elsewhere : Madagascar to Sri Lanka.

Remarks : Shell fusiform, sutures deep, whorls seven in number, aperture longer, columella with five oblique folds.

Subgenus *Nebularia* Swainson, 1840

146. *Mitra (Nebularia) aurantia aurantia* (Gmelin)

1792. *Voluta aurantia* Gmelin, *Syst. Nat.*, ed. 13 : 3454 No. 60, (refers Chemnitz *Conch. Cab. 4* : pl. 150, figs. 1393, 1394) (type loc. Not given).

1984. *Mitra (Nebularia) aurantia aurantia* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper No. 61* : 11, fig. 1.

1991. *Mitra (Nebularia) aurantia aurantia* : Subba Rao & Surya Rao, *Zool. Surv. India, State Fauna Series, Fauna of Lakshadweep, 2* : 333.

2003. *Mitra (Nebularia) aurantia aurantia* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 302, pl. 74, figs. 7, 8

Material examined : (i) 1 ex., Lamba, Kathiawar, coll. H.C. Roy, 1953; (ii) 3 exs., Subhashnagar, Porbandar, 28.viii.1972, coll. K.V.S.R.; (iii) 4 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Andaman & Nicobar Is., Lakshadweep.

Elsewhere : Indo-Pacific.

Remarks : Shell fusiform, sutures deep, whorls six in number longer, columella with four folds, outer lip crenulated and with a shallow notch at the upper part, with 12-14 are nulations, orange or chocolate brown colour.

147. *Mitra (Nebularia) aurantia subruppeli*
Finlay

1927. *Mitra subruppeli* Finlay, *Trans. Proc. New Zealand Inst.*, **57** : 508. (substitute name for *M. multisulcata* Sowerby, 1914) (type loc. Karachi, Pakistan).

1985. *Mitra (Nebularia) aurantia subruppeli* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper No.* **61** : 11. pl. 1, fig. 8.

2003. *Mitra (Nebularia) aurantia subruppeli* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ. Paper No.* **192** : 302, pl. 74, fig. 6

Material examined : (i) 2 exs., Dwaraka, 4.i.1953, coll. H.C.R.; (ii) 1 ex., Porbandar, nr. Port, 29.viii.1972, coll. K.V.S.R., (iii) 2 exs., Navibandar, N. & S., 2 & 4.xi.1971, coll. G.C.R. and T.K.S.; (iv) 1 ex., Veraval, 31.i.1953, coll. H.C.R.; (v) 1 ex., Delvada, 27.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Goa.

Elsewhere : Indo-Pacific.

Remarks : This elongate ovate form can be distinguished from the preceeding one by its thick and smooth outer lip.

Subgenus *Strigatella* Swainson, 1840

148. *Mitra (Strigatella) scutulata* (Gmelin)

1971. *Voluta scutulata* Gmelin, *Syst. Nat.* ed. **13** : 3452 (refers to Chemnitz, *Conch. Cab.*, figs. 1428, 1429).

1984. *Mitra (Strigatella) Scutulata* : Subba Rao & Dey, *Rec. zool. Surv. India, Occ. Paper No.* **61** : 29, pl. II, fig. 21.

1991. *Mitra (Strigatella) scutulata* : Surya Rao and Subba Rao. *Zool. Surv. India, State Fauna Series, Fauna of Lakshadweep*, **2** : 338.

2003. *Mitra (Strigatella) scutulata* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ. Paper No.* **192** : 304, pl. 76, fig. 3

Material examined : (i) 2 exs., Gulf of Kutch, Sikka Port, coll. H.C.R.; (ii) 1 ex., Hanumandandi, 23.i.1953, coll. H.C.R.; (iii) 4 exs., Okha, beach, 13.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Okha beach, 9.iv.1977, coll. K.V.S.R.; (v) 3 exs., Shore nr. Rest House, Dwaraka, 24.i.1953, coll. H.C.R.; (vi) 2 exs., Madhi, 1.xi.1971, coll. G.C.R. and T.K.S.; (vii) 1 ex., Miani, 31.x.1971, coll. G.C.R. and T.K.S.; (viii) 43 exs., Beach opp. to Circuit house, Porbandar, 24 & 30.viii.1972, coll. K.V.S.R.; (ix) 4 exs., Subhashnagar nr. Porbandar, 28.viii.1972, coll. K.V.S.R.; (x) 1 ex., Navibandar, s., 4.xi.1971, coll. G.C.R. and T.K.S.; (xi) 1 ex., Mangrol, 11.xi.1971, coll. G.C.R. and T.K.S., (xiii) 2 exs., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S., (xiv) 1 ex., Veraval beach, coll. A.D.; (xv) 4 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R., (xvi) 1 ex., Jaleswar, Veraval, 21.i.1978, coll. B.P.H.; (xvii) 1 ex., Sil, 12.xi.1971, coll. G.C.R. and T.K.S.; (xviii) 3 exs., Kotda, 24.xi.1971, coll. G.C.R. and T.K.S.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Goa, Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Tropical Indo-Pacific.

Remarks : Shell elongate ovate, whorls seven to eight in number, length of aperture nearly twice than that of spire, columella with four folds, outer lip not crenulated. Chocolate brown (yellow band) interrupted with below suture of each whorl.

Family 40. COSTELLARIIDAE

Genus 78. *Vexillum* Roeding, 1798

149. *Vexillum sculptilis* (Reeve)

1845. *Mitra sculptilis* Reeve. *Conch. Icon.*, **2** : *Mitra* sp. No. 290

1954. *Costellaria sculptilis* Var. *interviewi* Ray, *Mem. Indian Mus.*, **14** (1) : 12, pl. 1, fig. 3.

2000. *Vexillum sculptilis* Subba Rao and Dey. *Rec. zool. Surv. India, Occ. Paper No.* **187** : 156.

Material examined : (i) 1 ex., Mandvi beach, 25.vii.1972, coll. K.V.S.R.; (ii) 4 exs., Pirotan Is., Gulf of Kutch, 18.i.1953, coll. H.C.R.; (iii) 1 ex., Nayabandar, Bedi, 20.viii.1972, coll. K.V.S.R.; (iv) 3 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (v) 1 ex., Adatara beach, 10.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Danda, 3 kms n. of Port Okha, 14.i.1963, coll. H.C.R.; (vii) 1 ex., Veraval, Port area, 24.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andamans.

Remarks : Shell fusiformly elongate, whorls seven in number and sculptured with prominent angulate axial ribs, interstices spirally grooved, base of body whorl obliquely corded, aperture not longer than spire, narrow and lirated.

Family 41. CANCELLARIIDAE

Subfamily CANCELLARIINAE

Genus 79. *Scalptia* Jousseume, 1887

150. *Scalptia scalariformis* (Lamarck)

1822. *Cancellaria scalariformis* Lamarck, *Hist. Nat. Anim. Sans Vert.*, 7 : 113.

1992. *Scalptia Scalariformis* : Subba Rao *et al.*, *zool. Surv. India, State Fauna Series Fauna of West Bengal*, 3 (pt. 9) : 196, pl. 8, fig. 8.

Material examined : (i) 1 ex., Okha beach, S. of Port, 21.i.12953, coll. H.C.R.; (ii) 1 ex., Rozy port nr. Jamnagar, 22.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, West Bengal.

Elsewhere : Ranges Westward from the western Pacific.

Remarks : Whorls angulate and sculptured with prominent angulate axial ribs, ribs spinose at the suture, aperture narrow, outer lip lirated, columella calloused with three oblique folds, base of columella recurved towards the aperture. This species is reported from the west coast of India for the first time.

Family 42. CONIDAE

Genus 80. *Conus* Linnaeus, 1758

151. *Conus angulatus* A. Adams

1853. *Conus angulatus* A. Adams, *Proc. Zool. Soc. London* : 118

Material examined : (i) 3 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (ii) 4 exs., Balapur Bay, Beyt Is., 13.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above).

Remarks : Shell small with acuminate spire, shoulders with a series of small beads below the sutures, whorls sculptured with transverse grooves.

152. *Conus biliosus* (Roeding)

1792. *Conus punctatus* Hwass in Bruguiere, *Encycl. Moth. Vera.*, 1 : 628 (Non *C. punctatus* Gmelin).

1798. *Cucullus biliosus* Roeding, *Museum Boltenianum*, p. 39.

1978. *Conus biliosus* Kohn, *J. nat. Hist.*, 12 : 305, fig. 28

1995. *Conus biliosus* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 158, pl. 692.

2000. *Conus biliosus* : Subba Rao and Dey. *Rec. zool. Serv. India, Occ. Paper No. 187* : 160.

Material examined : (i) 9 exs., Subhashnagar beach, Porbandar, Coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh, Andaman & Nicobar Is., Maharashtra Tamil Nadu.

Elsewhere : Arabia, Persian Gulf, South African coast. Widely distributed Indo-west Pacific (Kohn, A.J. 2001).

Remarks : Heavy shell with slightly coronated spire, shoulder with heavy spiral ridges, spiral rows of brown spots present on body whorl.

153. *Conus coronatus* Gmelin

1791. *Conus coronatus* Gmelin, *Syst. Natu.* Ed. 13 : 389 (type loc. Not given).

1995. *Conus coronatus* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 159, pl. 696.

2000. *Conus coronatus* : Subba Rao and Dey. *Rec. zool. Serv. India, Occ. Paper No. 187* : 162.

2003. *Conus coronatus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 314, pl. 83, fig. 7

Material examined : (i) 1 ex., Okha beach, 13.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep, Maharashtra, Tamil Nadu.

Elsewhere : Throughout tropical Indo-west Pacific (Kohn, A.J. 2001).

Remarks : Heavy shell globosely ovate, with short spire, shoulder coronated lightly.

154. *Conus flavidus* Lamarck

1810. *Conus flavidus* Lamarck, *Ann. Du Museum*, 14 : 264.

1995. *Conus flavidus* : Bosch *et al.*, *Sea shells of Arabia*, p. 159, pl. 699.

2000. *Conus flavidus* : Subba Rao and Dey. *Rec. zool. Serv. India, Occ. Paper No. 187* : 163

2003. *Conus flavidus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 316

Material examined : (i) 1 ex., Mithapur nr. Okha, 14.viii.1972, coll. K.V.S.R., (ii) 1 ex., Subhashnagar beach, Porbandar, 28.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andamans.

Elsewhere : African coast, Amirantes, Arabia, Indonesia, Mocambique, Persian Gulf, Queensland, Reunion, Sri Lanka.

Remarks : Heavy shell with short spire, white spiral bands present on yellowish body whorl.

155. *Conus lentiginosus* Reeve

1952. *Conus lentiginosus* : Subramanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 53, fig. 157.

Material examined : (i) 2 exs., Mandvi beach nr. Okha Rest house, 25.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Mithapur nr. Okha, 14.viii.1972, coll.

K.V.S.R.; (iii) 2 exs., Hanumandandi, Beyt Is., nr. Okha, 12.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Hanumandandi, 8.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Maharashtra.

Elsewhere : Malacca.

Remarks : This moderately common species is found in shallow water (Abbott and Dance, 1982). Restricted to Indian ocean (Kohn, A.J. 2001).

156. *Conus lividus* Hwass in Bruguiere

1792. *Conus lividus* Hwass in Bruguiere, *Encycl. Meth. Vera.*, 1 (2) : 630.

1995. *Conus lividus* : Bosch *et al.*, *Sea shells of Eastern Arabia*. P. 160, pl. 704.

2000. *Conus lividus* : Subba Rao and Dey. *Rec. zool. Serv. India, Occ. Paper No. 187* : 165

2003. *Conus flavidus* : Subba Rao. *Rec. zool. Surv. India, Occ Paper No. 192* : 317, pl. 82, fig. 6

Material examined : (i) 1 ex., shore at low tide, Port Okha, Kathiawar, 21.i.1953, coll. H.C.R.; (ii) 1 ex., Muldwaraka e., 22.ii.1970, coll. A.K.N.

Distribution : India : Gujarat (as above), Kerala, Pondicherry, Tamil Nadu.

Elsewhere : Tropical Indo-Pacific, Queensland to north Western Australia.

Remarks : Heavy shell conically elongated with short coronated spire, shoulder also coronated. Rows of raised dots are found on the base.

157. *Conus monile* Hwass in Bruguiere

1792. *Conus monile* Hwass in Bruguiere, *Encycl. Meth. Vers.*, 1 : 646

1978. *Conus monile* : Kohn. *J. nat. Hist.* 12 : 316, fig. 57

1995. *Conus monile* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 162, pl. 711.

2000. *Conus monile* : Subba Rao and Dey. *Rec. zool. Serv. India, Occ. Paper No. 187* : 166

Material examined : (i) 1 ex., Madhavpur n., 6.xi.171, coll. G.C.R., and T.K.S.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Sri Lanka.

Remarks : This uncommon species is found in moderately deep water (Abbott and Dance, 1982).

158. *Conus piperatus* Dillwyn

1952. *Conus piperatus* : Subramanyam *et al.*, *J. Univ. Bombay*, **21** (3) : 53, fig. 156.

2003. *Conus piperatus* : Subba Rao. *Rec. zool. Surv. India, Occ Paper 192, Indian Sea Shells*, pt. 1 : 319, pl. 82, fig. 4

Material examined : (i) 1 ex., Mithapur nr. Okha, 14.viii.1972, coll. K.V.S.R., (ii) 2 exs., Madhi, 1.xi.1971, coll. G.C.R., and T.K.S.; (iii) 7 exs., Madhavpur, 6 & 7.xi.1971, coll. G.C.R. and T.K.S.; (iv) 1 ex., Veraval, 27.xi.1968, coll. A.D.; (v) 3 exs., Bedia (veraval), 19.xi.1971, coll. G.C.R. and T.K.S.; (vi) 5 exs., Veraval, 26.viii.1972, coll. K.V.S.R., (vii) 2 exs., Jaleswar, 18.xi.1971, coll. G.C.R. and T.K.S., (viii) 3 exs., Jaleswar, 26.iii.1971, coll. K.N.R.; (ix) 1 ex., Jaleswar, 21.i.1978, coll. B.P.H.; (x) 5 exs., Navibandar N., & S., 2 & 4.xi.1971, coll. G.C.R. and T.K.S., (xi) 3 exs., Porbandar, 30.x.1971, coll. G.C.R. and T.K.S.; (xii) 44 exs., Porbandar, 24, 28 & 30.viii.1972, coll. K.V.S.; (xiii) 15 exs., Subhashnagar beach, 28.viii.1972, coll. K.V.S.R., (xiv) 2 exs., Somnath, 17.xi.1971, coll. G.C.R. and T.K.S., (xv) 2 exs., Dwaraka, 11.viii.1972, coll. K.V.S.R., (xvi) 1 ex., Kotda, 24.xi.197, coll. G.C.R. and T.K.S.; (xvii) 1 ex., 3.xi.1971, coll. G.C.R. and T.K.S.; (xviii) 1 ex., Pata, 8.xi.1971, coll. G.C.R. and T.K.S.; (xix) 1 ex., Sil, 12.xi.1971, coll. G.C.R. and T.K.S., (xx) 3 ex., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S.; (xxi) 3 exs., Holiday camp, Chorwad, 23.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Maharashtra.

Remarks : Shell large, brown in colour, spire much depressed. This species is common on west coast. This species is rare in Andamans (Subba Rao, 2003).

Family 43. TURRIDAE

Subfamily TURRINAE

Genus 81. *Gemmula* Weinkauff, 1875

Subgenus *Unedogemmula* Macveil, 1960

159. *Gemmula (Unedogemmula) deshayesii* Doumet

1839. *Pleurotoma deshayesii* Doumet, *Rev. zool. (Soc. Cuv.)* **2** : 325

1840. *Pleurotoma deshayesii* Doumet, *Guerin's Mag. Zool. Anat. Comp. & Zool.*, Pl. 11, (title page dated 1840, plate 1840), (type loc. 'Mers de la Chine').

1964. *Gemmula (Unedogemmula) deshayesii* : Powell. *Indo-Pacific Mollusca*, **1**(5) : 270, pl. 175, figs. 7, 8, pl. 210, figs. 1, 2.

1982. *Gemmula deshayesii* : Abbott & Dance, *Compendium of Sea shells*, p. 238, fig.

2003. *Unedogemmula deshayesii* : Subba Rao. *Rec. zool. Surv. India, Occ Paper No. 192* : 332

Material examined : (i) 1 ex., Nayabandar, Bedi, 21.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above),

Elsewhere : China, Hong Kong, Japan.

Remarks : Kiener (1839-40) & Reeve 1840) erroneously identified the species as *indica* Deshayes, 1832 (Powell, 1964).

Genus 82. *Lophitoma* Casey, 1904

160. *Lophitoma indica* (Roeding)

1798. *Turris indica* Roeding, *Museum Bolteniannum*, p. 124 (refers Martini Chemnitz, pl. 145, figs. 1345, 1346 (type loc. Unknown).

1964. *Lophiotoma (Lophioturris) indica* : Powell, *Indo-Pacific Mollusca*, **1** (5) : 311, pl. 175, figs. 2, 3. 9. 16.

1995. *Lophiotoma indica* : Bosch, *et al.*, *Sea Shells of Eastern Arabia*, p. 169, pl. 754.

Material examined : (i) 4 exs., off Gujarat coast, 44 fms., coll. Marine Survey.

Distribution : India : Gujarat (as above), Andamans, Andhra Pradesh, Kerala,

Lakshadweep, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : Arabia, China, Persian Gulf, Sri Lanka, Australia and Fiji.

Remarks : Powell (1964) gave a detailed synonymy of this species.

Subfamily DRILLIINAE

Genus 83. *Clavus* Montfort, 1810

161. *Clavus unizonalis* (Lamarck)

1822. *Pleurotoma unizonalis* Lamarck, *Hist. Nat. Anim. Sans. Vert.*, 7 : 92.

1982. *Clavus unizonalis* : Abbott & Dance, *Compendium of sea shells*, p. 242, fig.

2000. *Clavus unizonalis* : Subba Rao and Dey. *Rec. zool. Serv. India, Occ. Paper No. 187* : 171

Material examined : (i) 1 ex., Okha beach, 13.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Mithapur nr. Okha, 16.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andamans.

Elsewhere : Kenya, Philippines, Western Pacific.

Remarks : Small shell with elongated acuminate spire, sculptured with axial nodules, aperture short and narrow, siphonal canal broad and open.

Genus 84. *Inquisitor* Hedley, 1918

162. *Inquisitor flavidulus* (Lamarck)

1995. *Inquisitor flavidulus* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 167. pl. 740.

Material examined : (i) 1 ex., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Nayabandar, 20.viii.1972, coll. K.V.S.R.; (iii) 1 ex., Bhadreswar, 29.vii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above).

Elsewhere : Arabian Sea, China, Japan, Red Sea, Singapore.

Remarks : Thick fusiform shell with prominent axial ribs on whorls encircled by unequal ridges.

Subfamily TURRICULINAE

Genus 85. *Turricula* Schumacher, 1817

163. *Turricula javana* (Linnaeus)

1767. *Murex javanus* Linnaeus, *Syst. Nat.*, ed. 12, sp. 550, p. 122 (type loc. Unknown).

1991. *Turricula javana* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa*, 1 (pt. 3) : 85.

2003. *Conus flavidus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 324, pl. 64, figs. 8, 9

Material examined : (i) 5 exs., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Salaya beach nr. Mandvi, 31.vii.1972, coll. K.V.S.R., (iii) 2 exs., Bhadreswar beach, Kutch, 29.vii.1972, coll. K.V.S.R., (iv) 1 ex., Adatara beach nr. Okha, 10.viii.1972, coll. K.V.S.R.; (v) 3 ex., Mithapur nr. Okha, 14.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Balapur Beyt. 13.ix.1977, coll. K.N.R.; (vii) 1 ex., Chorwad, 16.xi.1971, coll. G.C.R. and T.K.S.; (viii) 1 ex., Veraval trawl grounds, 26.xi.1968, coll. A.D.; (ix) 2 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.; (x) 1 ex., Gopnath nr. Bhavnagar, 1.ii.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Goa, Kerala, Maharashtra, Orissa, Pondicherry, Tamil Nadu, West Bengal.

Elsewhere : China, Indochina, Indonesia, Pakistan, Philippines, Sri Lanka, Tanzania, Thailand, Timor.

164. *Turricula nelliae spuria* (Hedley)

1922. *Inquisitor spurius* Hedley, *Rec. Austr. Mus.*, 13 (6) : 245 nom. Nuv. For *Pleurotoma tuberculata* Gray, 1839.

1964. *Turricula nelliae spurius* : Powell, *Indo-Pacific Mollusca*, 2 (10) : 238, pl. 197, figs. 2-7.

Material examined : (i) 4 exs., Kutch.

Distribution : India : Gujarat (as above), Goa, Maharashtra.

Elsewhere : Persian Gulf to China Seas (Powell, 1964).

Remarks : Periphery of whorls with nodulous keels and nodulous subsutural cords, spiral threads are fine on whorls but beaded on last whorls.

165. *Turricula tornata fulminata* (Kiener)

1839-40. *Pleurotoma fulminata* Kiener, *Congu- illes Vivantes*, 5, *Pleurotoma* : 21, pl. 10, fig. 2 (type loc. Ocean Indian).

1991. *Turricula tornata fulminata* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of Orissa* 1 (pt. 3) : p. 84.

2003. *Turricula tornata tornata* : Subba Rao *et al.*, *Rec. zool. Surv. India, Occ Paper No. 192* : 325, pl. 84, figs. 5, 6

Material examined : (i) 1 ex., Rukmavati river mouth, Mandvi, 26.vii.1972, coll. K.V.S.R.; (ii) 1 ex., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (iii) 14 exs., littoral zone, 3 miles s.e. of Port Okha, 22.i.1953, coll. H.C.R.

Distribution : India : Gujarat (as above), Goa, Karnataka, Maharashtra, Lakshadweep, Orissa.

Elsewhere : Persian Gulf, Arabian Sea to West coast of Southern India.

Family 44. TEREBRIDAE

Genus 86. *Diplomeriza* Dall, 1919

166. *Diplomeriza duplicata* (Linnaeus)

1758. *Buccinum duplicatum* Linnaeus, *Syst. Nat.*, ed. 10 : 758, ed. 12 : 1206.

1961. *Duplicaria duplicata* : Menon *et al.*, *Sea shells of Eastern Arabia*, p. 490, pl. 9, fig. 77

1995. *Duplicaria duplicata* : Bosch, *et al.* *Sea shells of Eastern Arabia*, p. 170, pl. 758.

2000. *Diplomeriza duplicata* : Subba Rao and Dey. *Rec. zool. Serv. India, Occ. Paper No. 187* : 163

2003. *Duplicaria duplicata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 319, pl. 87, fig. 3 and pl. 89, figs. 6, 7

Material examined : (i) 1 ex., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (ii) 1 ex.,

Hanumandandi, Beyt Is., 12.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Tamil Nadu, Maharashtra, Pondicherry.

Elsewhere : East Indies, Gulf of Oman, Madagascar, New Caledonia, Singapore, West Pacific.

Remarks : Shell turreted, large, brown with close-set vertical ribs traversed by prominent groove at each whorl.

Genus 87. *Hastula* H.A. Adams, 1853

167. *Hastula tenera* (Hinds)

1843. *Terebra tenera* Hinds, *Proc. Zool. Soc. London*, : p. 158.

1952. *Terebra tenera* : Subramanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 55, fig. 169.

1992. *Terebra tenera* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series, Fauna of West Bengal*, 3 (Pt. 9) : p. 200.

Material examined : (i) 3 exs., Bhadreswar, Kutch, 29.vii.1972, coll. K.V.S.R.; (ii) 2 exs., N. Kandla, 6.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Tamil Nadu, West Bengal.

Elsewhere : Pakistan, Sri Lanka, Malacca.

Remarks : Shell small, polished with darkish spiral bands, ribs transpiral.

Family 45. ARCHITECTONICIDAE

Genus 88. *Architectonica* Roeding, 1798

168. *Architectonica laevigata* (Lamarck)

1822. *Solarium laevigatum* Lamarck, *Hist. Nat. anim. Sans Vert.*, 7 : 3 (type loc. Not given).

1961. *Architectonica laevigata* : Menon *et al.*, *Sea shells of Eastern Arabia*, p. 482, pl. 4, figs. 32, 33

1991. *Architectonica laevigata* : Subba Rao *et al.*, *Zool. Surv. India, State Fauna Series 1 : Fauna of Orissa* (pt. 3), p. 40.

2003. *Duplicaria duplicata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 340, pl. 90, fig. 4

Material examined : (i) 1 ex., Sikka Port, 19.i.1953, coll. H.C.R.; (ii) 1 ex., Port Okha, 19.i.1953, coll. H.C.R.; (iii) 1 ex., Hanumandandi, 23.i.1953, coll. H.C.R.; (iv) 5 exs., Lamba shore, 28.i.1953, coll. H.C.R.; (v) 1 ex., Mithapur, 14.viii.1972, coll. K.V.S.R.; (vi) 1 ex., Muldwaraka e., 22.ii.1970, coll. A.K.N.; (vii) 1 ex., Miani beach, 27.viii.1972, coll. K.V.S.R.; (viii) 2 exs., Subhashnagar beach nr. Porbandar, 28.viii.1972, coll. K.V.S. R.; (ix) 3 exs., Veraval beach, 26.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Orissa, Pondicherry and Karaikal, Tamil Nadu.

Elsewhere : Iran, Myanmar, Pakistan, Persian Gulf, South Africa.

Remarks : Shell depressedly conical, margin angulate whorls fortyfive, flat ridges crassed by axid growth lines, blotches of pinkish purple, orange brown or yellowish brown, boards broken unit blotches, last with brown radial marking.

Genus 89. *Heliacus* Orbigny, 1842

169. *Heliacus dorsuosus* (Hinds)

1844. *Solarium dorsuosum* Hinds, *Proc. Zool. Soc. London*, 12 : 23 (type loc. Puerta Galero, Island of Mindoro, Philippines).

1982. *Torinia dorsuosa* : Rajagopal and Mookherjee, *Rec. zool. Surv. India, Occ. Paper No. 28*, p. 23.

2003. *Heliacus dorsuosus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 341

Material examined : (i) 1 ex., Hanumandandi, Beyt Is., 23.i.1953, coll. H.C.R.; (ii) 6 exs., Subhashnagar, Porbandar, 20.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andaman Is., Pondicherry, Tamil Nadu.

Elsewhere : Madagascar, Philippines, Sri Lanka.

Remarks : Disc like shell with broad crenulated umbilicus, margins of the shell is with two prominent ridges and a channel in between. Tryon (1887)

and Satyamurti (1952) have given adequate description.

Subclass OPISTHOBRANCHIA

Order CEPHALASPIDEA

Family 46. HYDATINIDAE

Genus 90. *Hydatina* Schumacher, 1817

170. *Hydatina physis* (Linnaeus)

1758. *Bulla physis* Linnaeus, *Syst. Nat. ed. 10* : 727

1995. *Hydatina physis* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 180, pl. 830.

Material examined : (i) 1 ex., littoral zone, N.W. of Port Okha, 21.i.1953, coll. H.C.R.; (ii) 1 ex., Lamba shore, 56 kms from Porbandar, 28.i.1953, coll. H.C.R.; (iii) 4 exs., Veraval Beach, 27.xi.1968, coll. A.D.

Distribution : India : Gujarat (as above).

Elsewhere : Arabia, Hawaiian Is., Japan, New Zealand, Queensland, Indo-Pacific (Powell, 1976).

Remarks : Shell thin, smooth and globose encircled by brown lines, spire depressed, aperture large.

171. *Hydatina zonata* (Lightfoot, 1786)

1791. *Bulla velum* Gmelin, *Syst. Nat.*, ed., 13, p. 3433

1952. *Hydatina velum* : Satyamurty, *Bull. Madras Govt. Mus.*, n.s. 1(2) pt. 6, p. 217, pl. 21, figs. 7a & 7b.

1961. *Hydatina velum* : Menon *et al.*, *Sea shells of Eastern Arabia*, p. 491, pl. 10, figs. 32, 33

2003. *Hydatina zonata* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 349, pl. 93, fig. 3, 4

Material examined : (i) 1 ex., off Porbandar, 2.ix.1977, coll. K.N.R.

Distribution : India : Gujarat (as above). Pondicherry, Tamil Nadu.

Remarks : Shell this, avoid spire Sunkun, aperture wide, cream in colour with two dark brown bandson either side of white band in the middle, lower part with white band *velum* Gmelin is synonym of this species.

Family 47. BULLIDAE

Genus 91. *Bulla* Linnaeus, 1758172. *Bulla ampulla* Linnaeus

1758. *Bulla ampulla* Linnaeus, *Syst. Nat.*, ed. 10, p. 727
 1961. *Bulla ampulla* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58** (2) : 491, pl. 10, fig. 78
 1995. *Bulla ampulla* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 179, pl. 823.
 2003. *Bulla ampulla* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 352, pl. 93, fig. 9

Material examined : (i) 5 exs., Danda, 3 kms N. of Sikka Port, Gulf of Kutch, 14.i.1953, coll. H.C.R., (ii) 1 ex., Pirotan Is., 20.ix.1977, coll. K.N.R.; (iii) 1 ex., Mithapur nr. Okha, 14.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Lakshadweep, Maharashtra, Pondicherry, Tamil Nadu.

Elsewhere : Arabia, Amirantes, Fiji, Malagasy, Mauritius, Pakistan, Philippines, Red Sea, Reunion, South Africa, Viti.

Remarks : Shell broadly oval, thick, inflated, and of moderate size, spire sunken, aperture narrow above and expanded below, columella with a white smooth callus; outer lip extends anteriorly. Surface smooth and polished method with chocolate brown markings.

Family 48. HAMINEIDAE

Subfamily HAMINEINAE

Genus 92. *Haminea* Turton & Kingston in Carrington, 1830173. *Haminea elegans* Leach

1852. *Haminea elegans* Leach in Gray, *A synopsis of the Mollusca of Great Britain*, p. 42.
 2003. *Haminea elegans* : Subba Rao, *Rec. zool. Surv. India, Occ. Paper No. 192* : 355, pl. 94, fig. 1

Material examined : (i) 50 exs., Danda, 3 kms N of Sikka Port, 14.i.1953, coll. H.C.R.; (ii) 10 exs., Bhadreswar, Kutch, 29.vii.1972, coll. K.V.S.R.; (iii) 3 exs., Salaya, Jamnagar, 18.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Pirotan Is., 19.iv.1977, coll. K.N.R.; (v) 1 ex., Subhashnagar, nr. Porbandar, 20.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Andhra Pradesh.

Remarks : Shell small, thin, spire sunken, aperture narrow above and wide below; columella short with reflected callous, outer lip thin and smooth.

Subclass GYMNOMAPHE

Order SYSTELLOMMATIPHIRA

Superfamily ONCHIDIOIDEA

Family 49. ONCHIDIIDAE

Genus 93. *Onchidium* Buchanan, 1800174. *Onchidium verruculatum* Cuvier

1830. *Onchidium verruculatum* Cuvier, *Le Ragne Animal* 2nd ed. 3 : 46
 1961. *Onchidium verruculatum* : Menon *et al.*, *J. Bombay nat. Hist. Soc.* **58** (2) : 493, pl. 10, fig. 84
 1991. *Onchidium verruculatum* : Surya Rao & Subba Rao, *Zool. Surv. India, State fauna Series, Fauna of Lakshadweep*, 2 : 346.
 2003. *Onchidium verruculatum* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 376, pl. 40, figs. 1, 2

Material examined : (i) 4 exs., Adatara beach, Okha, 10.viii.1972, coll. K.V.S.R.; (ii) 5 exs., Porbandar, 22.ii.1979, coll. K.V.S.R.; (iii) 2 exs., rocky shore nr. Veraval rest house, 31.i.1953, coll. H.C.R.; (iv) 42 exs., Veraval beach, 23-25.xi.1968, coll. A.D.; (v) 3 exs., Jaleswar, beach, Veraval, 21.i.1978, coll. B.P.H. and D.R.K.S.; (vi) 1 ex., opp. Guest house, Navalakhi Port, 23.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Andaman & Nicobar Is., Lakshadweep, Pondicherry, common in estuaries on both coasts.

Elsewhere : Indo-Pacific.

Subclass PULMONATA

Order ARCHAEPULMONATA

Family 50. ELLOBIIDAE

Subfamily ELLOBIINAE

Genus 94. *Ellobium* Roeding, 1798175. *Ellobium auris-judiae* (Linnaeus)

1758. *Bulla auris-judiae* Linnaeus, *Syst. Nat.*, ed. 10, p. 728, sp. 344 (type loc. Not given)

1995. *Ellobium auris-judiae* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 183, pl. 852.

2003. *Ellobium auris-judiae* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 370, pl. 95, fig. 5

Material examined : (i) 25 exs., Creek W. of New Kandla Port, 5.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Gogla, 15 miles from Bhavnagar, 5.ii.1953, coll. H.C.R., (iii) 4 exs., Umbargaon, 12.ii.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Andamans, Maharashtra, Orissa, West Bengal.

Elsewhere : Tropical Indo-Pacific and Queensland to North Western Australia. Ranges westward from Western Pacific (Cernohorsky, 1972).

Remarks : Shell thick, fusiform, large with small spire, columella folded twice or thrice, outer lip toothless.

Genus 95. *Cassidula* Ferussac, 1821

176. *Cassidula nucleus* (Gmelin)

1791. *Auricula nucleus* Gmelin, *sys. Nat.*, ed. 13, p. 3651

1961. *Cassidula nucleus* : Menon *et al.*, *Sea shells of Eastern Arabia*, p. 492, pl. 10, fig. 87

1995. *Cassidula nucleus* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 183, pl. 851.

2003. *Cassidula nucleus* : Subba Rao, *Rec. zool. Surv. India, Occ Paper No. 192* : 370, pl. 95, fig. 1

Material examined : (i) 5 exs., Creek, W. of Kandla Port, 5.viii.1972, coll. K.V.S.R.; (ii) 2 exs., Bedi bandar, nr. Jamnagar, 21.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra, Tamil Nadu, West Bengal.

Elsewhere : Arabia, Myanmar, ranges westwards from Central Pacific.

Remarks : Shell thick, and ovate with short spire, columella with two folds, outer lip thickened, obsolete denticulate and angulate, surface shown in colour, sculptured with striae. Cernohorsky (1972) gave a detailed description and synonymy of this species.

Subfamily MELAMPODINAE

Genus 96. *Melampus* Montfort, 1810

177. *Melampus flavus* (Gmelin, 1791)

1952. *Melampus fasciatus* (Deshayes) : Subramanyam *et al.*, *J. Univ. Bombay*, 21 (3) : 57, fig. 183.

Material examined : (i) 8 exs., Creek W. of Kandla Port, 5.viii.1972, coll. K.V.S.R.; (ii) 1 ex., Mithapur, Ca 6 km n. of Kandla, 7.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra.

Elsewhere : Throughout tropical Pacific.

Remarks : Shell smaller and thinner spire short, is variable in colour, and four sympatria colour forms have been recorded from the Pacific (Cernohorsky, 1972). The shells collected are white banded with four to five brown zones on body whorl and known as form *fasciatus* Deshayes.

178. *Melampus singaporensis* (Pfeiffer)

1952. *Melampus singaporensis* : Subramanyam *et al.*, 21 (3) : 57, fig. 185.

Material examined : (i) 13 exs., Creek W. of Kandla Port, 5.viii.1972, coll. K.V.S.R., (ii) 1 ex., Mithapur 6 kms. N. of Kandla, 7.viii.1972, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Maharashtra.

Elsewhere : Singapore.

Remarks : Small fusiform shell with coloured spiral bands, columella and outer lip with teeth.

Order BASOMMATOPHORA

Superfamily SIPHONARIOIDAE

Family 51. SIPHONARIIDAE

Genus 97. *Siphonaria* Sowerby, 1823

179. *Siphonaria siphonaria* Sowerby

1833. *Siphonaria siphonaria* Sowerby, *Gen. Shells.*, 2 : 21.

Material examined : (i) 1 ex., Rukmavati river mouth, Mandvi beach, 26.vii.1972, coll. K.V.S.R.; (ii) 2 exs., Adatara beach nr. Okha, 10.viii.1972, coll. K.V.S.R.; (iii) 4 exs., Dwaraka, 11.viii.1972, coll. K.V.S.R.; (iv) 3 exs., Okha beach, 13.viii.1972, coll. K.V.S.R.; (v) 8 exs., Lamba shore, 56 kms from Porbandar, 23.i.1953, coll. H.C.R., (vi) 3 exs., Rozy port, 22.viii.1972, coll. K.V.S.R.; (vii) 20 exs., Porbandar beach, opp. to Circuit house, 24.viii.1972, coll. K.V.S.R.; (viii) 8 exs., Porbandar beach, 29.viii.1972, coll. K.V.S.R.; (ix) 43 exs., Veraval beach nr. Rest house, 31.i.1953, coll. H.C.R., (x) 52 exs., Veraval beach, 27.xi.1968, coll. A.D.

Distribution : India : Gujarat (as above).

Remarks : The shell resembles limpet but recognised by presence of a shallow sulcus. This species is reported for the first time, the variety *exigua* Sowerby is reported from Andaman and Nicobar Is. by Subba Rao and Dey (2000).

Class SCAPHOPODA

Order DENTALOIDA

Family 52. DENTALIIDAE

Genus 98. *Dentalium* Linnaeus, 1758

The genus, commonly known as tusk shells, includes three species.

Key to species

1. Shell stout with eight raised longitudinal rings, aperture octagonal in outline.....
..... *D. octangulatum* Donovan
Shell narrow with concentric rings, aperture circular in outline 2
2. Concentric rings numerous and elevated, shell not well arched *D. eburneum* (Linnaeus)
Concentric rings a few and not elevated, shell well arched *D. longitrorsum* Reeve

180. *Dentalium eburneum* (Linnaeus)

Dentalium eburneum Linnaeus, *Syst. Nat.* ed.

1906. *Dentalium eburneum* : Smith, *Ann. Mag. Nat. Hist. Soc.* (7) 18 : 250.

Material examined : 3 exs., Balapur Bay, Beyt Is., Okha (Grab sample), 13.iv.1977, coll. K.N.R.

Distribution : India : Gujarat (as above), Kerala, West Bengal.

Elsewhere : Singapore, Margui Archipelago.

Remarks : Narrow elongated shell, feebly arched, semipellucid, amber coloured, banded with a number of elevated concentric rings, numerous concentric striae found in between elevated rings, apex slender with very small apical fissure.

181. *Dentalium longitrorsum* Reeve

1842. *Dentalium longitrorsum* Reeve, *Conch. Syst.*, II : 6, pl. 130, fig. 6, (type loc. Zanzibar).

1954. *Dentalium (Laevidentalium) longitrorsum* : Ludbrook, *John. Murry Exped. Sci. Report., Brit. Mus. Nat. Hist.*, 10 (2) : 104.

Material examined : (i) 1 ex., Simbor, Diu, 28.i.1978, coll. B.P.H.

Distribution : India : Gujarat (as above), Maharashtra,

Elsewhere : Gulf of Suez, Red Sea, Zanzibar, Durban, Torres Strait, Indo-Pacific. (Abbott & Dance, 1982).

This species is recorded for the first time from Gujarat.

Remarks : Shell slender, elongated, strongly curved, amber coloured and much polished, apex not cylindrical and angulated in outline, with small fissure, a few impressions of concentric rings, except for small growth lines.

182. *Dentalium octangulatum* Donovan

SUMMARY

1804. *Dentalium octangulatum* Donovan, *Nat. Hist. Brit. Shells.*, 5 : 162 (type loc. Japan).

1818. *Dentalium octogonum* Lamarck, *Hist. Nat. Anim. Sans. Vert.*, 5 : 344.

1995. *Dentalium octangulatum* : Bosch *et al.*, *Sea shells of Eastern Arabia*, p. 186, fig. 865.

Material examined : (i) 1 ex., Hanumandandi, Beyt Is., 3.i.1953, coll. H.C.R.; (ii) 1 ex., Adatara beach, 10.viii.1972, coll. K.V.S.R.; (iii) 2 exs., Mithapur, 14.viii.1972, coll. K.V.S.R.; (iv) 1 ex., Miani beach, 27.viii.1972, coll. K.V.S.R., (v) 1 ex., Miani beach, 27.viii.1972, coll. K.V.S.R.; (vi) 4 exs., Balapur Bay, Beyt Is., 16.ii.1979, coll. K.V.S.R.; (vii) 64 exs., Gopi near Okha, 17.ii.1979, coll. K.V.S.R.

Distribution : India : Gujarat (as above), Orissa, Tamil Nadu, West Bengal.

Elsewhere : China, Japan, Korea. Widely distributed in shallow waters, of the Pacific from South-Arabia to Japan, North Australia. This is the first record from the west Coast of India.

Remarks : Shell moderately stout, well arched, bluish white in colour, banded with very strong, raised eight longitudinal ribs, interstices traversed by numerous longitudinal striae, aperture wider end slightly oblique and octogonal in outline, minute and indented on convex side.

As revealed by our study, a total of 239 species of 138 genera under 69 families are recorded from the Gujarat Coast. Of these only 58 species are included on the basis of literature records. There are several new records – 115 species of 63 genera under 40 families for Gujarat coast. 37 species are endemic to west coast of India, out of which 25 species are restricted to Gujarat only. A few species viz., *Diodora exquisita* (Reeve), *D. fimbriata* (Reeve), *D. indusiaca* (Reeve), *D. subrostrata* (Gray), *Stomatella sulcifera* Lamarck, *Stomatia phymotis* Hebling, *Liotia reeviana* Hinds, *Planaxis savignyi* Deshayes, *Cerithium caeruleum* Sowerby, *Turritella maculata* Reeve, *Serpulorbis variabilis* Hadfield & Key, *Cypraea turdus wincworthy* Schilder & Schilder, *Phenacovolva brevirostris* (Schumacher), *Pyrene splendidula* (Sowerby), *Anachis miser* (Sowerby), *A. sulcosa* (Sowerby) *Mitrella blanda* (Sowerby), *Pugilina carinarium* (Roeding), *Bullia melanoides* Deshayes in Belanger, *Bullia otaheitensis* (Gray), *Conus angulatus* A. Adams, *Gemmula deshayesii* Doumet and *Inguisitor flavidula* (Lamarck) are recorded for the first time from India. The genus *Thalotia*, reported for the first time from Indian coast will be a new addition to NZC.

REFERENCES

- ABOTT, R.T. AND DANCE, S.P. 1982. *Compendium of Sea Shells. A color guide to more than 4,200 species of the world's Marine Shells.* E.P. Dutton. Inc., New York : ix + 411
- BENTON JUTTING, W.S.S. VAN, 1956. Systematic studies on the nonmarine mollusca of Indo-Australian Archipelago, V. Critical Revision of the Javanese Freshwater Gastropods, *Treubia Bogor*, 23 (2) : 259-477, 135 text figs.
- BOSCH, D.T., DANCE, S.P., MOOLENBEEK, R.G. AND OLIVER, P.G. 1995. *Sea Shells of Eastern Arabia*, 296 pp., 1271 pls., Motivate Publishing, Dubai, Abu Dhabi, London.
- BURN, R. 1970. *Phyllidia (Phyllidella) zeylanica* Keelarl – a rare nudibranch from the Indian subcontinent. *Mem. natn. Mus. Vict.* No. 31 : 37-40, 1 fig., 1 pl.
- BURN, R. AND K.R. NARAYANAN, 1970. Taxonomic notes on *Eolis militaris* Alden & Hancock, 1804 (Opisthobranchia, Eotidia) – *J. Malac. soc. Aust.*, 2 (1) : 83-86.

- CERNOHORSKY, W.O. 1967. *Marine shells of the Pacific*. Pacific Publ., Sydney, : 248 pp., 444 figs.
- CERNOHORSKY, W.O. 1971. The family Naticidae (Mollusca : Gastropoda) from the Fiji Islands. *Rec. Auckland Inst. Mus.*, **8** : 169-208, 70 figs.
- CERNOHORSKY, W.O. 1972. Indo-Pacific Nassariidae (Mollusca : Gastropoda). *Rec. Auckland Inst. Mus.*, **9** : 125-194, figs. 1-162.
- CERNOHORSKY, W.O. 1972. Marine shells of the Pacific, 2. *Pacific Publ.*, Sydney, : 411pp, 68 pls., 28 text figs.
- ELIOT, C. 1909. Nudibranchs collected by Hornell at Okhamandal, Kathiawar, *Rep. Govt., Baroda*, pt. **1** : 137-148.
- GIDEON, P.W., MENON, P.K.B., RAO, S.R.V. AND JOSE, K.V. 1957. On the Marine fauna of the Gulf of Kutch. A preliminary survey. *J. Bombay nat. Hist. Soc.*, **54** (3) : 630-706.
- GOPALAKRISHNAN, P. 1970. Some Observations on the Shore Ecology of the Okha Coast. *J. mar. biol. Ass. India*, **12** (1&2) : 15-34.
- GRAVELY, F.H. 1941. Shells and other Animal Remains found on the Madras Beach, *Bull. Madras Govt. Mus. New ser. (Nat. Hist. Soc.)*, Madras, **5** (1), No. 1 : 1-112, 31 text figs.
- GRAVELY, F.H. 1942. *Ibid*, **5** (2), No. 2 : 1-110, 17 text figs.
- HORNELL, J. 1909. *Report to the Govt. of Baroda on the Marine Zoology of Okhamandal*, London, I.
- HORNELL, J. 1916. *Ibid*, II. : 165pp.
- HOUBRICK, R.S. 1978. The family Cerithiidae in the Indo-Pacific pt. 1, the genera *Rhinoclavis*, *Pseudovertagus* and *Clavocerithium*. Monographs of the Marine Mollusca, No. **1** : 1-130, 98 pls., *Inc., Greenville, Delaware*.
- KILBURN, R.N. 1976. A revision of the Naticidae of South Africa and Mosambique (Mollusca), *Ann. Natal. Mus.*, **22** (3) : 823-884, 28 figs.
- MELVILL, J.C. AND STANDEN, R. 1901. The Mollusca of the Persian Gulf of Oman and Arabian Sea, as evidence mainly through the collections of Mr. F.W. Townsend, 1893-1900 with descriptions of new species, pt. 1, *Proc. zool. Soc. Lond.*, London, **2** : 327-460, 24pls.
- MENON, P.K.B., DUTTAGUPTA, A.K., AND DASGUPTA, D. 1961. The marine fauna of the Gulf of Kutch II. Gastropoda, *J. Bombay nat. Hist. Soc.*, **58** (2) : 475-494.
- MUKHERJEE, H.P. 1985. Contribution to the Molluscan fauna of India, pt. III, Marine Molluscs of the Coromandel Coast, Palk Bay and Gulf of Mannar—Gastropoda : Mesogastropoda (Part 2) *Rec. zool. Surv. India, Occ. Paper* No. **75** : 1-93, 15 pls.
- NARAYANAN, K.R., 1969. On the Opisthobranchiate fauna of the Gulf of Kutch. *Proc. Symposium Molluscs, Ernaculum – Cochin*, pt. **1** : 188-213.
- NARAYANAN, K.R., 1970. On a species of the genus *Berthellina* (Opisthobranchia : Notaspidea) of the Gulf of Kutch. *J. mar. biol. Ass. India*, **12** (1&2) : 210-212.

- NARAYANAN, K.R., 1971. On two Dorideaian Nudibranchs (Mollusca : Gastropoda) from the Gulf of Kutch, new to the Indian Coast. *J. Bombay nat. Hist. Soc.*, **65** (1) : 280-281.
- NEVILL, G., 1875. Description of new marine Mollusca from the Indian Ocean. *J. Asiat. Soc. Beng.*, **44** (2) : 83-104, pls. 7-8.
- PILSBRY, H.A. 1889. In *Tryon's Man Conch.*, Philadelphia, **11** : 519pp, pls. 67.
- PONDER, W.F. AND VOKES, E.H. 1988. A revision of the Indo-Pacific Fossil and recent species of *Murese* s.s. and *Haustellum* (Mollusca : Gastropoda : Muricidae). *Rec. Aust. Mus. Suppl.*, **8** (1) : 160, pls. 6-7.
- POWELL, A.W.B. 1964. The family Turridae in the Indo-Pacific, pt. 1. The subfamily Turrinae. *Indo-Pacific Mollusca*, **1** (5) : 227-346, pls.172-261.
- RADWIN, G.E. AND D'ATTILIO, A. 1976. *Murex shells of the World : An illustrated guide to the Muricidae*, Stanford Univ. Press, 284 pp 192 figs., 32 pls.
- RAJAGOPAL, A.S. AND MUKHERJEE, H.P. 1978. Contribution to the Molluscan fauna of India, pt. I, Marine Molluscs of the Coromandel Coast, Palk Strait and Gulf of Mannar—Gastropoda : Archaeogastropoda, *Rec. zool. Surv. India, Occ. Paper No. 12* : 1-48, 1 pls.
- RAJAGOPAL, A.S. AND MUKHERJEE, H.P. 1982. Contribution to the Molluscan fauna of India, pt. II, Marine Molluscs of the Coromandel Coast, Palk Strait and Gulf of Mannar—Gastropoda : Mesogastropoda, *Rec. zool. Surv. India, Occ. Paper No. 28* : 1-53.
- RAY, H.C. 1968. Small marine shells obtained off Puri, India. *Indian Mus. Bull.*, **3** (1&2) : 14-32, 34 fig.
- Rosewater, J. 1970. The family Littorinidae in the *Indo-Pacific Mollusca*, **2** (11) : 417-506, pls. 325-386.
- SATYAMURTI, S.T. 1952. The Mollusca Krusadai Island (in the Gulf of Mannar), *Bull. Madras Govt. Mus. New Ser. (Nat. Hist. Ser.)*, Madras **1** (2), pt. 6 : vii + 267, 34 pls.
- SUBBA RAO, N.V. AND SURYA RAO, K.V. 1993. Contribution to the knowledge of Indian Marine Molluscs 3. Family Muricidae, *Rec. zool. Surv. India, Occ. Paper No. 153* : 1-133, 14 pls.
- SUBBA RAO, N.V., DEY, A. AND BARUA, S. 1992. Estuarine and Marine Molluscs. *Fauna of West Bengal, State Fauna Series*, **3** (9) : 129-268, 30 pls.
- SUBBA RAO, N.V. AND SURYA RAO, K.V. AND MAITRA, S. 1991. Marine Molluscs. *Fauna of Orissa, State Fauna Series*, **3** (9) : 175pp, 30 pls.
- SUBRAHMANYAM, T.V., KARANDIKAR, K.R. AND MURTI, N.N. 1952. Marine Gastropoda of Bombay pt. II. *J. Univ. Bombay*, **21** (New ser.) pt. 3 (32), Sec. B : 26-59, 148 text figs., 2 pls.
- TRYON, G.W. 1887. *Man Conch.* Philadelphia, **9** : 488pp. 71 pls.
- VAUGHT, K.C. 1989. *A classification of the living Mollusca* (Edited by R.T. Abbott and K.J. Boss), *American Malacologist Inc.* Melbourne, Florida, : xii + 189pp.

SIPUNCULA

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INTRODUCTION

The present article gives a taxonomic account and a list of sipunculan species so far known from the Gujarat coast. The study is based on the material collected from various localities along the Gulf of Kutch, Okha, Porbandar, Navibandar, Chorward and Veraval by the author in 1989, by A. Misra in 1989 and by D.R.K.Sastry in 1992. Other areas i.e., Mandvi, Navlakhi, Kandla Port along the Gulf of Kutch and Mahuva, Bhavnagar and Jambusar along the Gulf of Cambay were surveyed between 1970 and 1978. As a result whole of the Gujarat coast from east to west and north to south was thoroughly surveyed so far as the sipunculan fauna is concerned. Studies of all the material reveal the occurrence of 19 species under 9 genera and 4 families. Of these, 16 species were dealt in the "Sipunculans of the Indian Coast" by the author in 1991. The rest three species, namely *Sipunculus (Austrosiphon) indicus*, *Siphonosoma vastum* and *Phascolosoma (Phascolosoma) granulatum* constitute new locality records.

With this, survey of the sipunculan fauna of the Gujarat coast by the author, A. Daniel, K.V. Surya Rao, K.N. Reddy, D.R.K. Sastry and A. Misra, is of certain relevance as to their distributional point of view. The paper deals with the material and methods, narcotisation and preservation, and morphology and terminology along with the diagnostic characters of the families, genera and species, and their distribution. Some aspects on the habits and habitat of the fauna are also discussed.

MATERIAL AND METHODS

A number of surveys have been made since 1970 at different localities of the Gujarat coast.

Emphasis has also been made to collect these animals from diversified habitats viz., muddy and sandy beds, sand and rock pools, coral and rock substrata, crevices, fissures, under stones and coral boulders.

According to the nature of substrata the method of their collection varies. For the sand- and mud-dwelling forms, the most suitable way is to dig out the worm with a hand-shovel at low tide. But it is more difficult to collect those intertidal forms which inhabit coral or rock, in this case the hard substrata are needed to break with a sharp blow of hammer along the fissure, gallery or tube inhabited by worms. Then the specimen, if any, is to be removed with the help of forceps. Where it is difficult to dissociate the specimen from the small piece of coral or rock, it is better to place the entire piece along with the worm in a very weak solution of formalin prepared from sea water. The worm then completely dislodge itself from its refuge after sometime. It is easier to collect specimens which take shelter in rock crevices or under stones.

NARCOTISATION AND PRESERVATION

The collected specimens are first narcotised to prevent shrinking, distortion in shape, etc. Different substances and methods are used for narcotisation. (i) Menthol/ Magnesium chloride : The animals are kept in a clean petridish or basin with sea water and small quantity of menthol or magnesium chloride is sprinkled over the water and covered with a lid. Within 4-6 hours the animals are narcotised. (ii) Alcohol/Chloral hydrate : 70% ethyl alcohol or 1% solution of chloral hydrate is added drop by drop at frequent intervals to sea water in which the animals are

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kept. The animals are thus narcotised in a relaxed condition.

The narcotised animals are transferred to 4% neutral formaldehyde solution and kept in it for a period varying from a few minutes to a few hours depending on the size of the animals to be killed and fixed until these do not respond to touch. Finally, they are transferred to 70% ethyl alcohol for permanent preservation.

MORPHOLOGY AND TERMINOLOGY

Introvert : It is usually shorter (in some species, quite long) and slender than trunk, retractile in nature, generally lies along the same axis of the trunk but sometimes it is displaced ventrally.

Mouth : Mouth lies at the distal tip of introvert.

Tentacle : Tentacles are variable in the degree of development and complexity, and usually surround the mouth.

Hook : Hooks are chitinous in nature, posteriorly directed either scattered or arranged in regular rings occupying distal part of introvert below the tentacular region.

Introvert-trunk Junction : The middorsal anus is usually located at the anterior end of the trunk as are the pair of ventrolateral nephridiopores. The pore(s) which is anterior in position demarcate(s) the introvert-trunk junction.

Trunk : The shape of the trunk varies from almost globular to cylindrical, but sometimes narrows down anteriorly and posteriorly. Its anterior end is generally simple but in few groups it is armed with varying shapes of calcareous cap and posterior end is blunt or pointed and sometimes provided with cap.

Papilla : Papillae are of various shapes and sizes being more dense at both ends than at the middle or localised regionally.

Musculature : The longitudinal and circular muscles of the body wall are frequently arranged in smooth uniform layers but sometimes these are gathered into bundles. Retractors, main muscles

of the coelom, varying from 1-4 in number, cross it as free longitudinal bands, being fixed anteriorly behind the oral disc and posteriorly, at different levels of the trunk wall and control the introvert. In the coelom usually three types of gut muscles are found, namely spindle muscle, wing muscles and fixing muscles. Spindle muscle is single, slender and thread-like and it originates from the body wall near anus or from rectal wall. It extends down the centre of intestinal coil and terminates posteriorly either in the intestinal coil or at the posterior end of the body. Wing muscles are paired, thin sheets and anchor the distal part of rectum to the body wall. Fixing muscle(s) is/are fine strands of varying numbers and anchor intestinal coils or oesophagus to body wall.

Contractile vessel : Sometimes called polian vessel or compensatory sac, it is a closed tubular structure connecting tentacular cavities, runs along the oesophagus and sometimes carries numerous villi or tubules.

Digestive tract : Digestive tract occupying the major portion of coelom, possesses a straight oesophagus, double helix intestine and rectum with or without caecum. The anus is usually placed at the anterior end of trunk.

Nephridia : Nephridia is single or usually two, simple tubular sac-like structure of various length and serve as excretory sacs and gonoducts. These either hang freely in the coelom or attached partially or wholly to body wall by mesentry.

LIST OF SPECIES KNOWN FROM THE GUJARAT COAST

1. *Sipunculus (Sipunculus) robustus* Keferstein
- *2. *Sipunculus (Austrosiphon) indicus* Peters
3. *Siphonosoma cumanense* (Keferstein)
- *4. *Siphonosoma vastum* (Selenka and Bulow)
5. *Themiste (Lagenopsis) lageniformis* Baird
6. *Antillesoma antillarum* (Grube and Oersted)
7. *Phascolosoma (Phascolosoma) agassizii* Keferstein
8. *Phascolosoma (Phascolosoma) albolineatum* Baird

- *9. *Phascolosoma (Phascolosoma) granulatum*
Leuckart
- 10. *Phascolosoma (Phascolosoma) nigrescens*
Keferstein
- 11. *Phascolosoma (Phascolosoma) pacificum*
(Keferstein)
- 12. *Phascolosoma (Phascolosoma) perlucens*
Baird
- 13. *Phascolosoma (Phascolosoma) scolops*
(Selenka and de Man)
- 14. *Apionsoma misakiana* (Ikeda)
- 15. *Apionsoma trichocephala* Sluiter
- 16. *Aspidosiphon (Aspidosiphon) elegans*
(Chamisso & Eysenhardt)
- 17. *Aspidosiphon (Paraspidosiphon) steenstrupii*
Diesing
- 18. *Cloeosiphon aspergillus* (Quatrefages)
- 19. *Lithacrosiphon cristatus lakshadweepensis*
Haldar

Species marked with asterisk (*) represents new locality record.

SYSTEMATIC ACCOUNT

- Phylum SIPUNCULA
- Class SIPUNCULIDEA
- Order A. SIPUNCULIFORMES
- Family I. SIPUNCULIDAE

Diagnosis : Tentacles may from clusters or be arranged in meridional rows; retractor muscles two pair except in *Siphonomecus*.

Remarks : Out of five genera of this family known from the world, two genera, namely *Sipunculus* and *Siphonosoma*, have so far been recorded from the Indian coast. (Haldar, 1991).

Key to genera of Sipunculidae known from the Gujarat coast

- Introvert with sub-triangular, scale-like papillae but without hooks; spindle muscle not attached posteriorly*Sipunculus* Linnaeus
- Introvert with prominent conical papillae; hooks or spines sometimes present; spindle

muscle attached posteriorly
..... *Siphonosoma* Spengel

Genus 1. *Sipunculus* Linnaeus

1766. *Sipunculus* Linnaeus. *Systema Naturae*, 12th edition : 1078.

1991. *Sipunculus* : Haldar. *Mem. zool. Surv. India*, 17 (4) : 9.

Diagnosis : Usually large and stout form; introvert shorter and clearly differentiated from trunk, carrying numerous scattered, flat sub-triangular papillae; trunk cylindrical, thick walled, showing square or rectangular areas; epidermal coelomic canals present as parallel longitudinal canals, tentacles arranged around the mouth; retractor muscles two pair; contractile vessels one pair but without villi; spindle muscle not attached posteriorly; nephridia one pair.

Remarks : The genus contains two subgenera, namely, *Sipunculus* and *Austrosiphon*, the latter one is emended by Gibbs and Cutler (1987).

Key to subgenera of *Sipunculus* known from the Gujarat coast

- Nephridia anterior to anus
..... *Sipunculus* Linnaeus
- Nephridia posterior to anus
..... *Austrosiphon* Fisher

Subgenus *Sipunculus* Linnaeus

1766. *Sipunculus* Linnaeus. *Systema Naturae*, 12th edition : 1078

1991. *Sipunculus* : Haldar. *Mem. zool. Surv. India*, 17 (4) : 10

Diagnosis : Nephridia anterior to anus; spindle muscle arising from body wall anterior to anus.

Remarks : Out of four species belonging to this subgenus so far reported from the Indian coast only one is available in the present collection.

1. *Sipunculus (Sipunculus) robustus* Keferstein

1865. *Sipunculus robustus* Keferstein. *Z. wiss. Zool.*, 15 : 421

1991. *Sipunculus (Sipunculus) robustus* : Haldar. *Mem. zool. Surv. India*, 17 (4) : 15-17, figs. 17, 58, 59.

Material examined : 1 ex., Bedi Port, near Jamnagar, "washed ashore" 22.xii.1989, A. Misra; 4 exs., Arambhada near Okha, 13.i.1990, B.P. Halder.

Description : Animals long, cylindrical and stout, pink in colour with slightly iridescent cuticle; trunk 80-125 mm long, 8-11 mm wide, thick-skinned and opaque, surface divided into small, quadratic areas; glans region usually rounded and swollen; introvert mostly retracted inside, 18-22 mm long, carrying posteriorly directed scale-like subtriangular papillae.

Longitudinal muscle layer grouped into 27-29, slightly anastomosing, prominent bands; retractor muscles two pair, stout, originating more or less at the same level from anterior third to fourth of trunk : ventral pair from muscles 2-5 whereas dorsal pair from muscles 9-11; post-oesophageal loop, racemose glands and caecum present; spindle muscle originating well ahead of anus and terminating in the intestinal coil; contractile vessels two in number, convoluted and without villi; nephridia two in number, thin walled, completely free from body wall and opening anterior to anus; digitate process of the brain lateral, long and stringy.

Remarks : The species is closely related to *Sipunculus nudus*, not available in the present collection but known from the Indian coast. The resemblances lie in the number of longitudinal muscle bands (within *S. nudus* range) and unattached nephridia (partially attached in *S. nudus*). The present species differs in the digitate processes of the brain, non-splitting nature of longitudinal muscle bands in the glans region as well as basal width of retractor muscles.

Previous Indian records : Dwarka, Gujarat (Halder, 1975); Madras, Tamil Nadu (Prashad, 1936; Rajulu, 1975); Nicobars (Prashad, 1936; Halder, 1991); Andamans (Prashad, 1936; Halder, 1975, 1976, 1991).

Distribution : This is usually a shallow, warm water, circumtropical form.

In India : Gujarat, Tamil Nadu; Andamans and Nicobars.

Elsewhere : Indian Ocean; Pacific Ocean and Atlantic Ocean.

Subgenus *Austrosiphon* Fisher

1954. *Xenosiphon (Austrosiphon) Fisher*. *Ann. Mag. nat. Hist.*, (12) 7 (76) : 314.

1991. *Sipunculus (Austrosiphon)* : Halder. *Mem. zool. Surv. India*, 17 (4) : 18-19.

Diagnosis : Nephridia posterior to anus; spindle muscle arising from ventral surface of rectum.

Remarks : The subgenus is represented by two species, of which one is so far known from the Indian coast.

2. *Sipunculus (Austrosiphon) indicus* Peters

1850. *Sipunculus indicus* Peters. *Arch. anat. physiol.*, 1850 : 382-383.

1991. *Sipunculus (Austrosiphon) indicus* : Halder. *Mem. zool. Surv. India*, 17 (4) : 19-21.

Material examined : 2 exs., Byet Balapur near Okha, 28.xii.1989, A. Misra; 2 exs., Nagoa, Diu, 31.xii.1989, B.P. Halder.

Description : Specimen long, cylindrical and almost uniformly thick; colour of skin, in fresh state, pinkish-white; trunk 185-225 mm long, 10.5-11 mm wide, thick-skinned; glans region slightly swollen terminating in a truncated cone; trunk surface divided into large number of square areas; introvert considerably short, 15-18 mm long and covered with numerous posteriorly directed scale-like papillae.

Longitudinal muscle layer of body wall divided into 37-40 separate prominent bands; retractor muscles two pair, equally strong, arising from the same level placed well behind nephridiopores : ventral pair from muscles 2-4 and dorsal from 10-12; spindle muscle stout, arising from ventral surface of rectum near roots of dorsal retractor muscles; rectum long with a diverticulum and a pair of broad wing muscles; post-oesophageal loop, intestinal coil and rectum attached to the body wall by numerous thin strands of fibres;

contractile vessels paired and without villi; nephridia long, attached to the body wall along their greater length and opening posterior to anus; brain simple and lacking the tufted organs.

Remarks : The species is so far not reported from the western coast of India. It can be easily recognised by its enormous size and absence of protractor muscle which separates it from other species of this subgenus.

The present specimens are comparatively smaller than those available with the author from the Andamans and the Lakshadweep where number of longitudinal muscle bands range from 36-44, attachment of dorsal retractor muscles span from 10-14 and rectal caecum is of tuberos type.

Previous Indian Records : Minicoy, Lakshadweep (Shipley, 1903; Johnson, 1969; Haldar, 1991); Andamans (Stephen and Edmonds, 1972; Haldar, 1991).

Distribution : This is an Indo-Pacific shallow water form.

In India : Lakshadweep; Gujarat and Andamans.

Elsewhere : Indian Ocean : East coast of Africa from Zanzibar to Cape Province and Madagascar, India, Mergui Archipelago and Western Australia.

Pacific Ocean : Billiton, South China Sea, Formosa, Guam, West Caroline Islands and Coral Sea.

Genus 2. *Siphonosoma* Spengel

1912. *Siphonosoma* Spengel. *Verh. dt. zool. Ges.*, 22 : 264.

1991. *Siphonosoma* : Haldar. *Mem. zool. Surv. India*, 17 (4) : 21-22.

Diagnosis : Introvert not well differentiated from trunk and sometimes possessing hooks or spines; tentacles usually numerous, thread-or finger-like and arranged around mouth; coelomic canals present in the body wall; longitudinal muscles grouped into anastomosing bands; retractor muscles two pair; contractile vessel single and dorsal, and with or without villi; spindle muscle attached both anteriorly and posteriorly; nephridia one pair.

Remarks : Only four species out of ten known under this genus are reported from the Indian coast. Amongst them only two species are presently collected from this coast.

Key to species of *Siphonosoma* known from the Gujarat coast

- Introvert with hooks or conical papillae arranged in rows *S. vastum* (Sel. & Bulow)
- Introvert without hooks or conical papillae *S. cumanense* (Kef.)

3. *Siphonosoma cumanense* (Keferstein)

1867. *Phascolosoma cumanense* Keferstein. *Z. wiss. Zool.*, 17 : 53-55, figs. 19-21.

1993. *Siphonosoma cumanense* : Saiz Salinus. *J. nat. Hist.*, 27 : 538 539.

Material examined : 4 exs., Nagoa, Diu, 31.xii.1989, B.P. Haldar; 3 exs., Somnath, 4.i.1990, A. Misra; 1 ex., Byet Balapur near Okha, 17.i.1990, B.P. Haldar.

Description : Specimens long and cylindrical, thick-walled and opaque; trunk 50-120 mm in length; introvert not strongly marked off from the trunk, comparatively short, 10-15 mm long and lacking hooks or conical papillae; tentacles numerous, small and finger-like.

Longitudinal muscles grouped into 18-23 anastomosing bands; retractor muscles two pair, arising from anterior fourth of trunk at about same level; dorsal pair from muscles 6-8 and ventral pair from muscles 2-4; anterior part of oesophagus held by thin membrane to united retractors formed by the union of dorsals and ventral ones; rectum with prominent rectal caecum held in position by broad and well developed wing muscles; spindle muscle arising anteriorly from 3-roots—one anterior to anus and other two from lateral sides near the roots of dorsal retractors; fixing muscles two, attached to last coil of intestine; contractile vessel with large number of small villi extended up to beginning of intestinal coil; transverse dissepiments absent in most of the specimens; nephridia long, about a fifth of their length

attached to body wall and opening anterior to anus; tufted organs near nephrostomes and 'oval bodies' attached to inner body wall present; gonads at the base of ventral retractors; brain without processes.

Remarks : The species is characterised by the origin of retractor muscles at the same level and absence of hooks or conical papillae on the introvert.

Improperly narcotised specimens contracted strongly like string of beads. Only large specimens collected in earlier survey trip from Port Okha in 1977 and Diu in 1978 possess transverse dissepiments.

Previous Indian Records : Lakshadweep (Shiple, 1903; Haldar, 1991); Gujarat, Tamil Nadu; Andamans and Nicobars (Haldar, 1975; 1991).

Distribution : It is usually found in intertidal and shallow water beds of tropical oceans.

In India : Gujarat; Diu; Lakshadweep; Tamil Nadu; Andamans and Great Nicobars.

Elsewhere : Indian Ocean, Pacific Ocean and Atlantic Ocean.

4. *Siphonosoma vastum* (Selenka and Bulow)

1883. *Sipunculus vastus* Selenka and Bulow. *Reisen im Archipel der Philippinen* von Dr. C. Semper, (2) 4 (1) : 103-104, Figs. 171-179.

1991. *Siphonosoma vastum* : Haldar. *Mem. zool. Surv. India*, 17 (4) : 28-30, Figs. 77-80.

Material examined : 1 ex., Porbandar, 29.xii.1989, A. Misra; 1 ex., Arambhada near Okha, 13.i.1990, B.P. Haldar; 2 exs., Poshitra Bay, Gulf of Kutch, 15.i.1990, B.P. Haldar.

Description : Specimens medium sized, cylindrical, off-white in colour; trunk 30-55 mm in length and 12-15 mm in width; introvert partially retracted, 15-20 mm in length, armed with 20-30 rows of blunt and slightly curved hooks; tentacles many, slender and digitiform.

Longitudinal muscles divided into 20-23 anastomosing bands; retractor muscles two pair,

ventral pair stouter, originating from anterior third of trunk from muscle bands 2-6 (1-6) and dorsal pair more anteriorly from muscle bands 9-10; oesophagus attached to ventral retractors by fine mesenteries and gut completely filled with sand and calcareous fragments; contractile vessel with large number of small villi; besides sac-like, globular rectal caecum large number of finger-like caeca of unknown function cover nearly whole outer surface of rectum; uncovered distal part of rectum held in position by well developed wing muscle; spindle muscle stout, originating by 3 roots anteriorly and attached to the bodywall posteriorly; fixing muscle with bifurcated origin attached to last whorl of intestine; nephridia two, with prominent semilunar nephrostomes, about a third of their length attached to body wall and open at the anal level; coelomic papillae, transverse dissepiments and "Keferstein's bodies" absent; brain small, lacking processes.

Remarks : The species is characterised by blunt and curved introvert hooks, single large globular rectal caecum and large number of finger-like caeca on rectum.

Previous Indian Records : Minicoy, Lakshadweep (Shiple, 1902); South Andamans (Haldar, 1975; 1991); North and Middle Andamans (Haldar, 1991); Nicobars (Haldar, 1991).

Distribution : This species is a tropical shallow water form.

In India : Lakshadweep; Gujarat; Andamans; Nicobars.

Elsewhere : Widely distributed in Indian and Pacific Ocean.

Order B. GOLFINGIIFORMES

Family II. THEMISTIDAE

Diagnosis : Longitudinal and circular musculature continuous; coelomic extensions in body wall absent; tentacles borne on stem-like extension.

Remarks : This is a monotypic family recorded previously from the Indian coast (Haldar, 1991).

Genus 3. *Themiste* Gray

1828. *Themiste* Gray, *Spicilegia Zoologica*. 16 : 8. pl. 6, figs. 4, 4a.

1991. *Themiste* : Halder, *Mem. zool. Surv. India*, 17(4) : 37.

Diagnosis : Introvert with or without hooks or spines; tentacles surround mouth and branching, consisting of 4-8 stems which by subdivision giving rise to tentacles; longitudinal musculature continuous; retractor muscles one pair, rarely two; spindle muscle not attached posteriorly; contractile vessel with few to many short or long villi; nephridia paired and free.

Remarks : According to Gibbs and Cutler (1987) the genus is divided into two subgenera, namely *Themiste* (*s.s.*) and *Lagenopsis* on the basis of number of retractor muscles and length of contractile vessel villi. Along the Gujarat coast subgenus *Lagenopsis* is only available.

Subgenus *Lagenopsis* Edmonds

1980. *Themiste* (*Lagenopsis*) Edmonds, *Rec. S. Aust. Mus.*, 18(1) : 33.

1991. *Themiste* (*Lagenopsis*) : Halder, *Mem. zool. Surv. India*, 17(4) : 39-40.

Diagnosis : Contractile vessel with short, finger-like villi.

Remarks : Only one species under this subgenera is so far known from the Indian coast.

5. *Themiste* (*Lagenopsis*) *lageniformis* Baird

1868. *Themiste lageniformis* Baird, *Proc. zool. soc. Lond.*, 1868 : 98-99, fig.

1991. *Themiste* (*Lagenopsis*) *lageniformis* : Halder, *Mem. zool. Surv. India*, 17(4) : 40-42, figs. 24, 92.

Material examined : 4 exs., Sikka, 20.xii.1989, A. Misra : 1 ex., Bedi Port near Jamnagar, 22.xii.1989, A. Misra; 3 exs., Porbandar, 29.xii.1989, A. Mishra : 4 exs., Jalandhar beach, Diu, 30.xii.1989, B.P. Halder; 1 ex., Nagoa (West), Diu, 31.xii.1989, B.P. Halder; 2 exs., Fort area, Diu, 2.i.1990, B.P. Halder; 3 exs., Chorwad, Veraval, 8.i.1990, A. Misra; 5 exs., Adatra beach, Okha, 11.i.1990, B.P. Halder; 6 exs., Light House Area, Dwarka, 16.i.1990, B. P. Halder; 3 exs.,

Pirotan Island, 26.i.1990, B.P. Halder.

Description : Stout and pear-shaped in contracted state and, longer and less stout in relaxed state; trunk 10-25 mm long and maximum width at posterior third of trunk, light to dark brown in colour, bending ventrally in relaxed ones; body wall apparently smooth having small glandular pores; body surface often divided into small quadrangular areas; posterior tip either rounded or pointed. Introvert short, 3-6 mm long, darker than trunk, having dark blue band anteriorly below tentacular crown; tentacles white arising from four primary stems which further divide to give rise tentacles.

Retractor muscles two in number, very stout, originating from posterior third of trunk and free for most of their length; oesophagus very long, running up to retractor base and held in position by very short fixing muscle (f_1) arising between base of retractor muscles; intestine with 12-18 well developed spiral; rectum of moderate length and with rectal caecum; second fixing (f_2) muscle arising from mid-trunk level and attached to beginning of rectum and third fixing muscle (f_3) arising from right dorso-lateral body wall at mid trunk level and attached to last intestinal coil; contractile vessel tubular, carrying numerous finger-like villi and extending upto retractor base; nephridia free, tubular, about one-third of trunk length and opening a little behind the anus. Gonads at base of retractors; brain with two eyespots.

Remarks : The species is well known along west coast and south-east coast of India as well as from the Andamans. It can easily be recognised by pyriform to sub-globose shaped form in contracted state, lacking hooks, non-pigmented tentacle tips and dark blue ring at distal part of introvert posterior to collar.

Previous Indian Records : Gujarat (Halder, 1975; 1991; Cutler and Cutler, 1979); Maharashtra (Awati and Pradhan, 1935; Halder, 1991); Lakshadweep (Halder, 1975; 1991); Kerala (Halder, 1991); Tamil Nadu (Gravelly, 1927; Halder, 1975, 1991; Rajula 1975; Reddiah, 1975); Andamans (Halder, 1975, 1991).

Distribution : This is a widely distributed form in the Indo-West Pacific tropical waters.

In India : Gujarat, Maharashtra; Lakshadweep; Kerala; Tamil Nadu; Andamans.

Elsewhere : Indian Ocean; West Pacific and a few localities in the Atlantic Ocean.

Class PHASCOLOSOMATIDEA

Order C. PHASCOLOSOMATIFORMES

Family III. PHASCOLOSOMATIDAE

Diagnosis : Longitudinal muscle layer of body wall either divided into bands or continuous; papillae most closely placed at both ends of trunk.

Remarks : At present the family contains three genera, namely *Antillesoma*, *Phascolosoma* and *Apionsoma* and all of them are found in the study area.

Key to genera of PHASCOLOSOMATIDAE known from the Gujarat coast

1. Contractile vessel with villi; introvert hooks absent *Antillesoma* Stephen and Edmonds
- Contractile vessel without villi; introvert usually provided with hooks 2
2. Longitudinal muscle layer of body wall divided into bands *Phascolosoma* Leuckart
- Longitudinal muscle layer of body wall continuous *Apionsoma* Sluiter

Genus 4. *Antillesoma* Stephen and Edmonds

1972. *Phascolosoma* (*Antillesoma*) Stephen and Edmonds. *The Phyla Sipuncula and Echiura*. Trustees of British Museum (*Nat. Hist.*) : 277 (in part).

1972. *Phascolosoma* (*Rueppellisoma*) Stephen and Edmonds. *The Phyla Sipuncula and Echiura*. Trustees of British Museum (*Nat. Hist.*) : 271 (in part).

1991. *Antillesoma* : Haldar. *Mem. zool. Surv. India*, 17(4) : 44.

Diagnosis : Introvert more than half of trunk-length; with few scattered hooks in some; tentacles numerous, arranged around nuchal organ dorsal to mouth; longitudinal muscle as separate anastomosing bands; retractor muscles two pair; contractile vessel with many short digitiform villi.

Remarks : This is presently a monotypic genus

formed by synonymising two subgenera of the genus *Phascolosoma*.

6. *Antillesoma antillarum* (Grube and Oersted)

1858. *Phascolosoma antillarum* Grube and Oersted. *Vidensk. Meddr. dansk naturh. Foren*, 1858 : 117-118.

1993. *Antillesoma antillarum* : Saiz Salinus. *J. nat. Hist.*, 27 : 543.

Material examined : 1 ex., Bedi Port near Jamnagar, 22.xii.1989, A. Misra; 3 exs., Dwarka, 27.xii.1989, A. Misra; 2 exs., Porbandar, 29.xii.1989, A. Misra; 4 exs., Nagoa (West), Diu, 31.xii.1989, B.P. Haldar; 1 ex., Harshad, 1.i.1990, A. Misra; 3 exs., Fort area, Diu, 2.i.1990, B.P. Haldar; 2 exs., Holiday Camp near Veraval, 4.i.1990, B.P. Haldar; 5 exs., Jaleswar beach, Veraval, 8.i.1990, B.P. Haldar; 3 exs., Port Okha, 14.i.1990, B.P. Haldar; 2 exs., Hanuman Dandi, Byet Island, 18.i.1990, B.P. Haldar; 6 exs., Pirotan Island, Gulf of Kutch, 25.i.1990; B.P. Haldar.

Description : Trunk 15-20 mm, stout, pear-shaped and posterior end nearly rounded; introvert, in preserved state, about one-fourth of trunk length but attaining three-fourths in living state; trunk dark brown anteriorly and posteriorly and the rest pale brown; tentacles 30-70, digitiform, arranged surrounding nuchal organ; collar, a smooth zone, placed below tentacular crown; papillae at anterior and posterior end of trunk much larger than elsewhere and ventral papillae slightly larger than dorsal ones; in the anal region papillae much larger and irregular shaped; hooks absent.

Internally, longitudinal musculature divided into anastomosing bundles, 14-18 anteriorly and 28-32 posteriorly; retractor muscles two pair arising from posterior third of trunk, dorsal pair close to ventrals and muscles of each side soon fuse to a single unit; in non-relaxed specimens retractors appear to be single pair; intestinal coil held in position, both anteriorly and posteriorly by spindle muscle, and single fixing muscle attached to beginning of rectum; rectum long and usually without caecum; contractile vessel with numerous conspicuous tubular villi, sometimes with branching tips, extending along dorsal surface of most of the length of oesophagus up to beginning of intestinal coil; nephridia brown to dark brown

in colour, about half the length of trunk and more or less completely attached to body wall; nephridiopore lying either at the same level of or just posterior to anus; gonad, a narrow digitate band of tissue, extending from lateral edge of right ventral to lateral edge of left ventral retractor base.

Remarks : Stout, pear-shaped body, short introvert and conspicuous crown of tentacles help the specimen superficially resembling a Themistid form but presence of branched contractile vessel villi, two pairs of retractors and absence of introvert hooks differentiate this *Antillesoma* species from those of *Themiste* and *Phascolosoma*.

Previous Indian Records : Gujarat (Haldar, 1991); Lakshadweep (Shiple, 1903; Haldar, 1991); Off Ganges Delta (Cutler, 1977); Andamans (Johnson, 1971; Haldar, 1991); Nicobars (Haldar, 1991).

Distribution : This is a shallow water cosmopolitan species of tropical and subtropical waters.

In India : Gujarat; Lakshadweep; Off Ganges Delta; Andamans; Nicobars.

Elsewhere : Tropical and subtropical waters of the Indian, Pacific and Atlantic Oceans.

Genus 5. *Phascolosoma* Leuckart

1828. *Phascolosoma* Leuckart. *Breves animalium quorandam maxima ex marinorum descriptiones*, Heidelberg : 22, fig. 52.

1991. *Phascolosoma* Haldar. *Mem. zool. Surv. India*, 17 (4) : 47.

Diagnosis : Introvert variable in length; hooks laterally compressed, posteriorly directed and arranged in rings around distal part of introvert; tentacles arranged around nuchal organ in an arc dorsal to mouth; papillae well developed and concentrated at both ends of trunk and base of introvert; longitudinal musculature gathered in anastomosing bundles; retractor muscles two pairs; contractile vessel without villi; spindle muscle attached posteriorly (except in one species).

Subgenus *Phascolosoma* Leuckart

1828. *Phascolosoma* Leuckart. *Breves animalium quorandum*

maxima ex parte marinorum descriptiones, Heidelberg; 22, fig. 52 (in part).

1991. *Phascolosoma (Phascolosoma)* : Haldar. *Mem. zool. Surv. India* : 17 (4) : 48.

Diagnosis : Spindle muscle attached posteriorly; hooks without accessory spinelets at base.

Remarks : Cutler and Cutler (1990) redefined subgenus *Phascolosoma* and critically reviewed all the species under the subgenus *Phascolosoma* of Stephen and Edmonds (1972) which presently includes 16 species only. Out of them seven speices are found along the Gujarat coast.

Key to species of subgenus *Phascolosoma* known from the Gujarat coast

1. More than 50 rings (complete and/or incomplete) of hooks..... 2
 - Less than 50 rings (complete and/or incomplete) 4
2. Nephridia as long as trunk
 - *P. (P.) pacificum* (Keferstein)
 - Nephridia about half as long as trunk 3
3. Clear streak of hook with swelling in middle of vertical and horizontal portion
 - *P. (P.) nigrescens* Keferstein
 - Clear streak of hook without abrupt swelling
 - *P. (P.) granulum* Leuckart
4. Apex of hook bending to form a right angle or more to main axis
 - *P. (P.) albolineatum* Baird
 - Apex of hook bending to form less than a right angle to main axis 5
5. Concave side of hook provided with large rounded hump; papillae on posterodorsal surface of introvert cone-shaped and posteriorly directed
 - *(P.) perlucens* Baird
 - Concave side of hook smooth or with small tooth 6
6. Hook with distinct triangle
 - *P. (P.) scolops* (Selenka and de man)
 - Hook triangle indistinct or absent
 - *P. (P.) agassizii* Keferstein

7. *Phascolosoma (Phascolosoma) agassizii* Keferstein

1866. *Phascolosoma agassizii* Keferstein. *Nachr. Ges. wiss. Gottingen*, 1866 : 218.

1866. *Phascolosoma (Phascolosoma) agassizii* : *Mem. zool. Surv. India*, 17 (4) : 49-51.

Material examined : 1 ex., Porbandar, 29.xii.1989, A. Misra; 1 ex., Fudum, Diu, 1.i.1990, B.P.Haldar; 1 ex., Chorwad near Veraval, 3.i.1990, A. Misra; 2 exs., Arambhada near Okha, 13.i.1990, B.P. Haldar; 3 exs., Light House area, Okha, 19.i.1990, B.P. Haldar; 2 exs., Pirotan Island, Gulf of Kutch, 25.i.1990, B.P. Haldar.

Description : Trunk 30-45 mm, cylindrical, opaque to semi-translucent, pinkish grey or pale sepia in colour, posterior extremity bluntly pointed; introvert in retracted condition less than half of trunk length, marked by irregular transverse bands on its dorsal surface and armed with 18-23 rings of hooks; each hook in middle row brown in colour with variable clear streak and indistinct triangular area (absent in posterior row); papillae large and conical crowded at introvert base and posterior end of the body, papillae in other parts of trunk and introvert proper small and less conical but structurally similar; tentacles 20-24 in number, slender, arranged around nuchal organ and placed dorsal to mouth.

Longitudinal musculature splitted into 14-22 anastomosing bands; retractor muscles two pair, ventral pair from posterior third of body and dorsal pair a little anterior to former; oesophagus fairly long carrying simple contractile vessel on its dorsal surface, rectum a straight tube with caecum in some; spindle muscle attached both anteriorly and posteriorly; fixing muscle single but after bifurcation attached to rectum and first whorl of intestine; nephridia half as long as trunk, anterior half attached to the body wall and open at the same level as anus.

Remarks : The species shows variations in external characters such as colour, size and shape of larger papillae of anal region and posterior end of trunk, and the introvert hooks.

Previous Indian Records : Gujarat (Johnson, 1971; Haldar, 1991; Diu (Haldar, 1991); Lakshadweep (Shiple, 1903; Haldar, 1991); Andamans (Haldar, 1991).

Distribution : The species is one of the most common sipunculans in the intertidal zone of temperate and tropical waters of both the hemispheres.

In India : Gujarat : Veraval, Porbandar, Okha, Pirotan Island (Gulf of Kutch); Diu : Fudum : Lakshadweep : Minicoy, Kavaratti; South Andamans : Chidyatapu, Neil Island.

Elsewhere : Tropical waters of the Indian Ocean, temperate and tropical waters of the Pacific and Atlantic Oceans.

8. *Phascolosoma (Phascolosoma) albolineatum* Baird

1868. *Phascolosoma albolineatum* Baird. *Proc. zool. Soc. Lond.*, 1868 : 91-92.

1991. *Phascolosoma (Phascolosoma) albolineatum* : Haldar. *Mem. zool. Surv. India*, 17 (4) : 51-54.

Material examined : 2 exs., Sikka Port, 20.xii.1989, A. Misra; 1 ex., Bedi Port, 22.xii.1989, A. Misra; 3 exs., Light House area, Dwarka, 27.xii.1989, A. Misra; 1 ex., Harshad, 1.i.1990, A. Misra; 2 exs., Fudum, Diu, 1.i.1990, B.P.Haldar; 3 exs., Fort Area, Diu, 2.i.1990, B.P. Haldar; 2 exs., Holiday camp, Varaval, 7.i.1990, B.P.Haldar; 1 ex., Adatra beach, Okha, 11.i.1990, B.P. Haldar; 4 exs., Light House area, Dwarka, 12 & 16.i.1990, B.P. Haldar; 2 exs., Poshitra Bay, 15.i.1990; B.P. Haldar.

Description : Slender medium sized, thin-skinned form; trunk 22-45 mm long with posterior tip tapering to a point; introvert in fully stretched specimens about three-fourths of trunk length and with dark brown irregular bands on dorsal side; tentacles 14-18 in number, digitiform and arranged around nuchal organ and placed dorsal to mouth; hooks in 20-25 rows, characterised by broad base and sharply bent apex to form a right angle or more to main axis along with clear central streak and clear triangular area at the convex side of base; papillae conical and closely set at proximal part of introvert and that of posterior end of trunk largest, sub-conical and less abundant.

Internally, longitudinal musculature divided into 18-22 anastomosing bands; retractor muscles two pair, arising from middle of trunk, ventral

pair stouter than dorsal one; oesophagus long and straight tube passing over the united retractor unit; rectum short and without rectal caecum; nephridiopores opening almost at same level as anus; spindle muscle attached at both ends; contractile vessel simple; fixing muscle single, after bifurcation attached to post-oesophageal gut and beginning of rectum; nephridia less than a half of the trunk length and anterior half attached.

Remarks : The species can be readily distinguished from other species of this subgenus by the shape of the hook, the apex of which bends to form a right angle or more to the base and a clear triangular space.

Previous Indian Records : Gujarat : Okha, Pirotan Island in the Gulf of Kutch (Haldar, 1991); Lakshadweep : Minicoy, Kavaratti, Bangaram, Agatti (Haldar, 1991); Andamans : South Andamans (Johnson, 1971), Little Andaman (Haldar, 1976), North Andamans (Haldar, 1991); Nicobars : Nancowry, Great Nicobar (Haldar, 1991).

Distribution : Wide spread but not common in Indo-West Pacific tropical shallow waters.

In India : Gujarat; Lakshadweep; Andamans and Nicobars.

Elsewhere : *Indian Ocean* : Somali coast; east coast of Africa; Natal; Diego Garcia; South coast of Java and Timor.

Pacific Ocean : Japan; Korea; Formosa; Tokara Island; West Caroline Island; Marshall Islands; Indo-China; Philippines; Amboina; Queensland.

9. *Phascolosoma (Phascolosoma) granulatum* Leuckart

1828. *Phascolosoma granulatum* Leuckart. *Breves animalium quorundum maxima ex parte marinorum descriptiones*. Heidelberg : 22, text-fig. 5.

1991. *Phascolosoma (Phascolosoma) granulatum* : Haldar, *Mem. zool. Surv. India*, 17 (4) : 56-58, figs. 31, 114-116.

Material examined : 2 exs., Holiday camp, Veraval, 7.i.1990, B.P. Haldar; 1 ex., Dwarka light house area, 12.i.1990, B.P. Haldar; 1 ex., Port

area, Okha, 14.i.1990, B.P. Haldar; 1 ex., Poshitra Bay, 15.i.1990; B.P. Haldar; 3 exs., Pirotan Island, 25.i.1990, B.P. Haldar.

Description : Trunk 20-30 mm in length, thick, opaque-skinned, cylindrical, dark brown in colour; introvert partially retracted in all; tentacles 14-18, short and digitiform; hooks arranged in 35-43 rows, in addition to some incomplete rows, hooks tall with narrow, clear transparent streak and indistinct granular triangle; papillae densely arranged at proximal part of introvert and at both extremities of trunk, granular, dome-shaped, usually darker than body colour.

Longitudinal musculature grouped into anastomosing bands, 18-20 anteriorly and 23-26 posteriorly; retractor muscles two pair, equally strong, originating from middle third of trunk, fusing with each other in their course; oesophagus long and slender; rectum long straight tube without rectal caecum; contractile vessel simple; nephridia half as long as trunk, partly attached anteriorly and opening more or less at same level of anus.

Remarks : The species is closely related to *Phascolosoma stephensoni* unknown to this coast and the difference between them is not very clear. Smooth and cone-shaped preanal papillae and clear crescentic area on the concave side of the hook separates *P. stephensoni* from *P. granulatum*.

Previous Indian Records : Andamans (Haldar, 1991); Gulf of Mannar, Tamil Nadu, (Haldar, 1991).

Distribution : This is a tropico-temperate shallow water form.

In India : Gujarat; Tamil Nadu; Andamans.

Elsewhere : Common in the north-eastern Atlantic Ocean; a few localities in the Indian and Pacific Ocean.

10. *Phascolosoma (Phascolosoma) nigrescens* Keferstein

1865. *Phascolosoma nigrescens* Keferstein. *Z. wiss. Zool.*, 15 : 424, pl. 31, 32.

1993. *Phascolosoma (Phascolosoma) nigrescens* : Saiz Salinus. *J. nat. Hist.*, 27 : 543-544.

Material examined : 1 ex., Nayabunder near Jamnagar, 23.xii.1989; 1 ex., Jalandhar, Diu, 30.xii.1989; 1 ex., Light House area Veraval, 5.i.1990, B.P. Haldar; 1 ex., Kacchhigad Light House, Shivarajpur, 8.ii.1992, D.R.K. Sastry.

Description : Trunk 15-28 mm long, light to dark brown in colour, tapering posteriorly; introvert narrower and shorter than trunk; tentacles short, digitiform and placed dorsal to mouth; collar smooth, present behind the tentacular crown; 20-28 rings of brown to dark brown hooks followed by some incomplete rings and scattered hooks; each hook having clear transparent streak with slight expansion at middle and lacking a separate triangular area.

Papillae on trunk and introvert numerous and uniform in shape; papillae at posterior extremity of trunk conical in shape; dark papillae scattered on trunk and introvert.

Longitudinal muscles gathered into 22-26 anastomosing bundles; retractor muscles two pair, ventrals stouter and dorsals slender, arising more anteriorly but both the muscles of same side fuse together anteriorly; spindle muscle strong, attached at both ends; fixing muscle attached to post-oesophageal gut; contractile vessel without villi; nephridia more or less half as long as trunk and fixed by anterior half.

Remarks : The species is distinguished from other congeners by the structure of introvert hooks gently curved and pointed apex but without triangular area.

Previous Indian Records : Gujarat (Haldar, 1991); Krusadai Island, Gulf of Mannar (Gravelly, 1927); Madras (Haldar, 1975); South Andamans (Haldar, 1976); Great Nicobar (Cutler, 1977).

Distribution : This is a common circumtropical and subtropical shallow water species.

In India : Gujarat; Lakshadweep; Tamil Nadu; Madras, Mandapam Camp, Rameswaram and Krusadai Island; Andamans : North, Middle and South; Nicobar : Camorta and Great Nicobar.

Elsewhere : Widely in Indo-Pacific region; West Africa.

11. *Phascolosoma (Phascolosoma) pacificum* Keferstein

1866. *Phascolosoma pacificum* Keferstein. *Nachr. Ges. wiss. Gottingen*, 1866 : 8-9.

1990. *Phascolosoma (Phascolosoma) pacificum* : Cutler and Cutler, *Proc. Biol. Soc. Wash.*, 103 (3) : 715-716.

Material examined : 2 exs., Nabibunder near Porbandar, 30.xii.1989, A. Misra; 1 ex., Somnath near Veraval, 4.i.1990, A. Misra; 3 exs., Arambhada near Okha, 13.i.1990, B.P. Haldar; 1 ex., Positra Bay, Gulf of Kutch, 15.i.1990, B.P. Haldar.

Description : Trunk 35-44 mm long and maximum width in the posterior third of trunk, thick-skinned, light brown to rusty brown in colour; introvert about as long as trunk, having irregular pigmented bands on dorsal surface; tentacles digitiform, arranged in a group, placed dorsal to mouth; hooks in numerous complete and incomplete rows, dark brown in colour with sharp and strongly curved apical tooth.

Papillae numerous, closely placed, conical in shape and sharply pointed- as a result skin rough in texture; papillae tallest at posterior end of trunk.

Longitudinal muscles forming anastomosing bundles with 20-23 anteriorly and 35-38 posteriorly; of the four retractors ventral pair stout, originating from middle third of trunk while the dorsal pair more anteriorly-retractors of the same side fuse anteriorly; intestinal coils numerous, rectum short and without caecum; fixing muscle attached to posterior most coil of intestine; spindle muscle stout and attached both anteriorly and posteriorly; contractile vessel simple; nephridia brown, as long as trunk and fixed to the bodywall for the entire length.

Remarks : The species may be easily differentiated from other congeners by the hook structure and very long nephridia which is entirely attached to the body wall.

Previous Indian Records : India (Selenka & de Man, 1883); Gujarat (Haldar, 1991) Minicoy, Lakshadweep (Shiple, 1903); Bay of Bengal (Haldar, 1975); Andamans (Haldar, 1976);

Nicobars (Haldar, 1975, 1976).

Distribution : The species belongs to the Indo-Pacific shallow water family.

In India : Gujarat; Lakshadweep; Kerala; Andamans; Bay of Bengal.

Elsewhere : Indo-Pacific : Madagascar; Zanzibar; Red Sea; Amboina; Indo-China; Japan; Philippines Guam; New Britain; West Carolines.

12. *Phascolosoma (Phascolosoma) perlucens* Baird

1868. *Phascolosoma perlucens* Baird. *Proc. Zool. Soc. Lond.*,
1868 : 90-91, pl. 10.

1991. *Phascolosoma (Phascolosoma) perlucens* : Haldar.
Mem. zool. Surv. India, 17 (4) : 65-68, figs. 34,
136-141.

Material examined : 2 exs., Salaya, 2.xii.1989, A. Misra; 3 exs., Light House area, Dwarka, 27.xii.1989, A. Misra; 1 ex., Nagoa West, Diu, 31.xii.1989, B.P. Haldar; 4 exs., Fort area, Diu, 2.i.1990, B.P. Haldar; 2 exs., Holiday camp, Veraval, 7.i.1990, B.P. Haldar; 3 exs., Port area, Okha, 14.i.1990, B.P. Haldar; 4 exs., Pirotan Island, 25.i.1990, B.P. Haldar.

Description : Trunk 25-45 mm in length, slender, thin-skinned, straw coloured, posterior part tapering; introvert about three quarters as long as trunk in fully relaxed state and with brown pigmented band on antero-dorsal surface while prominent, dark red-brown spine-like papillae on postero-dorsal surface; tentacles short, digitiform; hooks arranged in rows, some incomplete rows also present behind regular rows, each hook strongly bent, central clear area expanded near its middle and a clear triangular area basally.

Longitudinal muscle in 20-22 anastomosing bands; retractor muscles two pair, ventral pair stouter, arising from middle third of trunk and dorsal pair weaker, arising from middle of trunk; rectum long straight tube and without rectal caecum; single fastening muscle attached to last whorl of intestinal coil; contractile vessel simple; nephridia short, about one-third of trunk length and attached to the body wall by one-third of their length.

Remarks : The shape of introvert hooks and presence of large spine-like papillae on postero-dorsal surface of introvert help to

differentiate the species from other congeners. In literature it is better known as *P. dentigerum*.

Previous Indian Records : Minicoy, Lakshadweep (Shipley, 1903); Gujarat (Haldar, 1991); Diu (Haldar, 1991); Kerala (Haldar, 1991); Gulf of Mannar (Haldar, 1991); Andhra Pradesh (Haldar, 1991); Andamans (Johnson, 1971; Haldar, 1991); Nicobars (Haldar, 1991).

Distribution : It is widely distributed in the shallow waters of the Pacific Ocean and its distribution in the Indian and the Atlantic Ocean is very restricted.

In India : Gujarat : Diu; Lakshadweep; Kerala; Gulf of Mannar; Andhra Pradesh; Andamans and Nicobar.

Elsewhere : Madagascar; Mahe, Maldives; West Indies; Java and Java Sea; Batavia; Philippines; South China Sea; Japan; Marshall Islands; Eniwetock Atoll and Hawaiian Islands; Queensland; Victoria; Rotuma and Funafuti; Gulf of Panama; Mexico and Baja California.

13. *Phascolosoma (Phascolosoma) scolops* (Selenka & de Man)

1883. *Phymosoma scolops* Selenka and de Man. *Reisen im Archipel der Philippinen von Dr. C. Semper* (2) 4 (1) : 75-76, figs. 138-144.

1993. *Phascolosoma (Phascolosoma) scolops* : Saiz Salinas.
J. nat. Hist., 27 : 544.

Material examined : 1 ex., Fort area, Diu, 2.i.1990, B.P.Haldar; 1 ex., Light House area, Dwarka, 16.i.1990, B.P.Haldar; 1 ex., Pirotan Island, Gulf of Kutch, 25.i.1990, B.P. Haldar.

Description : Trunk 14-18 mm in length and maximum width noted in posterior third of trunk, thin-skinned and dark brown extremities; introvert as long as trunk with dark brown bands on dorsal surface; tentacles 10-12 in number, digitiform, arranged in a ring placed dorsal to mouth; hooks arranged in complete and incomplete rows, slightly curved with a secondary tooth, clear streak running from apex to base and clear triangular area in the convex portion together with transverse bar at base of the concave portion; papillae distributed over the entire trunk, large conical and closely placed round the both ends and at introvert base.

Longitudinal muscle in 20-23 anastomosing bands visible through translucent body wall; retractor muscles two pair : ventral pair broad and strong originating from middle third of trunk while weak and narrow dorsal pair originating slightly in front of ventral, retractors of each side fuse anteriorly; fixing muscle one, attached to last whorl of intestine arising from base of left dorsal retractor; spindle muscle attached both anteriorly and posteriorly; contractile vessel simple; rectum without caecum; wing muscles delicate; nephridia about quarter to half as long as trunk and attached to body wall by their anterior halves.

Remarks : The shape of the hook with clear triangular area and the clear streak from apex to base is characteristic of this species.

Previous Indian Records : Gujarat and Daman (Halder, 1991); Off-north-west of Bombay (Cutler and Cutler, 1979); Lakshadweep (Shiple, 1903; Halder, 1991); Off Cochin (Halder, 1991); Gulf of Mannar (Shiple, 1903); Andamans and Nicobars (Halder, 1976); Andaman Sea (Cutler and Cutler, 1979).

Distribution : This is a widespread circumtropical and subtropical shallow water species.

In India : Gujarat; Daman, Diu; Off Bombay; Off Cochin; Lakshadweep; Gulf of Mannar; Andamans and Nicobars; Andamans Sea.

Elsewhere : Widely reported from the Indian, Pacific and Atlantic Ocean.

Genus 6. *Apionsoma* Sluiter

1902. *Apionsoma* Sluiter. *Siboga Exped.*, **25** : 42.

1993. *Apionsoma* : Saiz Salinas. *Fauna Iberica*, Sipuncula, **4** : 125.

Diagnosis : Introvert length variable, always longer than trunk; hooks (absent in *A. trichocephala*) recurved and with accessory spinelets at base in some species; tentacles (absent in *A. trichocephala*) arranged around nuchal organ placed dorsal to mouth; muscle layer continuous; contractile vessel without villi; nephridia paired, single or bilobed.

Remarks : Out of a total of eight species under this genus only three including an anonymous

have so far been reported from the Indian coast (Halder, 1991).

Key to species of the genus *Apionsoma* known from the Gujarat coast

Hooks and tentacles present
..... *A. misakiana* (Ikeda)

— Hooks and tentacles absent
..... *A. trichocephala* Sluiter

14. *Apionsoma misakiana* (Ikeda)

1904. *Phascolosoma misakiana* Ikeda. *J. Coll. Sci. imp. Univ. Tokyo*, **20** (4) : 7-9, pl. 1, fig. 3, pl. 3, figs. 30-33.

1993. *Apionsoma misakiana* : Saiz Salinas. *J. nat. Hist.*, **27** : 544-547, fig. 4.

Material examined : 1 ex., Light House Area, Dwarka, 27.xiii.1989, A. Misra; 1 ex., Adatra beach, Okha, 11.i.1990, B.P. Halder.

Description : Trunk 6 and 8 mm long, slender, cylindrical, smooth-skinned and translucent, tapering at both ends; introvert about twice as long as trunk; tentacles short, placed dorsal to mouth; hooks small, sharply bent with accessory comb of 4-5 spinelets at base; papillae variable in size, usually tall at anterior and posterior ends of trunk and at introvert base.

Muscle layer of body wall continuous; retractor muscles two pair, both the pair originating more or less equidistant from the anus; intestinal coils large numbers; spindle muscle attached at both ends; fixing muscle absent; contractile vessel simple and without villi; nephridia bilobed, lobes of unequal size but completely free from body wall, nephridiopores anterior to anus.

Remarks : The species can be readily differentiated from the other species known from this coast by the presence of tentacles and hooks.

Previous Indian Records : Lakshadweep and Gujarat (Halder, 1991).

Distribution : The species appears to be circumtropical and subtropical shallow water form.

In India : Gujarat; Lakshadweep.

Elsewhere : Reported from various places along

the tropics and subtropics of the Indian, Pacific and Atlantic Oceans.

15. *Apionsoma trichocephala* Sluiter

1902. *Apionsoma trichocephalus* Sluiter. *Siboga Exped.*, 25 : 42-44, pl.4, Figs. 8-11.

1991. *Apionsoma trichocephala* : Haldar. *Mem. zool. Surv. India*, 17 (4) : 73-75, Figs. 36, 152-156.

Material examined : 2 exs., Port Okha, 14.i.1990, B.P. Haldar, 1 ex., Pirotan Island, Gulf of Kutch, 25.i.1990, B.P. Haldar.

Description : Trunk 3.5-5.2 mm long, pointed posterior end and bulbous mid-trunk, ventrally curved, white-brown and semi-transparent resulting visibility of internal organs; introvert 4-6 times as long as trunk, narrow, tubular; hooks and tentacles absent.

Longitudinal musculature continuous; retractor muscles two pair, small and slender, originating close to nerve cord—posterior pair from middle of trunk while anterior pair more anteriorly; intestinal coils 10-14 in number and without rectal caecum; spindle muscle attached posteriorly; contractile vessel not prominent; nephridia paired, brown coloured, tubular and free-lobes of equal length and somewhat coiled.

Remarks : The species is readily distinguished from its other congener of this coast by long, narrow, tubular introvert and absence of hooks and tentacles.

Previous Indian Records : Off Veraval, Arabian Sea (Cutler and Cutler, 1979); Off Okha, Off Bombay, Off Lawson's Bay (Haldar, 1991).

Distribution : This is a shallow warm water circumtropical form recorded from various places.

In India : Off Gujarat; Off Bombay; Off Lawson's Bay, Waltair.

Elsewhere : Various places of the Indian, Pacific and Atlantic Ocean.

Order D. ASPIDOSIPHONIFORMES

Family IV. ASPIDOSIPHONIDAE

Diagnosis : Anterior end of trunk modified into horny, epidermal or calcareous anal shield; retractor muscles single pair.

Remarks : At present the family contains three genera, namely *Aspidosiphon*, *Cloeosiphon* and *Lithacrosiphon* and all of them are known from this coast.

Key to genera of Aspidosiphonidae known from the Gujarat Coast

1. Introvert protruding through centre of anal shield; anal shield composed of small calcareous plates *Cloeosiphon* Grube.
- Introvert protruding from ventral margin of anal shield 2
2. Shield composed of large number of horny plates *Aspidosiphon* Diesing
- Shield composed of single calcareous unit ..
..... *Lithacrosiphon* Shipley

Genus 7. *Aspidosiphon* Diesing

1851. *Aspidosiphon* Diesing. *Systema helminthum*, 2 : 67-68 (restricted).

1851. *Aspidosiphon* : Saiz Salinas, *Fauna Iberica*, Sipuncula, 4 : 130-132.

Introvert usually longer than trunk with recurved hook arranged in numerous rings; shield present invariably (occasionally ill-developed) at anterior end of trunk; introvert arising from ventral side of anal shield; tentacles arranged in a horse shoe-shaped ring enclosing nuchal organ; longitudinal muscle layer of body wall either continuous or gathered into bands; retractor muscles single pair, more or less completely fused; contractile vessel without villi; spindle muscle attached posteriorly.

Remarks : Cutler (1973) divided the genus into two subgenera, viz., *Aspidosiphon* (*s.s.*) and *Paraspidosiphon* on the basis of the nature of the longitudinal muscle layer of the body wall. Later on, Cutler and Cutler (1989) erected a new subgenus, *Akrikos*, separating five species from *Aspidosiphon* (*s.s.*) based on the arrangement of hooks or absence of hooks. Two subgenera, *Aspidosiphon* (*s.s.*) and *Paraspidosiphon* are known from the Indian coast, while *Akrikos* is so far not reported from the Indian coast.

**Key to subgenera of the genus *Aspidosiphon*
known from the Gujarat coast**

1. Longitudinal muscle layer divided into anastomosing bands
.....*Paraspidosiphon* Stephen
— Hooks bidentate; retractor muscles arising from posterior seventh to tenth of trunk
.....*A. (P.) steenstrupii* Diesing
2. Longitudinal muscle layer continuous except near anal shield *Aspidosiphon (s.s.)* Diesing
— Hooks bidentate; retractor muscles arising well in front of caudal shield
...*A. (A.) elegans* (Chamisso & Eysenhardt)

**16. *Aspidosiphon (Aspidosiphon) elegans*
(Chamisso & Eysenhardt)**

1821. *Sternaspis elegans* Chamisso & Eysenhardt, *Nova Acta Acad. Caesar Leop. Carol.*, **10** : 351-352, pl. 24, Figs. 5a-e.
1868. *Aspidosiphon elegans* : Grube, *Jber. Scheles. Ges. Vaterl. Kult.* **45** : 49.
1991. *Aspidosiphon (Aspidosiphon) elegans* : Haldar, *Mem. zool. Surv. India*, **17** (4) : 81-83, figs. 42, 161-166.

Material examined : 1 ex., Harshad near Veraval, 1.i.1990, A. Misra; 3 exs., Fort area, Diu, 2.i.1990, B.P.Haldar; 2 exs., Light House area, Veraval, 5.i.1990, B.P. Haldar.

Description : Trunk 22-29 mm long and 3.5-5.0 mm wide, slender, almost cylindrical forms of creamy white colour, thin-skinned and semi-transparent; introvert, partially retracted in all, 12-16 mm long; tentacles very small, 7-10 in number; hooks bidentate and compressed in nature arranged in rings of 12-15 towards distal part of introvert while dark brown spines/conical hooks found scattered behind the regular rings; anal shield non-grooved while caudal shield weakly developed.

Longitudinal muscle layer of the body wall continuous except near the anal shield where splitting of muscle layer is observed; retractor muscles single pair arising by broad and flat roots from posterior fourth to sixth of trunk and soon fused; rectal caecum found only in one specimen; fixing muscle not observed; contractile vessel

without villi; nephridia long, extending up to retractor base almost completely attached to the body wall and opening just posterior to anus; spindle muscle fixed at both ends.

Remarks : This species is found only in association with coral. It may be easily recognised by the nature of bidentate hooks which are sharply bent and with clear streak having posteriorly directed tongue-like extension, and posteriorly placed dorsal spines larger and sharply bent.

Previous Indian Records : Krusadai Island, Gulf of Mannar, Tamil Nadu (Gravelly, 1927); Okha and Dwarka, Gujarat (Johnson, 1964; Haldar, 1991).

Distribution : This species is a shallow water form and widespread in the Indo-Pacific region and with two records from the Atlantic.

In India : Gujarat; Tamil Nadu.

Elsewhere : *Indian Ocean* : Red Sea to Tanganyika, Mozambique and Diego Garcia, then to Penang and Cocos-Keeling Islands.

Pacific Ocean : From southern Japan to Northern Australia out to Hawaii. *Atlantic Ocean*; From Northern Brazil to the Florida Keys to Bermuda.

17. *Aspidosiphon (Paraspidosiphon) steenstrupii* Diesing

1859. *Aspidosiphon steenstrupii* Diesing. *Sber. Akad. Wiss. Wien*, **37** : 767, pl. 2, figs. 1-6.
1969. *Paraspidosiphon steenstrupii* : Rice. *Am. Zool.*, **9** : 804, figs. 1, 5c.
1984. *Aspidosiphon (Paraspidosiphon) steenstrupii* : Cutler, Cutler and Nishikawa. *Publs Seto mar. biol. Lab.* **29** (4/6) : 308-309, text-figs. 13.
1991. *Aspidosiphon (Paraspidosiphon) steenstrupii* : Haldar. *In* : *State Fauna series 2 : Fauna of Lakshadweep* : 167-183.

Material examined : 3 exs., Holiday Camp, Veraval, 7.i.1990, B.P. Haldar; 2 exs., Poshitra Bay, Gulf of Kutch, 15.i.1990, B.P.Haldar; 4 exs., Byet Island, Gulf of Kutch, 18.i.1990, B.P. Haldar; 6 exs., Pirotan Island, Gulf of Kutch, 25.i.1990, B.P. Haldar.

Description : Trunk 25-45 mm long, thin-skinned in the mid-trunk region and brown in colour; introvert 18-32 mm long, light brown, narrower than trunk and provided with 15-18 short, finger-like tentacles arranged in a ring-like manner placed dorsal to mouth; hooks in numerous complete rings, bidentate in nature, 0.06-0.09 mm in height, having a tongue-like extension of the clear streak; pyramidal hooks measuring 0.04-0.07 mm in height lying scattered at proximal part of introvert; anal shield distinct, dark in colour non-grooved and more or less oval in shape whereas caudal shield less distinct, knob-like in shape, light brown in colour having radial and semicircular furrows.

Internally, retractor muscles single pair originating from 70-90% of the distance to the posterior end of the trunk; longitudinal muscle layer grouped into 15-26 (15-22 anteriorly and 20-26 posteriorly) anastomosing bundle; a small round rectal caecum observed in most of the specimens examined; spindle muscle attached at both ends; contractile vessel without villi; nephridia 50-70% of the trunk length and attached to the body wall by 60-80% of their length.

Remarks : The species may readily be identified by the structure of bidentate hooks having tongue-like extension of clear streak and tall pyramidal hooks on the introvert. The species is for the second time reported from the Gujarat coast.

Previous Indian Records : Minicoy, Lakshadweep (Shipley, 1903; Haldar, 1975, 1991); Gujarat (Haldar, 1991); North and South Andamans (Johnson, 1964; Haldar, 1975, 1976); Nicobars (Haldar, 1976); Tamil Nadu (Haldar, 1991).

Distribution : This is circumtropical shallow water coral rock-dwelling species excepting for the eastern Pacific and it is fairly common and widely spread in the Indo-Pacific area.

In India : Gujarat; Lakshadweep; Tamil Nadu; Andamans; Nicobar.

Elsewhere : Throughout the western and northern Indian Ocean, Queensland through Indonesia and the South China Sea to Southern Japan, out through the Western Pacific islands to

Hawaii. In the eastern Atlantic from the Cape Verde Islands and the Gulf of Guinea.

Genus 8. *Cloeosiphon* Grube

1868. *Cloeosiphon* Grube. *Jber. Schles. Ges. Vaterl. Kult.* **45** : 48.

1991. *Cloeosiphon* : Haldar. *Mem. zool. Surv. India*, **17** (4) : 98-99.

Diagnosis : Introvert longer than trunk and armed with numerous rings of recurved hooks, protruding from centre of anal shield; anal shield conspicuous, composed of small rectangular calcareous white plates; tentacles arranged in a horse shoe-shaped ring enclosing nuchal organ; muscle layer of body wall continuous; retractor muscles one pair, almost completely fused; spindle muscle attached posteriorly; with two nephridia.

Remarks : This is a monotypic genus widely distributed in tropical Indo-Pacific water.

18. *Cloeosiphon aspergillum* (Quatrefages)

1865. *Cloeosiphon aspergillum* Quatrefages. *Histoire naturelle des Anneles marine et d'eau douce*, Paris, **2** : 605.

1868. *Cloeosiphon aspergillum* : Grube. *Jber. Schles. Ges. Vaterl. Kult.*, **45** : 48-49.

1993. *Cloeosiphon aspergillum* : Saiz Salinas. *J. nat. Hist.*, **27** : 553.

Material examined : 3 exs., rocky beach near GFASRI, Okha, 14.1.1990, B.P. Haldar; 5 exs., Light House area, 12.1.1990, B.P. Haldar. 2 exs., Pirotan Island, Gulf of Kutch, 25.1.1990, B.P. Haldar; 1 ex., rocky shore at Adatra, Okha, 5.11.1992, D.R.K. Sastry.

Diagnosis : Trunk 18-52 mm long, cylindrical, off-white to light brown in colour, bluntly pointed posteriorly; introvert almost completely retracted in all, slender, protruding from centre of anal shield; tentacle number and the nature of arrangement not possible to ascertain; hooks in 12-20 complete rows, some scattered hooks are also present, hook bidentate in nature, with sharply pointed apical teeth, height and width being more or less same; anal shield white, rounded, made up of polygonal/ rectangular calcareous units each with a dark central spot on its top surface; no caudal shield.

Muscle layers of the body wall continuous; retractor muscles one pair, often almost completely fused in such a manner that appearing to be a single unit and originating from posterior fifth of trunk; rectum without caecum; anal aperture prominent, lying dorsal posterior border of anal shield; spindle muscle attached posteriorly; fixing muscle single, being attached to beginning of rectum; contractile vessel simple and without villi; nephridia dark brown in colour and visible through semi-transparent skin, very long extending up to base of retractor muscles and completely attached to body wall; anus and nephridiopores lying at same level but latter close to nerve cord than the former.

Remarks : The species may easily be recognised by its unique white round anal shield. This is one of the commonst sipunculan species of the coral habitat but difficult to collect in intact state from coral zig-zag burrow.

Previous Indian Records : Minicoy, Lakshadweep (Shiple, 1903; Haldar, 1991); Gujarat - Pirotan Island, Veraval, Dwarka (Haldar, 1975, 1991); Diu (Haldar, 1991); Kerala (Haldar, 1991); Tamil Nadu Krusadai Island, Appa & Rameswaram Island (Haldar, 1991); North Andmans (Haldar, 1975, 1991); South Andmans (Haldar, 1991); Nicobars (Haldar, 1991).

Distribution : This species is a tropical shallow water coral-dwelling form of the Indo-West Pacific region.

In India : Gujarat; Diu; Kerala; Lakshadweep; Tamil Nadu; Gulf of Mannar; North and South Andmans; Nicobars.

Elsewhere : Reported numerous times from throughout the Indo-West Pacific shallow water region.

Genus 9. *Lithacrosiphon* Shipley

1903. *Lithacrosiphon* Shipley. In : Gardiner, J.S. *Fauna and Geography of Maldive and Laccadive Archipelagoes*, 1 : 139.

1991. *Lithacrosiphon* : Haldar. *Mem. zool. Surv. India*. 17 (4) : 101-102.

Diagnosis : Introvert armed with numerous rows of unidentate or bidentate recurved hooks

and arising from ventral side of trunk; anal shield a hard calcareous, cone-shaped cap borne on a pad of skin placed at the anterior end of trunk; tentacles arranged in a horse shoe-shaped ring enclosing nuchal organ; longitudinal muscle bands anastomosing freely; retractor muscles single pair but almost completely fused; nephridia two; spindle muscle fixed posteriorly.

Remarks : Critically reviewing the genus Cutler and Jurczak (1975) reduced the number of species from nine to three. Out of three only one is so far reported from the Indian coast.

19. *Lithacrosiphon cristatus lakshadweepensis* Haldar

1991. *Lithacrosiphon cristatus lakshadweepensis* Haldar. *Sipuncula*, (In) *State Fauna series 2 : Fauna of Lakshadweep* : 179, figs. 6-13.

Material examined : 1 ex., Chorward near Veraval, 3.i.1990, A. Misra; 2 exs., Pirotan Island, Gulf of Kutch Gujarat, 25.i.1990, B.P.Haldar.

Diagnosis : Trunk 10-15 mm long, light brown in colour; introvert partially retracted, 5-8 mm in length, about 3/4 ths as long as trunk, protruding from ventral side of trunk from calcareous cap, more or less antipodal to anus; tentacle number not possible to ascertain exactly; hooks two types-bidentate ones arranged in rings placed distally while unidentate ones scatterly distributed on the proximal part of introvert; anal shield prominent, hard, calcareous cone-shaped cap placed at anterior end of trunk and with 18-22 almost longitudinal furrows converging towards its apex.

Longitudinal muscles in 10-16 frequently anastomosing thin bands and showing a tendency to fuse above the nephridiopores and below the retractor base; retractor muscles one pair but fused immediately after their origin from posterior end of trunk; rectum long, a small caecum attached to its middle part; spindle muscle attached posteriorly; fixing muscle absent; contractile vessel simple; nephridia nearly as long as trunk and fully attached to the body wall and open at the same level as anus.

Remarks : The species may readily be recognised by the presence of furrowed anal

shield. Number of longitudinal furrows on the anal shield, number of longitudinal muscle bands, origin of retractor muscles and the percentage of their fusion help to separate this subspecies from the nominate species.

Previous Indian Records : Lakshadweep; Gujarat.

Distribution : This subspecies is an endemic form found in intertidal to shallow water coral belt.

In India : Gujarat; Lakshadweep.

SUMMARY

The paper deals with a comprehensive account of sipunculan fauna of the Gujarat coast. Studies reveal the occurrence of 19 species under 9 genera and 4 families, of these three species constitute new locality records. All the species have been keyed and

described for easy identification. Diagnostic characters are provided for all the families as well as genera occurring in that coast. In addition, the state-wise distribution in India is summarised in a table. A general account of morphology and terminology, material and methods, and collection and preservation is added.

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REFERENCES

- Awati, P.R. and Pradhan, L.B. 1935. The anatomy of *Dendrostoma signifer* Selenka et de Man. Part I. *J. Univ. Bombay* **3** : 102-113, 2 pls., 8 text-figs.
- Cutler, E.B. 1973. Sipuncula of the Western north Atlantic. *Bull. Am. Mus. nat. Hist.*, **152** (3) : 103-204, 59 figs., 13 tabs.
- Cutler, E.B. 1977. Shallow water sipunculans collected by the Galathea Expedition (Sipuncula). *Steenstrupia*, **4** : No. 12 : 151-155.
- Cutler, E.B. and Cutler, N.J. 1979. Madagascar and Indian Ocean Sipuncula. *Bull. Mus. natn. Hist. nat. Paris.* (4) 1 (A/4) : 941-990, 21 figs.
- Cutler, E.B. and Cutler, N.J. 1989. A revision of the genus *Asidosiphon* (Sipuncula : Aspidosiphonidae). *Proc. Biol. Soc. Wash.*, **102** (4) : 826-865.
- Cutler, N.J. and Cutler, E.B. 1990. A revision of the subgenus *Phascolosoma* (Sipuncula : Phascolosomatidae). *Proc. Biol. Soc. Wash.*, **103** (3) : 691-730.
- Cutler, E.B. and Jurczak, E. 1975. The sipunculan genus *Lithacrosiphon* Shipley : A taxonomic review. *Zool. J. Linn. Soc.*, **56** (3) : 235-248, 2 figs. 2 tabs.
- Gibbs, P.E. and Cutler, E.B. 1987. A classification of the phylum Sipuncula. *Bull. Br. Mus. nat. Hist. (Zool.)*, **52** (1) : 43- 58.
- Gravelly, F.H. 1927. The littoral fauna of Krusadai Islands in the Gulf of Mannar. Gephyrea and Phoronis. *Bull. Madras Govt. Mus., n. ser.*, **1** : 87-88, figs. a,b.

- Haldar, B.P. 1975. Sipuncula of the Indian Ocean in the collection of the Zoological Survey of India. *Proc. Internat. Symp. Biol. Sipuncula and Echiura*, Kotor, 1 : 51-92, 2 tabs.
- Haldar, B.P. 1976. Sipuncula from the Andaman and Nicobar Islands. *Rec. Zool. Surv. India*, 70 : 1-9.
- Haldar, B.P. 1991a. Sipuncula of the Indian coast. *Mem. zool. Surv. India*, 17 (4) : 169 pp., 206 figs.
- Haldar, B.P. 1991b. Sipuncula. In : *State Fauna Series 2 : Fauna of Lakshadweep* : 167 - 183, 13 figs.
- Haldar, B.P. 1991c. Sipuncula. In : *Animal Resources of India, Zoological Survey of India* : 119-124.
- Johnson, P. 1964. Two new species of *Aspidosiphon* (Sipunculoidea). *Ann. Mag. nat. Hist.* (13) 7 (76 & 77) : 331-335, pls. 7-8.
- Johnson, P. 1969. New subgenus of *Xenosiphon* (Sipunculidae) and description of a new species from Indian waters. *J. Bombay nat. Hist. Soc.*, 66 (1) : 43-46, 7 figs.
- Johnson, P. 1971. On a collection of sipunculids from Indian waters. *J. Bombay nat. Hist. Soc.*, 68 (3) : 596-608, 4 pls., 41 figs.
- Prashad, B. 1936. On the sipunculoidea from Indian waters in the Indian Museum. *Rec. Indian Mus.*, 38 : 231-238, pl. 9.
- Rajulu, S.G. 1975. Asexual reproduction by budding in the sipuncula. *Proc. Internat. Symp. Biol. Sipuncula and Echiura*, Kotor, 1 : 177-182, 9 figs.
- Reddiah, K. 1975. Sipunculan habitats of the penninsular India. *Proc. Internat. Symp. Biol. Sipuncula and Echiura*, Kotor, 1 : 285-289, 8 figs.
- Saiz Salinas, J.I. 1993. Sipuncula from Reunion Island (Indian Ocean). *J. nat. Hist.*, 27 : 535-555.
- Selenka, E., de Man, J.G. and Bulow, C., 1883. Die sipunculiden. *Risen im Archipel der Philippinen von Dr. C. Semper*. Leipzig and Wiesbaden, (2) 4 (1) : 1-133, 14 pls.
- Shiple, A.E. 1903 a. Sipunculoidea, with an account of a new genus *Lithacrosiphon*. In: Gardiner, J.S. (Ed.) *Fauna and Geography of the Maldive and Laccadive Archipelagoes*, 1 : 131-140, pl.7.
- Shiple, A.E. 1903 b. Report on the Gephyrea collected by Prof. Herdman at Ceylon in 1902. *Herdman Rep. Pearl Oyster Fishery*. 1 (3) suppl. : 169-176, 1 pl., figs. 4-10.
- Stephen, A.C. and Edmonds, S.J. 1972. *The phyla Sipuncula and Echiura*. Trustees of the British Museum (Natural History), London, 528 pp., 60 figs., 17 tabs.

Table showing distribution of sipunculans in different Indian coasts

Sl. No.	Name of species	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Andamans	Nicobars	Kerala	Lakshadweep	Maharashtra	Gujarat		
											Gulf of Cambay	Arabian coast	Gulf of Kutch
1.	<i>Sipunculus</i> Linnaeus <i>S. robustus</i> Keferstein				+	+	+					+	+
*2.	<i>S. indicus</i> Peters					+			+			+	+
3.	<i>Siphonosoma</i> Spengel <i>S. cumanense</i> (Keferstein)				+	+	+		+			+	+
*4.	<i>S. vestum</i> (Selanka & Bulow)											+	+
5.	<i>Themiste</i> <i>T. lageniformis</i> Baird				+	+		+	+	+		+	+
6.	<i>Antillesoma</i> Stephen & Edmonds <i>A. antillarum</i> (Grube & Dersted)	+				+	+		+			+	+
7.	<i>Phascolosoma</i> Leuckart <i>P. agassizii</i> Keferstein					+			+			+	+
8.	<i>P. albolineatum</i> Baird					+	+		+			+	+
*9.	<i>P. granulatum</i> Leuckart				+	+						+	+
10.	<i>P. nigrescens</i> Keferstein				+	+	+					+	+
11.	<i>P. pacificum</i> (Keferstein)					+	+		+			+	+
12.	<i>P. perlucens</i> Baird			+	+	+	+	+	+			+	+
13.	<i>P. scolops</i> (Selenka & de Man)				+	+	+	+	+	+		+	+
14.	<i>Apionsoma</i> Sluiter <i>A. misakiana</i> (Ikeda)								+			+	+
15.	<i>A. trichocephala</i> Sluiter			+						+			+
16.	<i>Aspidosiphon</i> Diesing <i>A. elegans</i> (Chamisso & Eysenhardt)				+							+	
17.	<i>A. steenstrupii</i> Diesing					+	+		+			+	+
18.	<i>Cloesiphon</i> Grube <i>C. aspergillus</i> (Quatrefages)				+	+	+	+	+			+	+
19.	<i>Lithacrosiphon</i> Shipley <i>L. cristatus lakshadweepensis</i> Halдар								+			+	+

NEMATODA

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INTRODUCTION

This is an established fact that the members of the phylum Nematoda (nematodes) are highly diversified and found in all kinds of habitats. On the basis of their habitats and feeding habits, the nematodes can be divided in following groups: Parasites of vertebrates, Parasites of invertebrates, Parasites of plants, Free living or Saprophagous and Predaceous. The parasites of plants, saprophagous and predaceous nematodes are also known as terrestrial nematodes because they are usually found in the soil. The present paper reports all the known species of terrestrial nematodes, which include phytophagous, saprophagous and predaceous groups from Gujarat. From economic point of view, the phytophagous nematodes are very important because they cause considerable damage (12-15%) to the agricultural and horticultural crops. Most of the saprophagous nematodes help in maintaining eco-balance in the terrestrial fauna while some are being used as indicator of aquatic pollution. The predaceous nematodes act as agents of biological control of phytophagous nematodes.

During the last four decades, commendable work has been done by nematologists on survey, distribution and taxonomy of plant and soil nematodes. However, our knowledge on nematode fauna of Gujarat has been found meagre (Jairajpuri & Baqri, 1995). In Gujarat, most of the surveys have been conducted for important phytophagous nematodes (root-knot and cyst nematodes) only. In fact, the survey and identification work started rather late in the state. Patel, Desai and Shah (1962) were the first to publish a survey report on stunt nematode associated with tobacco crop in Gujarat. Other important references on

taxonomical studies from Gujarat are: Jairajpuri & Baqri (1968), Husain & Rasheed (1969), Patel, D.J. *et al.*, (1979-1988), Patel, B.A. *et al.* (1987), Patel, G.J. *et al.* (1962, 1986), Patel, H.K. *et al.* (1988), Shah *et al.* (1985), Siddiqi & Patel (1990), Desai (1992), Sharma *et al.* (1992-93), Ahmad (1993), Khan *et al.* (1994 & 1995), Huseni *et al.* (1997) and a few others.

Keeping in view the poor state of knowledge of nematodes fauna from Gujarat state, the surveys were planned in the state by the authors so that the wide gap in our knowledge may be filled up. During 2000-01, the following 11 districts have been surveyed: Junagarh, Jamnagar, Rajkot, Surendranagar, Bharuach, Valsad, Vadodara, Surat, Narmada, Navasari and Dangs. The details about localities and hosts are furnished in Table No. I.

The samples collected by us yielded a wide variety of nematodes, of which 83 species belonging to 41 genera spread over to 18 families of the Orders Tylenchida, Aphelenchida, Dorylaimida and Mononchida have been identified. Their body measurements, brief descriptions along with other necessary information on hosts, habitats and localities of the newly recorded species from the state have been provided in this paper. All the newly recorded species from Gujarat have been marked by asterisk.

For the sake of uniformity and to fulfil the objective of this paper, information on the already known species from Gujarat have also been compiled by us. Their brief descriptions, measurements and other information in this paper are based on the observations furnished by earlier scientists. Before providing the measurements and descriptions etc., all the known and newly recorded

TABLE - I. Details about the localities and hosts/habitats surveyed for the present study:

Name of districts	No. of samples	Localities	Hosts/Habitat
Junagarh	25	Sasan Gir, Amrapura, Nani-khoda, Mendrada, Bagdu, Dhokpur, Kedipur, Bhandar, Gura	Unidentified grasses, Bajra (<i>Pennisetum americanum</i>), Groundnut (<i>Arachis hypogaea</i>), Jowar (<i>Sorghum bicolor</i>), Maize (<i>Zea mays</i>), Castor (<i>Ricinus communis</i>)
Surendra nagar	36	Dhrangadhra, Lakhtar, Wadhwan, Talsana, Patardia, Devalia, Limbdi, Sadia, Ratanpur, Ukra, Chotila, Muli, Tal danri, Varsani, Sahad	Cotton (<i>Gossypium spp.</i>), Til (<i>Sesamum indicum</i>), Bajra (<i>Pennisetum americanum</i>), Jowar (<i>Sorghum bicolor</i>), Cucurbit (<i>Cucurbita sp.</i>), Paddy (<i>Oryza sativa</i>), Moong (<i>Phaseolus aureus</i>), Castor (<i>Ricinus communis</i>)
Jamnagar	30	Dhrol, Jodiya, Mabapo, Bhadra, Kala, Bawana, Bayrangpur, Falla, Motiwanagar, Lakhtar	Ajawain, Cotton (<i>Gossypium spp.</i>), Groundnut (<i>Arachis hypogaea</i>), Castor (<i>Ricinus communis</i>), Rizka (<i>Medicago sativa</i>), Maize (<i>Zea mays</i>), Jowar (<i>Sorghum bicolor</i>), Brinjal (<i>Solanum melongona</i>), Til (<i>Sesamum indicum</i>), Arhar (<i>Cajanus cajan</i> (L.) Onion (<i>Allium cepa</i>)
Rajkot	35	Padhari, Aamater, Rampur Mobaiya, Lodhika, Paidi, Gondal, Hadmata, Biliyala, Bhojpura, Kalipat, Kashrba Dam, Aniyara, Rajsamdiyala, Morbi Road, Bedi vill., Gauridar, Hadala, Reebara, Taldanri, Deepalia, Lodhika, Hadala	Groundnut (<i>Arachis hypogaea</i>), Til (<i>Sesamum indicum</i>), Castor (<i>Ricinus communis</i>), Jowar (<i>Sorghum bicolor</i>), Arhar (<i>Cajanus cajan</i> (L.) mill), Cotton (<i>Gossypium spp.</i>), Sugarcane (<i>Sacchharum officinarum</i>), Brinjal (<i>Solanum melongona</i>), Chilli (<i>Capsicum annum</i>), Maize (<i>Zea mays</i>), Coriander (<i>Corcandrum sativum</i>)
Narmada	23	Tunda, Kesherpura, Sagbara, Chaupada Navapara, Rajpipla Mebalda, Babri Nimbda Alampura, Gangapur Ralda, Ranepur	Oat (<i>Hordeum vulgare</i>), Arhar (<i>Cajanus cajan</i> (L.)), Maize (<i>Zea mays</i>), Cotton (<i>Gossypium spp.</i>), Sugarcane (<i>Sacchharum officinarum</i>) Tomato (<i>Lycopersicon esculentum</i>) Brinjal (<i>Solanum melongona</i>) Bean (<i>Phaseolus sp.</i>) Carrot (<i>Daucas carota</i>) Gram (<i>Phaseolus sp.</i>) Chilli (<i>Capsicum annum</i>) Wheat (<i>Triticum aestivum</i>) Cabbage (<i>Brassica oleracea</i>) Potato (<i>S. tuberasum</i>)
Navsari	15	Pipalkhaid, Bansda, Gondak, Ganderi Road, Khokharada	Chilli (<i>Capsicum annum</i>), Sugarcane (<i>Sacchharum officinarum</i>), Tomato (<i>Lycopersicon esculentum</i>), Banana (<i>Musa paradisiaca</i>), Gram (<i>Phaseolus sp.</i>), Brinjal (<i>Solanum melongona</i>), Cauliflower (<i>Brassica oleracea</i>), Guar (<i>Cyamopis tetragonoloba</i>),

Name of districts	No. of samples	Localities	Hosts/Habitat
			Raddish (<i>Raphanus sativus</i>), Arhar (<i>Cajanus cajan</i> (L.) mill), Wheat (<i>Triticum aestivum</i>), Coriander (<i>Corcandrum sativum</i>)
Valsad	42	Dungra, Nargol, Nanaponda, Dharampur, Kaparda, Sarigaon, Pathari, Chikhala, Karan village, Kharai, Dadia, Faria, Sarai. Umbergam, Dungara, Pardi, Atak Pondi	Banana (<i>Musa paradisiaca</i>), Bean (<i>Phaseolus sp.</i>), Brinjal (<i>Solanum melongona</i>), Cauliflower (<i>Brassica oleracea</i>), Chilli (<i>Capsicum annum</i>), Coriander (<i>Corcandrum sativum</i>), Cucurbit (<i>Cucurbita sp.</i>), Lady's finger (<i>Abdmoschus esculentus</i>), Onion (<i>Allium cepa</i>), Papaya (<i>Carica papaya</i>), Raddish (<i>Raphanus sativus</i>), Spinach (<i>Spinacia oleracea</i>), Sugarcane (<i>Sacchharum officinarum</i>), Tomato <i>Lycopersicon esculentum</i>), Wheat (<i>Triticum aestivum</i>)
Dang	23	Rupon village, Mandavi, Rajpipla, Kurkas, Jakhara, Jamla road, Ahwa, Rambhas, Bazz, Pipari village, Moolchowk	Arhar (<i>Cajanus cajan</i> (L.) mill.), Arvi (<i>Colacasia sp.</i>), Banana (<i>Musa paradisiaca</i>), Brinjal (<i>Solanum melongona</i>), Chilli (<i>Capsicum annum</i>), Garlic (<i>Allium sativum</i>) (L.), Gram (<i>Phaseolus sp.</i>), Sweet potato (<i>Ipomoea batatos</i>), Lobia (<i>Vigna unguiculata</i> (L.)), Millet (<i>Pennisetum americanum</i>), Oat (<i>Hordeum vulgare</i>), Paddy (<i>Oryza sativa</i>), Sugarcane (<i>Sacchharum officinarum</i>), Wheat (<i>Triticum aestivum</i>)
Surat	31	Rupari village, Srinathnagar, Beddacha, Vutwada, Malda, Bardoli, Tarsada, Korribarsana, Sathau, Jahangirpur, Aadhamirat, Valod, Kadod, Nadira	Arhar (<i>Cajanus cajan</i> (L.) mill.), Arvi (<i>Colacasia sp.</i>), Banana (<i>Musa paradisiaca</i>), Brinjal (<i>Solanum melongona</i>), Cauliflower (<i>Brassica oleracea</i>), Chilli (<i>Capsium annum</i>), Cotton (<i>Gossypium spp.</i>), Guar (<i>Cyamopis tetragonaoba</i>), Gram (<i>Phaseolus sp.</i>), Lady's finger (<i>Abdmoschus esculentus</i>), Oat (<i>Hordeum vulgare</i>), Tomato (<i>Lycopersicon esculentum</i>), Sugarcane (<i>Sacchharum officinarum</i>), Wheat (<i>Triticum aestivum</i>)
Bharuch	30	Valia ,Netrang, Jhaghadia, Amod, Bharuch, Jambusar, Dedia, Pada, Sagbara, Raj Pipla, Tilakwara	Banana (<i>Musa paradisiaca</i>), Brinjal (<i>Solanum melongena</i>), Cotton (<i>Gossypium spp.</i>), Sugar cane (<i>Sacchharum officinarum</i>), Wheat (<i>Triticum aestivum</i>), Jowar (<i>Sorghum bicolor</i>)
Vadodara	25	Dhaboi, Karjan, Sankheda, Bodeli, Chota Udaipur, Tarjan, Padra, Vadodara, Vagbodia	Wheat (<i>Triticum aestivum</i>), Onion (<i>Allium cepa</i>), Tomato (<i>Lycopersicon esculentum</i>), Bhindi (<i>Abelmoschus esculentus</i>), Cauliflower (<i>Brassica oleracea</i>), Carrot (<i>Daucas carota</i>), Oat (<i>Hordeum vulgare</i>), Castor (<i>Ricinus communis</i>), Jowar (<i>Sorghum bicolor</i>)

species from the State are being listed below according to their systematic position.

SYSTEMATIC LIST OF NEMATODES FROM GUJARAT

- Order TYLENCHIDA Thorne, 1949
 Suborder TYLENCHINA Chitwood
 in Chitwood & Chitwood, 1950
 Infraorder TYLENCHATA Siddiqi, 2000
 Superfamily TYLENCHOIDEA Orley, 1880
 Family TYLENCHIDAE Orley, 1880
 Subfamily BOLEODORINAE Khan, 1964
 Genus *Basiria* Siddiqi, 1959
 1. *Basiria brevistylus** (Khera, 1970) Ebsary, 1991
 2. *Basiria bilineata* (Saha & Khan, 1982) Ebsary, 1991
 Infraorder ANGUINATA Siddiqi, 2000
 Superfamily ANGUINIOIDEA Nicoll, 1935 (1926)
 Family ANGUINIDAE Nicoll, 1935 (1926)
 Subfamily ANGUININAE Nicoll, 1935 (1926)
 Genus *Ditylenchus* Filipjev, 1936
 3. *Ditylenchus triformis* Hirschmann & Sasser, 1955
 Suborder HOPLOLAIMINA Chizhov
 & Berezina, 1988
 Superfamily HOPLOMAIMOIDEA
 Filipjev, 1934 (Paramonov, 1967)
 Family HOPLOMAIMIDAE
 Filipjev, 1934 (Wieser, 1953)
 Subfamily HOPLOLAIMINAE
 Filipjev, 1934
 Genus *Hoplolaimus* Daday, 1905
 4. *Hoplolaimus indicus* Sher, 1963
 5. *Hoplolaimus pararobustus* (Schuurmans
 Stekhoven & Tenuissen, 1938) Sher, 1963
 Genus *Scutellonema* Andrassy 1958
 6. *Scutellonema brachyurus* (Steiner, 1938)
 Andrassy, 1958
 Subfamily ROTYLENCHOIDINAE Whitehead, 1958
 Genus *Helicotylenchus* Steiner, 1945
 7. *Helicotylenchus dihystra** (Cobb, 1893) Sher, 1961
 8. *Helicotylenchus anehelicus** Sher, 1966
 9. *Helicotylenchus erythrinae* (Zimmermann,
 1904) Golden, 1956
 10. *Helicotylenchus exallus** Sher, 1966
 11. *Helicotylenchus indicus* Siddiqi, 1963
 12. *Helicotylenchus multicinctus** (Cobb, 1893)
 Golden, 1956
 13. *Helicotylenchus orthosomaticus** Siddiqi, 1972
 14. *Helicotylenchus retusus** Siddiqi & Brown, 1964
 15. *Helicotylenchus rotundicauda** Sher, 1966
 16. *Helicotylenchus truncatus** Roman, 1965
 Family ROTYLENCHULIDAE Husain & Khan,
 1967, Husain, 1976
 Subfamily ROTYLENCHULINAE Husain &
 Khan, 1967
 Genus *Rotylenchulus* Linford & Oliveira, 1940
 17. *Rotylenchulus reniformis* Linford & Oliveira, 1940
 Family PRATYLENCHIDAE Thorne, 1949
 (Siddiqi, 1963)
 Subfamily PRATYLENCHINAE Thorne, 1949
 Genus *Pratylenchus* Filipjev, 1936
 18. *Pratylenchus loosi** Loof, 1960
 19. *Pratylenchus thornei* Sher & Allen, 1953
 20. *Pratylenchus zae* Graham, 1951
 Subfamily HIRSCHMANNIELLINAE Fotedar &
 Handoo, 1978
 Genus *Hirschmanniella* Luc & Goodey, 1964
 21. *Hirschmanniella gracilis** (de Man, 1880) Luc
 & Goodey, 1964
 22. *Hirschmanniella mucronata* (Das, 1960) Khan,
 Siddiqi, Khan, Husain & Saxena, 1964
 23. *Hirschmanniella oryzae* (van Breda de Haan,
 1902) Luc & Goodey, 1964
 Subfamily RADOPHOLINAE Allen & Sher, 1967
 Genus *Radopholus* Thorne, 1949
 24. *Radopholus similis* (Cobb, 1893) Thorne, 1949
 Family MELOIDOGYNIDAE Skarbilovich, 1959
 (Wouts, 1973)

- Subfamily MELOIDOGYNINAE Skarbilovich, 1959
- Genus *Meloidogyne* Goeldi, 1892
25. *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1949
26. *Meloidogyne hapla* Chitwood, 1949
27. *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949
28. *Meloidogyne javanica* (Treub, 1885) Chitwood, 1949
29. *Meloidogyne indica* Whitehead, 1968
- Family HETERODERIDAE Filipjev & Schuurmans, Stekhoven, 1941 (Skarbilovich, 1947)
- Subfamily HETERODERINAE Filipjev & Schuurmans Stekhoven, 1941
- Genus *Heterodera* Schmidt, 1871
30. *Heterodera cajani* Koshy, 1967
31. *Heterodera zaeae* Koshy, Swarup & Sethi, 1971
- Superfamily DOLICHODOROIDEA Chitwood in Chitwood & Chitwood, 1950 (Siddiqi, 1986)
- Family TELOTYLENCHIDAE Siddiqi, 1960
- Subfamily TELOTYLENCHINAE Siddiqi, 1960
- Genus *Telotylenchus* Siddiqi, 1960
32. *Telotylenchus paaloofi** Tikyani & Khera, 1970
33. *Tylenchorhynchus divittatus** Siddiqi, 1961
34. *Tylenchorhynchus latus* Allen, 1955
35. *Tylenchorhynchus mashhoodi** Siddiqi & Basir, 1959
36. *Tylenchorhynchus microcephalus* Siddiqi & Patel, 1990
37. *Tylenchorhynchus nudus** Allen, 1955
- Genus *Bitylenchus* Filipjev, 1934
38. *Bitylenchus brevilineatus* (Williams, 1960) Jairajpuri, 1982
39. *Bitylenchus vulgaris* (Upadhyay, Swarup & Sethi, 1972), Jairajpuri, 1982
- Genus *Scutylenchus* Jairajpuri, 1971
40. *Scutylenchus hexincisus* (Jairajpuri & Baqri, 1968) Siddiqi, 1979
- Family PSILENCHIDAE Paramonov, 1967 (Khan, 1969)
- Subfamily PSILENCHINAE Paramonov, 1967
- Genus *Psilenchus* de Man, 1921
41. *Psilenchus hilarus* Siddiqi, 1963
- Suborder HEXATYLINA Siddiqi, 1980
- Family PAURODONTIDAE Thorne, 1941 (Massey, 1967)
- Subfamily PAURODONTINAE Thorne, 1941
- Genus *Paurodontus* Thorne, 1941
42. *Paurodontus similis* Siddiqi, 1961
- Order APHELENCHIDA Siddiqi, 1980
- Suborder APHELENCHINA Geraert, 1966
- Superfamily APHELENCHOIDEA Fuchs, 1937 (Thorne, 1949)
- Family APHELENCHIDAE Fuchs, 1937 (Steiner, 1949)
- Subfamily APHELENCHINAE Fuchs, 1937
- Genus *Aphelenchus* Bastian, 1865
43. *Aphelenchus avenae** Bastian, 1865
- Superfamily APHELENCHOIDOIDEA Skarbilovich, 1947 (Siddiqi, 1980)
- Family APHELENCHOIDIDAE Skarbilovich, 1947 (Paramonov, 1953)
- Subfamily APHELENCHOIDINAE Skarbilovich, 1947
- Genus *Aphelenchoides* Fischer, 1894
44. *Aphelenchoides besseyi* Christie, 1942
45. *Aphelenchoides parascalcaudatus* Chawla, Bhamburkar, Khan & Prasad, 1968
- Order DORYLAIMIDA Pearse, 1942
- Suborder DORYLAIMINA Pearse, 1936
- Superfamily DORYLAIMOIDEA de Man, 1876
- Family DORYLAIMIDAE de Man, 1876
- Subfamily DORYLAIMINAE de Man, 1876
- Genus *Laimydorus* Siddiqi, 1969
46. *Laimydorus baldus** Baqri & Jana, 1982

47. *Laimydorus finalis** Thorne, 1975

48. *Laimydorus kherai** Baqri, 1985

Genus *Mesodorylaimus* Andrassy, 1959

49. *Mesodorylaimus adalbarti** Andrassy, 1963

50. *Mesodorylaimus brassicus** Soni & Nama,
1981

51. *Mesodorylaimus caudatus* Ahmad, 1993

52. *Mesodorylaimus margeritus** Basson & Heyns,
1974

53. *Mesodorylaimus mesonyctius** (Kreis, 1930)
Andrassy, 1959

54. *Mesodorylaimus szunyoghyi** Andrassy, 1968

Subfamily THORNENEMATINAE Siddiqi, 1969

Genus *Thornenema* Andrassy, 1959

55. *Thornenema mauritianum** (Williams, 1959)
Baqri & Jairajpuri, 1969

Genus *Sicaguttur* Siddiqi, 1971

56. *Sicaguttur sartum** Siddiqi, 1971

Family APORCELAIMIDAE Heyns, 1965

Subfamily APORCELAIMINAE Heyns, 1965

Genus *Aporcelaimellus* Heyns, 1965

57. *Aporcelaimellus heynsi** Baqri & Jairajpuri,
1968

Genus *Tubixaba* Monteiro & Lordello, 1980

58. *Tubixaba parva** Pretorius, Kruger & Heyns,
1987

Family QUDSIANEMATIDAE Jairajpuri, 1965

Subfamily QUDSIANEMATINAE Jairajpuri, 1965

Genus *Labronema* Thorne, 1939

59. *Labronema confusum** (Jana & Baqri, 1983)
Andrassy, 1991

Genus *Ecumenicus* Thorne, 1974

60. *Ecumenicus monohystera** (De Man, 1880)
Thorne, 1974

Genus *Allodorylaimus* Andrassy, 1986

61. *Allodorylaimus kosambaensis* Khan, Ahmad
& Jairajpur, 1995

Subfamily DISCOLAIMINAE Siddiqi, 1969

Genus *Discolaimus* Cobb, 1913

62. *Discolaimus major** Thorne, 1939

Genus *Discolaimium* Thorne, 1939

63. *Discolaimium mukhtarpuriense** Baqri &
Jairajpuri, 1969

Genus *Discolaimoides* Heyns, 1963

64. *Discolaimoides bulbiferus** (Cobb, 1906)
Heyns, 1963

Genus *Latocephalus* Patil & Khan, 1982

65. *Latocephalus gracile** Patil & Khan, 1982

Family NORDIIDAE Jairajpuri & A.H. Siddiqi, 1964

Subfamily NORDIINAE Jairajpuri & A.H.

Siddiqi, 1964

Genus *Longidorella* Thorne, 1939

66. *Longidorella xenura** Khan & Siddiqi, 1963

Subfamily PUNGENTINAE Siddiqi, 1969

Genus *Kochinema* Heyns, 1963

67. *Kochinema farodai** Baqri & Bohra, 2001

68. *Kochinema caudatum** Baqri & Bohra, 2001

Subfamily ACTINOLAIMOIDINAE Jairajpuri &
Ahmad 1992

Genus *Oriverutus* Siddiqi, 1971

69. *Oriverutus labiatus** Ahmad & Jairajpuri,
1987

Superfamily ACTINOLAIMOIDEA Thorne, 1939

Family ACTINOLAIMIDAE Thorne, 1939

Subfamily NEOACTINOLAIMINAE Thorne, 1967

Genus *Neoactinolaimus* Thorne, 1967

70. *Neoactinolaimus kosambus* Khan, Ahmad &
Jairajpuri, 1994

71. *Neoactinolaimus attenuatus* Khan, Ahmad &
Jairajpuri, 1994

Superfamily LONGIDOROIDEA Thorne, 1935

Family LONGIDORIDAE Thorne, 1935

Subfamily LONGIDORINAE Thorne, 1935

Genus *Longidorus* Micoletzky, 1922 (Filipjev,
1934)

72. *Longidorus elongatus** (de Man, 1876)

Micoletzky, 1922

- Genus *Paralongidorus* Siddiqi, Hooper & Khan, 1963
73. *Paralongidorus beryllus** (Siddiqi, Husain, 1965) Hunt 1993
74. *Paralongidorus citri** (Siddiqi, 1959) Siddiqi, Hooper & Khan, 1963
75. *Paralongidorus major** Verma, 1973
76. *Paralongidorus microlaimus** Siddiqi, 1964
- Family XIPHINEMATIDAE Dalmasso, 1969
- Subfamily XIPHINEMATINAE Dalmasso, 1969
- Genus *Xiphinema* Cobb, 1913
77. *Xiphinema americanum** Cobb, 1913
78. *Xiphinema basiri** Siddiqi, 1959
79. *Xiphinema elongatum** Sch. Stekhoven & Teunissen, 1938
80. *Xiphinema insigne** Loos, 1949
81. *Xiphinema orbum** Siddiqi, 1964
- Superfamily BELONDIROIDEA Thorne, 1939
- Family BELONDIRIDAE Thorne, 1939
- Subfamily BELONDIRINAE Thorne, 1939
- Genus *Belondira* Thorne, 1939
82. *Belondira bulbosa** Siddiqi, 1966
83. *Belondira porta** Thorne, 1964
84. *Belondira tenuidens** Thorne, 1964
- Genus *Axonchium*, Cobb, 1920
85. *Axonchium (Axonchium) bulbosum** Williams, 1958
86. *Axonchium (Axonchium) nitidum** Jairajpuri, 1964
- Subfamily DORYLAIMELLINAE Jairajpuri, 1964
- Genus *Dorylaimellus* Cobb, 1913
87. *Dorylaimellus (Dorylaimellus) demani** Goodey, 1963
88. *Dorylaimellus (Axodorylaimellus) parvulus** Thorne, 1939
89. *Dorylaimellus (Belondorylaimellus) discocephalus** Siddiqi, 1964
- Superfamily TYLENCHOLAIMOIDEA Filipjev, 1934
- Family TYLENCHOLAIMIDAE Filipjev, 1934
- Subfamily TYLENCHOLAIMINAE Filipjev, 1934
- Genus *Tylencholaimus* de Man, 1876
90. *Tylencholaimus nagauriensis** Baqri & Bohra, 2001
91. *Tylencholaimus leptonchoides** Loof, 1964
92. *Tylencholaimus gertii** Kruger, 1965
93. *Tylencholaimus annulatus** Baqri & Bohra, 2001
- Genus *Utahnema* Thorne, 1939
94. *Utahnema tenuidens** Thorne, 1939
- Family LEPTONCHIDAE Thorne, 1935
- Subfamily LEPTONCHINAE Thorne, 1935
- Genus *Leptonchus* Cobb, 1920
95. *Leptonchus granulatus** Cobb, 1920
- Genus *Proleptonchus* Lordello, 1955
96. *Proleptonchus clarus** Timm, 1964
- Subfamily TYLEPTINAE Jairajpuri, 1964
- Genus *Tyleptus* Thorne, 1939
97. *Tyleptus projectus** Thorne, 1939
- Family MYDONOMIDAE Thorne, 1964
- Subfamily MYDONOMINAE (Thorne, 1964),
Jairajpuri & Ahmad 1992
- Genus *Dorylaimoides* Thorne & Swanger, 1936
98. *Dorylaimoides (Digidorylaimoides) micoletzkyi** (de Man, 1921) Thorne & Swanger, 1936
99. *Dorylaimoides (Longidorylaimoides) leptura** Siddiqi, 1965
100. *Dorylaimoides (Dorylaimoides) parateres** Siddiqi, 1964
101. *Dorylaimoides (Tarjania) constrictoides** Goseco, Ferris & Ferris, 1976
- Suborder NYGOLAIMINA Ahmad & Jairajpuri, 1979
- Superfamily NYGOLAIMOIDEA Thorne, 1935
- Family NYGOLAIMIDAE Thorne, 1935
- Subfamily NYGOLAIMINAE Thorne, 1935
- Genus *Aquatides* Heyns, 1968
102. *Aquatides aquaticus** (Thorne, 1930) Thorne, 1974

103. *Aquatides thornei** (Schneider, 1937) Ahmad & Jairajpuri, 1982

Order MONONCHIDA Jairajpuri, 1969

Suborder MONONCHINA Kirjanova & Krall, 1969

Superfamily MONONCHOIDEA Chitwood, 1937

Family MONONCHIDAE Chitwood, 1937

Genus *Mononchus* Bastian, 1865

104. *Mononchus aquaticus** Coetzee, 1968

Family MYLONCHULIDAE Jairajpuri, 1969

Genus *Mylonchulus* (Cobb, 1916) Altherr, 1953

105. *Mylonchulus contractus** Jairajpuri, 1970

106. *Mylonchulus hawaiiensis** (Cassidy, 1931) Andrassy, 1958

107. *Mylonchulus lacustris** (N.A. Cobb in M.V. Cobb, 1915) Andrassy, 1958

108. *Mylonchulus minor** (Cobb, 1893) Andrassy, 1958

109. *Mylonchulus subsimilis** (Cobb, 1917) Meyl, 1957

Genus *Sporonchulus* (Cobb, 1917) Andrassy, 1958

110. *Sporonchulus vagabundus** Jairajpuri, 1971

Family IOTONCHIDAE Jairajpuri, 1969

Genus *Iotonchus* (Cobb, 1916) Altherr, 1950

111. *Iotonchus jairi** (Lordello, 1958) Clark, 1960

Table II. Nematodes identified by authors from Gujarat

Sl. No.	Orders	Total No. of species	No. of species recorded for the first time	New species
1.	Tylenchida	20	15	—
2.	Aphelenchida	1	1	—
3.	Dorylaimida	54	54	3
4.	Monochida	8	8	—
	Total	83	78	3

Order TYLENCHIDA Thorne, 1949

Key to suborders of TYLENCHIDA (after Siddiqi, 2000)

1. Median oesophagel bulb absent.....
..... HEXATYLINA
- Median oesophageal bulb present..... 2
2. Female reproductive system monodelphic with no postvulval uterine sac; phasmids or prophasmids absent; spermatheca ventral to gonad axis, hypopygma single; male oesophagus degenerate.. CRICONEMATINA
- Female reproductive system didelphic, if monodelphic then usually with a post vulval uterine sac; phasmids or prophasmids present; spermatheca not ventral to gonad axis; hypopygma double; male oesophagus rarely degenerate 3
3. Female reproductive system didelphic; phasmids present HOPLOLAIMINA
- Female reproductive system monodelphic; phasmids absent TYLENCHINA

Suborder TYLENCHINA Chitwood

in Chitwood & Chitwood, 1950

Family TYLENCHIDAE Orley, 1880

1. *Basiria brevistylus* (Khera, 1970) Ebsary, 1991
1970. *Boleodorus brevistylus* Khera, *Proc. zool. Soc. Calcutta*, 23 : 53-65

Measurements : Females (4) : L= 0.70-0.75 mm; a = 35-43; b= 5.1-6.3; c= 11.1-11.5; V= 77-80¹³⁻¹⁵; *Male* (1) : L=0.68 mm; a= 37; b= 5.3; c=11.1; T=65.

Description : Female : Lip region rounded, Stylet 8-9 m long with rounded basal knobs. Basal bulb set off and pyriform. Female reproductive system mono-prodelphic. Post vulval uterine sac 29-30 µm or 1.3-1.4 corresponding body-width long. Tail 63-65 µm long, conoid-elongate with rounded terminus. *Male* : Spicules 20 µm long. Gubernaculum 6 µm long. Bursa adanal. Tail 61 µm long, conoid similar to female.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of til and castor at Amata village 20 km from Rajkot Jamnagar Road, district Rajkot.

Elsewhere : Rajasthan.

Remarks : This species is being reported for the first time from the State.

2. *Basiria bilineata* (Saha & Khan, 1982)
Ebsary, 1991

1982. *Duotylenchus bilineatus* Saha & Khan, *Indian J. Nematol.*, 11 (2) : 205-211

Measurements (After Saha & Khan, 1982):
Females : L=0.39-0.61 mm; a= 32-90; b= 4.47-6.1; c= 4.1-6.5; V= 62-66; *Males* : L= 0.51-0.65 mm; a= 36-40; b= 5.6-5.9; c= 4.2-5.0

Description : *Female* (After Saha & Khan, 1982): Body ventrally arcuate upon fixation. Head continuous with body, conoid-truncate, smooth. Stylet 9-11 µm long, basal knobs moderately developed, slightly asymmetrical. Cardia distinct. Reproductive system mono-prodelphic. Spermatheca oval, filled with sperms. Post uterine sac half the corresponding body-width long. *Male* : Spicules 17-19 µm long. Gubernaculum 7-9 µm long, trough shaped. Bursa small, adanal. Tail 180 µm long, elongate conoid with pointed terminus.

Habitat & locality : Reported by Patel *et al.* (1987) from around roots of tobacco at Anand, district Anand.

3. *Ditylenchus triformis* Hirschmann & Sasser, 1955

Measurements (after Ahmad, 1996): *Females*: L= 1.30-1.40 mm; a= 18-30; b= 7.5-12.9; c= 10-12; c¹ = 4.4-5.1; V= 75-82

Description : *Female* : Body slender. Lip region smooth, slightly set off from body. Lateral fields marked by six incisures. Stylet 7.5-9.5 µm long. Spermatheca elongate, post vulval uterine sac present. Tail rounded. *Male*: Spicules 25-33 µm long. Bursa 30-50% of tail.

Habitat & locality : Reported by Patel *et al.* (1987) from roots of tobacco plants at Anand, district Anand.

Key to Superfamilies of HOPLOLAIMINA

1. Sub-ventral oesophageal glands enlarged, usually extending past the dorsal gland; sexual dimorphism in anterior region
..... HOPLOLAIMOIDEA
- Sub-ventral oesophageal glands not enlarged, not extending past the dorsal gland; sexual dimorphism in anterior region not manifest ...
..... DOLICHODOROIDEA

Superfamily HOPLOLAIMOIDEA Filipjev, 1934

**Key to Families of Hoplolaimoidea
(after Siddiqi, 2000)**

1. Mature female round, pear or lemon-shaped behind neck, with anus terminal or nearly so; male with stylet larger than that of female, and tail very short or absent, non-bursate (except *Bursadera*). Male develops by metamorphosis (except *Meloidodera*); third and fourth stage juveniles often swollen..... 2
- Mature females not round, pear or lemon-shaped, with anus not terminal; male with stylet equal or smaller than that of female and tail bursate, not very short (except *Verutus*), does not develop by metamorphosis; third-and fourth-stage juvenile normally not swollen 3
2. Excretory pore in mature female opposite to median bulb; female labial disc dorsoventrally elongated; male with large lip cap and large transverse slit-like amphidial apertures; gall inciting MELOIDOGYNIDAE
- Excretory pore in mature female behind median bulb; female labial disc rounded; male with small lip cap and with small oval to round amphidial apertures; not gall inciting
..... HETERODERIDAE
3. Juveniles and females with low arched cephalic framework, generally endo-parasites of roots *Pratylenchidae*
- Juveniles and females with high arched cephalic framework, generally ectoparasites of roots 4
4. Mature female swollen, sedentary..
..... ROTYLENCHULIDAE

— Mature female not swollen, migratory.
..... HOPLOLAIMIDAE

Family HOPLOLAIMIDAE Filipjev,
1934 (Wieser, 1953)

**Key to subfamilies of
HOPLOLAIMIDAE from Gujarat**

1. Phasmids large, scutellum-like
..... HOPLOLAIMINAE

— Phasmids small, pore-like
..... ROTYLENCHOIDINAE

Subfamily HOPLOLAIMINAE Filipjev, 1934

4. *Hoplolaimus indicus* Sher, 1963

1979. *Basirolaimus indicus* (Sher, 1963) Shamsi, *Nematol. Medit.*, 7 : 15-19

1982. *Hoplolaimus arachidis* Maharaja & Das, *Proc. Indian Acad. Parasitol.*, 3 : 30-32

Measurement: Females (10) : L=1.02-1.40 mm; a= 22-36; b= 7.5-9.7; c= 42-65; c =0.60-0.68; V¹⁰⁻¹¹= 52-57¹⁰⁻¹¹; *Males* (5) : L=0.94-1.30 mm; a= 26-36; b= 7.9-10.1; c=31-38; T= 50-55

Description: Female: Lip region hemispheroid, marked by 3-4 annules. Stylet robust, 30-34 µm long, basal knobs tulip shaped. Female reproductive system amphidelphic. Epiptygma single or double. Spermatheca filled with sperms. Tail with 8-13 annules. *Male:* Similar to female in general morphology. Spicules arcuate and cephalated, 37-48 µm long. Gubernaculum 12-20 µm long. Tail conoid. Bursa terminal.

Habitats & localities: Collected by ZSI party from soil around roots of groundnut, sugarcane, maize, cotton, chillies, brinjal, lady's finger etc. at different localities of Junagarh, Jamnagar, Rajkot, Surat, Valsad, Vadodara and Dangs districts.

Elsewhere : Rajasthan, West Bengal, Delhi, Himachal Pradesh, Bihar, Punjab, Haryana, U.P., Sikkim, etc.

Remarks : It is a widely distributed species in the State.

5. *Hoplolaimus pararobustus* (Schuurmans Stekhoven & Tenuissen, 1938) Sher, 1963

1938. *Tylenchorhynchus pararobustus* Sch. Stekh. & Teun. *Bruxelles : Inst. Pares. nat. Congo Belge*, 22 : 1-229

1959. *Hoplolaimus angustalatus* Whitehead, *Nematologica*, 4 : 70-75

Measurements (after Sher, 1963) : *Females* : L=1.42-1.52 mm; a=23-25; b= 8.8; c= 42-47; V= 57-62; *Males* (3) : L= 1.04-1.19 mm; a= 25-36; b= 7.0-8.5; c= 27.5-38.0; T = 44-53.

Description : Female : Lip region hemispherical, set off from body by constriction, marked by 3-4 annules. Stylet 38-49 µm long, with tulip- shaped basal knobs. Oesophagus typical of the genus. Reproductive system amphidelphic. Sperma- theca spherical, axial with sperms. Tail short, rounded, usually hemispherical, with 7-15 annules. Anterior and posterior scutellum 24-52% and 58-89% respectively. *Male :* Similar to female in general morphology. Spicules 44-51 µm long. Gubernaculum 21-22 µm long trough-like. Bursa large, with crenate margins enclosing tail. Tail conoid.

Habitat & locality: Singh *et al.* (1964) reported this species from around roots of tobacco in Gujarat.

Elsewhere : Maharashtra.

6. *Scutellonema brachyurum* (Steiner, 1938) Andrassy, 1958

1938. *Rotylenchus brachyurus* Steiner, *J. Agric. Research. U.S. Dept. Agric.* 56 : 1-8.

1958. *Scutellonema brachyurum* (Steiner, 1938) Andrassy, *Nematologica*, 3 : 44-56.

Measurements (after Baqri, 1991) : *Females* L= 0.52-0.80 mm; a= 22-34; b= 5.3-7.7; c= 49-88; V= 56-¹⁸⁻³¹64¹⁵⁻²⁸

Description : Female : Body curved ventrally into an open circle. Lip region slightly offset from body, marked by 3-4 annules. Oesophageal glands overlap intestine dorsally. Reproductive system amphidelphic. Sperma- theca with sperms. Rectum about 1.0-1.5 anal body-width long. Tail 8-12 µm

long, bluntly rounded, varying considerably at the tip with a ventral side more pointed than dorsal; marked by 6-10 annules ventrally. Scutellum slightly anterior or posterior to anus. *Male* : Not found.

Habitat & Locality : Patel *et al.* (1988) reported this species from around roots of banana at Baroda district.

Elsewhere : West Bengal, Himachal Pradesh, Orissa and Sikkim.

Subfamily ROTYLENCHOIDINAE
Whitehead, 1958

Key to Species of *Helicotylenchus* from Gujarat

1. Tail hemispherical, subcylindrical or subconoid lacking ventral projection 2
- Tail dorsally convex-conoid to pointed terminus or with a slight to well developed ventral projection or terminal projection 7
2. Lip region truncate *truncatus*
- Lip region rounded 3
3. Spermatheca functional *anhelicus*
- Spermatheca non functional 4
4. Spear 35-37 μm long *orthosomaticus*
- Spear 30 μm long 5
5. Lip annules indistinct, tail hemispherical
..... *retusus*
- Lip annules distinct, tail not hemispherical. 6
6. Tail terminus smooth ventrally . *rotundicauda*
- Tail terminus annulated *multicinctus*
7. Ventral or terminal projection of tail slightly developed (less than 2 annules long) 8
- Ventral or terminal projection of tail well developed (2 or more annules long) 10
8. Spermatheca functional 9
- Spermatheca non functional *indicus*
9. Tail projection elongate, usually ending in mucro or point 10
- Tail projection short and blunt, without mucro

..... *exallus*

10. Spear 30-32 μm long *erythrinae*
- Spear 24-27 μm long *dihystera*

7. *Helicotylenchus anhelicus* Sher, 1966

Measurements: Females (2) : L=0.84-0.86 mm; a= 27-30; b= 5.8-6.2; c= 44-45; c =1.0-1.1; V= 54¹¹⁻¹²-60¹¹⁻¹²

Description : Female : Body ventrally curved spirally. Lip region hemispherical, marked by 4-5 annules. Stylet 27-28 μm long. Spermatheca offset with sperms. Phasmids 4-5 annules anterior to anus. Tail more curved dorsally, 19 μm long, with hemispherical terminus, marked by 11 annules. *Male*: Not found.

Habitat & locality : Collected by ZSI party in October, 2001 from soil around roots of cotton at Reebara, Taluka Gondal, district Rajkot.

Remarks : The species is being reported here for the first time from India.

**8. *Helicotylenchus dihystera* (Cobb, 1893)
Sher, 1961**

1960. *Helicotylenchus crenatus* Das, *Z. Parasitenk.* 19 : 553-605

1968. *H. puniceae* Swarup & Sethi, *Bull. Ent.*, 9 : 76-80.

Measurements : Females (20) : L= 0.54-0.83 mm; a = 20-32; b= 4.5-6.4; c= 44-46; c 1.0-1.3; V= ¹²⁻¹⁵ 60-66¹¹⁻¹³

Description : Female : Body spirally curved upon fixation. Lip region continuous with body, hemispherical, marked by 4-5 striae. Stylet 24-27 μm long, with concave or anteriorly indented basal knobs. Female reproductive system amphidelphic. Spermatheca rounded, functional. Tail 13-18 μm long, dorsally convex-conoid, with slight ventral projection. Phasmids 6-8 striae anterior to anus. *Male* : Not found.

Habitats & localities: Collected by ZSI party in September, October, 2000 from soil around roots of jowar and groundnut at Bhojpur, Taluka Gondal, district Rajkot and Sasan Gir at district Junagarh.

Elsewhere : Himachal Pradesh, West Bengal, Rajasthan, Karnataka, Orissa, Sikkim, Haryana, Madhya Pradesh, Maharashtra, etc.

Remarks : This species is being reported for the first time from the State.

9. *Helicotylenchus erythrinae*
(Zimmermann, 1904) Golden, 1956

Measurements : Females (10) : L= 0.73-0.88 mm; a= 23-26; b= 6.6-7.5; c= 29-32; c= 1.3-1.5; V= ¹⁴⁻¹⁶ 58-63¹⁵⁻¹⁷

Description : Female : Body spirally curved. Lip region hemispherical, marked by 4-5 striae. Stylet 30-32 μ m long, basal knobs slightly anteriorly directed. Spermatheca functional. Tail 25-26 μ m long, tapering into a pronounced ventral projection. Phasmids 1-3 annules anterior to anus. *Male* : Not found.

Habitats & localities: Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Sasan Gir, district Junagarh. Also collected from around roots of groundnut at Bedi Taluka Rajkot, district Rajkot.

Elsewhere: West Bengal, Rajasthan and Tamil Nadu.

10. *Helicotylenchus exallus* Sher, 1966

Measurements : Females (2) : L= 0.61-0.65 mm; a= 26-28; b= 6.0-6.2; c= 40-45; c =0.7-1.2; V= ¹⁰⁻¹¹60-62⁸⁻¹⁰

Description : Female : Body spirally curved. Lip region hemispherical, marked by 4 annules. Stylet 25-27 μ m long, with flattened anteriorly basal knobs. Spermatheca offset with sperms. Phasmids 3-5 annules anterior to anus. Tail more curved dorsally with slight ventral projection, marked by 12 annules. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Sasan Gir, district Junagarh.

Elsewhere : Rajasthan & Sikkim.

Remarks : The species is being reported for the first time from the State.

11. *Helicotylenchus multicinctus* (Cobb, 1893) Golden, 1956

1893. *Tylenchus multicinctus* Cobb, *Macleay Mem. Vol. Linn. Soc., NSW*, 252-308

Measurements : Females (5) : L= 0.73-0.87 mm; a= 30-36; b= 6.1-6.6; c= 44-50; c =0.60-1.00; V= ⁸⁻⁹60-66⁸⁻⁹

Description : Female : Body spirally curved. Lip region hemispherical, marked by 3-5 striae. Stylet 25-29 μ m long, with anteriorly indented basal knobs. Tail dorsally curved with hemispherical terminus, 16-18 μ m long marked by 7-9 striae ventrally. Phasmids slightly anterior to anus. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around unidentified grasses and groundnut at Sasan Gir, district Junagarh.

Elsewhere : West Bengal, Rajasthan and Orissa.

Remarks : This species is being reported for the first time from the State.

12. *Helicotylenchus orthosomaticus* Siddiqi, 1972

Measurements : Females (2) : L= 0.73-0.79 mm; a= 28-30; b= 5.2-5.9; c= 43-44; c = 0.80-0.85; V= ¹⁰⁻¹² 63-65¹¹⁻¹³

Description : Female: Body curved spirally. Lip region elevated, broadly rounded, continuous, without annules; frame work heavily sclerotized. Stylet 35-37 μ m long, with rounded basal knobs. Spermatheca small, axial without sperms. Tail hemispheroidal, with 15-17 annules. Phasmids 11-15 annules anterior to anus. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of til at Verawal, Junagarh Road, district Junagarh.

Remarks : This species is being recorded for the first time from India.

13. *Helicotylenchus retusus*
Siddiqi & Brown, 1969

Measurements: Females (8) : L=0.75-0.94 mm; a= 24-27; b= 5.4-7.3; c= 53-61; c=0.9-1.0; V= ¹¹⁻¹²60-62¹⁰⁻¹¹

Description : Female : Body 'C' shaped upon fixation. Lip region hemispherical with indistinct annules. Stylet 25-26 μm long, with anteriorly indented basal knobs. Female reproductive system amphidelphic. Spermatheca without sperms. Tail terminus hemispherical, symmetrical, marked by 10-14 annules ventrally. Phasmids 9-12 annules anterior to anus. *Male* : Not found.

Habitats & localities : Collected by ZSI party in September, 2000 from around roots of groundnut at Khedipur & Sasan Gir, district Junagarh.

Elsewhere : West Bengal, Rajasthan, Bihar, Maharashtra.

Remarks : This species is being recorded for the first time from the State.

14. *Helicotylenchus rotundicauda* Sher, 1966

Measurements : Females (3) : L= 0.62-0.91 mm; a= 26-35; b= 4.4.-6.4; c= 31-39; c=1.0-1.3; V= $8\text{-}9\text{61-}64\text{9-}10$

Description : Female : Body spirally curved. Lip region hemispherical, marked by 4 annules. Stylet 25-26 μm long, with rounded basal knobs. Spermatheca offset without sperms. Phasmids 4-5 annules anterior to anus. Tail 20-23 μm long, more curved dorsally, terminus irregularly hemispherical, without striations ventrally, marked by 9 annules. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of groundnut at Sasan Gir, district Junagarh.

Elsewhere : Rajasthan.

Remarks : This species is being recorded for the first time from the State.

15. *Helicotylenchus truncatus* Roman, 1965

Measurements: Females (3): L= 0.50-0.52 mm; a= 25-30; b= 48-52; c= 36-37; c=0.9-1.2; V= $10\text{-}11\text{63-}64\text{11-}12$

Description : Female : Body spirally curved. Lip region truncate, marked by 3-4 annules. Stylet 21-22 μm long, with cupped-

shaped basal knobs. Spermatheca functional. Phasmids at anus level. Tail 14 μm long, truncate. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of groundnut at Sasan Gir, district Junagarh.

Remarks : This species is being reported for the first time from the State.

16. *Helicotylenchus indicus* Siddiqi, 1963

Measurements (after Siddiqi, 1963) : *Female* : L= 0.45-0.63 mm; a= 23-32; b= 5.5.-6.4; c= 35-47; V=60-65

Description : Female : Body spiral-shaped. Lip region truncate, 1 or 3 indistinct annules. Stylet 21-23 μm long, with basal knobs having sloping anterior surface. Spermatheca without sperms. Phasmids slightly posterior to 4 annules anterior to anus. Tail more curved dorsally, terminus hemispherical or with slight ventral projection, marked by 9 to 12 annules. *Male* : Not found

Remarks : This species has been reported by Sharma *et al.* (1993) from pigeon pea fields of districts Bharuch, Vadodara, Kheda & Surat.

Family ROTYLENCHULIDAE

Husain & Khan, 1967 (Husain, 1976)

17. *Rotylenchulus reniformis*

Linford & Oliveira, 1940

Measurements (after Dasgupta *et al.* 1968) : *Females (immature)*: L= 0.34-0.42 mm; a= 22-27; b= 3.6-4.3; b¹ = 2.4-3.5' c= 14-17; c= 2.6-3.4; V= 68-73; Spear = 16-18 μm ; *Females (mature)*: L= 0.38-0.52 mm; a= 4-5; V=68-73; *Males* : L= 0.38-0.43 mm; a= 24-29; b¹ = 2.8-4.8; c= 12-17; T= 35-45; stylet = 12-15 μm ; spicules = 19-23 mm; gubernaculum = 7-9 μm .; *Juveniles*: L= 0.35 mm ? 0.41 mm; a=20- 24; b¹ = 3.5-4.1; c= 12-16; stylet= 13-15 μm .

Description : Immature Female : Body slender, open c-shaped. Lip region elevated; conoid, continuous with body. Cephalic framework heavily

sclerotized. Stylet knobs rounded, sloping posteriorly. Oesophageal glands overlapping intestine ventrally and laterally. Ovaries immature. Tail tapering to narrow, rounded terminus and distinct hyaline portion. *Mature Female* : Obese, kidney-shaped, neck contour irregular. Vulva raised. Body beyond anus hemispherical, with a 5-9 μm long slender terminal portion. Eggs laid in gelatinous matrix. *Male* : Anterior region degenerate, stylet and oesophagus degenerate. Spicules elongateslender, ventrally arcuate; gubernaculum linear; bursa reduced, subterminal.

Remarks : *R. reniformis* is a sedentary and semi-endoparasite attacking several crops and fruit trees in India.

Family PRATYLENCHIDAE
Thorne, 1949 (SIDDIQI, 1963)

Key to subfamilies of *Pratylenchidae* from Gujarat (after Siddiqi, 2000)

1. Oesophageal glands extending over intestine mostly ventrally and ventro laterally; no marked sexual dimorphism in anterior region 2
- Oesophageal glands extending over intestine mostly dorsally and dorsolaterally; with marked sexual dimorphism in anterior region 3
2. Tails similar between sexes; phasmids near terminus HIRSCHMANNIELLINAE
- Tails dissimilar between sexes; phasmids near terminus PRATYLENCHINAE
3. Mature female swollen; sexual dimorphism in cephalic region, stylet and oesophagus present; migratory endoparasites of roots; sometimes sedentary RADOPHOLINAE

Subfamily PRATYLENCHINAE Thorne, 1949

Key to Species of *Pratylenchus* from Gujarat

1. Lip region marked by two annules *loosi*
- Lip region marked by three annules 2
2. Stylet 15-16 μm long *zeae*
- Stylet 19-20 μm long *thornei*

18. *Pratylenchus loosi* Loof, 1960

Measurements : *Females*(2) : L= 0.43-0.46 mm; a= 24-25; b= 3.5-3.6; c= 17-18; c =1.7; V= 71-74¹⁵⁻¹⁷

Description : *Female* : Body more or less straight. Lip region marked by two annules. Stylet 14-16 μm long. Female reproductive system prodelphic. Spermatheca filled with sperms. Tail terminus narrowly rounded to subacute. *Male* : Not found.

Habitat & locality : Collected by ZSI party in October, 2001 from soil around roots of sugarcane at Pipalikhaid, district Navsari.

Elsewhere : West Bengal, Sikkim.

Remarks : This species is being recorded for the first time from the State.

19. *Pratylenchus thornei* Sher & Allen, 1953

Measurements : *Females* (2) : L= 0.45-0.53 mm; a= 25-27; b= 4.6-4.6; c= 18-21; c =1.6; V= 77-78¹⁷⁻¹⁸

Description : *Female*: Lip region continuous, marked by three annules; labial sclerotization extending backwards on two or three body annules. Stylet 19-20 μm long. Spermatheca without sperms. Tail tip broadly rounded to truncate, smooth. *Male*: Not found.

Habitat & locality : Collected by ZSI party in October, 2001 from soil around roots of chilli at Taluka Gondal, district Rajkot.

Elsewhere : Haryana, Punjab.

20. *Pratylenchus zeae* Graham, 1951

Measurements : *Females* (2) : L= 0.38-0.57 mm; a= 18-22; b= 6.0-6.5; c= 14-18; V=69-74

Description : *Female* : Body almost straight. Lip region marked by three annules. Stylet 15-16 μm long. Tail tip bluntly pointed (20-25 annules), smooth. *Male* : Not found.

Habitat & locality : Collected by ZSI party in October, 2001 from soil around roots of chilli at Taluka Gondal, district Rajkot.

Elsewhere : Haryana, Maharashtra, Punjab.

Subfamily HIRSCHMANNELLINAE
Fotedar & Handoo, 1978

21. *Hirschmanniella gracilis* (De Man, 1880)
Luc & Goodey, 1963

Measurements : *Females* (5) : L= 1.43-1.96 mm; a= 42-62; b= 11.6-12.0; c= 16-21; V= 48-54; *Males* (2) : L= 1.22-1.18 mm; a= 42-64; b= 10.4-13.7; c= 15.5-22.5; T= 50-52.

Description : *Female* : Body slightly curved ventrally. Lip region continuous with body, apex usually flattened, marked by 3-5 annules. Stylet robust, 20-24 μ m long, with rounded basal knobs. Female reproductive system amphidelphic. Spermatheca filled with sperms. Tail elongate conoid, 3.5-6.0 anal body-width long, terminus with a pointed projection. Phasmids located in posterior half of tail, 21-41% of tail length from terminus. *Male* : Spicules 28-36 μ m long. Gubernaculum 9-14 μ m long. Bursa subterminal. Tail slightly ventrally curved with terminus bearing a pointed ventral projection.

Habitat & locality : Collected by ZSI party in January, 1998 from soil around roots of rice at Godhra, district Panchmahal.

Elsewhere : This is a widely distributed species in USA, Canada, Netherlands, Germany and India. In India, *H. gracilis* has been established as key pest of rice in West Bengal State.

Remarks : This species has been reported for the first time from the State.

22. *Hirschmanniella mucronata* (Das, 1960)
Luc & Goodey, 1963

Measurements (after Jairajpuri & Baqri, 1991) : *Females*: L= 1.67-2.20 mm; a= 57-60; b= 11-14; c= 18-20; V= 49-53; *Males*: L= 1.70-1.83 mm; a= 52-60; b= 12-14; c= 17-21; T=51-52.

Description : *Female* : Body slightly ventrally curved. Lip region continuous, low, hemispherical, marked by 4-6 annules. Stylet robust, 24-29 μ m long; basal knobs rounded, slightly sloping anteriorly. Female reproductive system amphidelphic.

Spermatheca filled with sperms. Intestine slightly overlapping rectum. Tail terminus pointed, usually with a ventral projection or mucro. Phasmids in posterior third of tail. *Male* : Spicules 29-36 μ m long. Gubernaculum 9-14 μ m long. Bursa subterminal.

Habitat & locality: Reported by Patel *et al.* (1999) from around roots of rice at Ahmedabad district.

Elsewhere : Andhra Pradesh and Orissa

23. *Hirschmanniella oryzae* (van Breda de Haan, 1902) Luc & Goodey, 1963

Measurements (after Jairajpuri & Baqri, 1991) : *Females* : L= 1.14-1.63 mm; a= 50-67; b=8.8-12.1; c=15-19; V= 50-55; *Males*: L= 1.01-1.40 mm; a= 52-61; b= 9.1-11.3; c= 16-18; T=50-51.

Description : *Female* : Body straight or slightly curved ventrally. Lip region continuous with body, low, flattened with rounded apex, marked by three to four annules. Stylet robust, 16-19 μ m long, with rounded basal knobs. Female reproductive system amphidelphic. Spermatheca with sperms. Intestine not overlapping rectum. Tail elongate conoid 4.3-6.5 anal body width long, with mucronate terminus. Phasmids located in the posterior half of tail. *Male* : Spicules cephalated, slightly arcuate, 18-28 μ m long. Gubernaculum 7-9 μ m long. Bursa subterminal. Tail with a pointed ventral mucro.

Habitat & locality : Patel and his co-workers have reported this species from Kheda district.

Elsewhere : West Bengal, Bihar.

Remarks : *H. oryzae* is widely distributed and considered a keypest of rice in far east and tropical countries (including India).

Subfamily RADOPHOLINAE Allen & Sher, 1967

24. *Radopholus similis* (Cobb, 1893)
Thorne, 1949

1893. *Tylenchus similis*, Cobb, *Macleay Mem. Vol. linn. Soc. NSW*, 252-308.

1936. *Rotylenchus similis* (Cobb, 1893) Filipjev, *Proc. Helminth. Soc. Wash.* 3 : 80-82.

Measurements (after Sher, 1963) : *Females* : L=0.52-0.88 mm; a=22-30; b=4.7-7.4; c=8-13; V=55-61. *Gravid* : L=0.61-0.74 mm; V=52-57. *Male* : L=0.59-0.76 mm; a=31-44; b=6.1-6.6; c=8-10.

Description : *Females* : Lip region slightly marked from body, with 3-4 annules. Stylet 17-20 μ m, with rounded and slightly anteriorly indented basal Knobs. Reproductive system amphidelphic. Spermatheca spherical, filled with rod like sperms. Intestine indistinctly overlapping rectum. Tail elongate-conoid, with a narrow rounded or indented terminus. *Males* : Lip region high, hemispherical, distinctly offset, marked with 3-5 annules in the posterior region, lateral lips distinctly smaller. Oesophagus and Stylet degenerate. Spicules 19-22 μ m long. Gubernaculum 8-12 μ m long, protrusible with distinct sharp clawlike titillae at distal end. Bursa coarsely crenate, enveloping about 2/3 of tail. Tail tapering to rounded or almost pointed terminus.

Habitat & locality : Patel *et al.* reported this species from kheda, Vadodara, Bharuch and Surat districts.

Elsewhere : Jammu, Andhra Pradesh, Tamil Nadu, Kerala etc.

Family MELOIDOGYNIDAE Skarbilovich, 1959 (Wouts, 1973)

Key to species of *Meloidogyne* from Gujarat (Modified after Whitehead, 1968)

1. Posterior cuticular pattern of female with lateral fields 2
— Posterior cuticular pattern without lateral fields 3
2. Lateral fields in posterior cuticular pattern with two incisures *javanica*
— Lateral fields of pattern, if present, ill defined, distinct tail whorl present, phasmids fairly close to tail *indica*
3. Posterior region of pattern 'stippled' dorsal arch hemispherical, striae close smooth to wavy *hapla*

— Posterior region of pattern without 'stippling' dorsal arch low or trapezoid in shape 4

4. Mean total length of second stage larvae 450 μ -490 μ ; dorsal arch pattern low, indented laterally *arenaria*

— Mean total length of second stage larvae 341 μ -383 μ ; dorsal arch of pattern trapezoid in shape *incognita*

25. *Meloidogyne arenaria* (Neal, 1889) Chitwood, 1948

1889. *Anguillula arenaria*, Neal Bull., U. S. Bur. Ent. No. 20 : 1-31.

Measurements (after Chitwood, 1949) : *Females* : L=510-1000 μ m; width=400-600 μ m; stylet=14.4-15.8 μ m. *Males* : L=1270-2000 μ m; a=11-16; stylet=20-24 μ m. *Second stage juvenile* : L=450-490 μ m; a=26-32; b=7.2-7.8; c=6.0-7.5; stylet=10 μ m.

Description (after Whitehead, 1868) : *Female* : Body poriform, head with one annule behind head cap. Stylet with rounded basal knobs. Posterior cuticular pattern round to oval (with longer axis parallel to vulva). Dorsal arch low, usually compressed dorso-laterally. Striae fairly widely separated and mostly smooth. No stippling or punctate markings between anus and tail terminus. *Male* : Head low, a recorded truncate, cone shaped. Body narrowing slightly behind head. Stylet with rounded knobs. Spicules thin walled, tapering to subacute bifid termini, ventrolateral flange present. Gubernaculum simple, crescentic. Tail straight near terminus. Phasmids at cloacal level or anterior. *Second stage juvenile* : Head not offset, a truncate cone in lateral view with faintly separated annules behind the wide flat head cap. Stylet knobs fairly prominent, rounded. Tail narrow, tapering to subacute terminus.

Host & locality : Reported by Patel *et al.* (1987) from roots of tobacco at Anand.

Elsewhere : West Bengal, Bihar, Uttar Pradesh, Haryana, Himachal Pradesh, Punjab, Delhi, Tamil Nadu, Maharashtra, etc.

26. *Meloidogyne hapla* Chitwood, 1949

Measurements (after Whitehead, 1968):
Females : L= 419-845 μm ; width = 311-561 μm ; stylet= 10-13 μm . *Males* : L= 791-1432 μm ; a= 33.3-47.0; head length = 4.3-7.9 μm ; stylet = 17.3-22.7 μm ; Spicules = 21.6-28.10 μm ; gubernaculum = 7.2-9.4 μm . *Second stage juveniles* : (2) : L= 312-355 μm ; a= 20.1-26.6; c= 7.3-10.2; tail= 33-48 μm .

Description : *Female*: Body pyriform with short neck. Head with 2 annules behind head cap. Stylet knobs rounded, inconspicuous. Posterior cuticular pattern roughly circular, composed of closely spaced smooth or slightly wavy striae. Dorsal arch low. Tail with few striae distinct punctations forming a stippled area between the anus and tail terminus. *Male* : Head not offset, a truncate cone to hemispherical in outline, usually one annule behind head cap. Stylet slender, stylet knobs rounded. Lateral fields with 4 incisures. Tail terminus bluntly rounded. Phasmids at cloacal level. Spicule slightly curved. Gubernaculum crescentic. *Second stage juvenile* : Head not set off, a truncate cone shape. Head cap followed by 3 annules on sublateral head sector, 1 annule on lateral head sectors. Stylet knobs rounded. Lateral fields with 4 incisures. Tail tip variable, subacute or sometimes bifid.

Host & locality : This species has been reported by Patel *et al.* (1987) from roots of tobacco at Anand.

Elsewhere : Assam, Himachal Pradesh, West Bengal, Tamil Nadu, etc.

27. *Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949

Measurements (after Whitehead, 1968) :
Females : (10) : L=0.50-0.72 μm ; width = 331-520 μm ; stylet = 13-16 μm . *Males* (4) : L= 1.10-1.95 μm ; a= 31-35; head height= 6.8-8.6 μm ; stylet = 23-27 μm ; spicules = 29-40 μm ; gubernaculum = 24.9-31.5 μm . *Second stage juveniles* (6) : L= 0.33-0.40 mm; a= 24-31; b=2.0-2.14; c= 64.8.4; stylet = 9-10 μm .

Description : *Female*: Body spherical with projecting neck. Lip region bearing 2-3 striae behind

head cap. Lateral fields not clear. Stylet knobs rounded. Posterior cuticular pattern highly variable, with striae closely spaced; wavy to zigzag, specially dorsally and laterally. *Male* : Body slender, cuticle transversely striated. Lateral fields marked by four incisures. Lip region almost continuous with body, truncate, cone-shaped, marked by distinct striae. Stylet with flat concave basal knobs. Tail bluntly rounded with smooth terminus. Phasmids at cloacal level. Spicules curved. Gubernaculum crescent-shaped. *Second stage juvenile*: Lateral fields marked by four incisures. Lip region continuous, truncate, cone-shaped in lateral view, marked by two striae in lateral view and three striae in dorsal or ventral view. Lip cap wide. Tail tapering to subacute terminus.

Hosts & localities: Collected by ZSI party from roots of cotton and brinjal at district Sabarkantha.

Elsewhere : Himachal Pradesh, West Bengal, Delhi, Karnataka, Uttar Pradesh, Kerala, Tamil Nadu, Assam, Rajasthan, Haryana, Orissa, Bihar, Maharashtra, Madhya Pradesh.

28. *Meloidogyne javanica* (Treub, 1885)
 Chitwood, 1949

Measurements (after Whitehead, 1968):
Females (5) : L= 0.54-0.80 mm; width= 31-58 μm ; stylet= 14-18 μm . *Males* (5) : L= 0.75-1.29 mm, a= 17.5-24.3; stylet= 20-23 μm spicules = 21-32 μm ; gubernaculum = 7.2-9.4 μm . *Second stage juvenile* (5) : L= 0.38-0.45 mm; a=27-36; b= 2.1-3.3; stylet = 9.4-11.4 μm

Description : *Female* : Body almost spherical, with projecting neck, rounded posteriorly but lip region protruding slightly. Lateral fields marked by two incisures. Lip region slightly wider than adjoining body, marked by one stria behind head cap. Stylet slender with rounded basal knobs. Perineal pattern round or oval to pear-shaped, dorsal arch varying from rounded to moderate height, may be flattened dorsally, striae smooth to wavy. *Male* : Lip region rounded in dorso-ventral view, continuous with body, the basal striae wider than first one. Lateral fields marked by four incisures. Stylet knobs rounded. Tail shape variable, digital in lateral view and bluntly rounded in ventral. Phasmids situated at cloacal level.

Spicules slightly curved. Gubernaculum thin crescentic. *Second stage juvenile* : Lip region continuous, truncate, cone-shaped in lateral view, marked by three striae behind head cap. Stylet knobs prominent. Lateral fields marked by four incisures. Tail tapering to subacute or finely rounded terminus.

Host & localities : Reported from roots of groundnuts from groundnut growing areas of the State.

Elsewhere : Himachal Pradesh, West Bengal, Delhi, Karnataka, Uttar Pradesh, Rajasthan, Haryana, Bihar, Madhya Pradesh, etc.

29. *Meloidogyne indica* Whitehead, 1968

Measurement (after Whitehead, 1968) : *Larvae*: L=381-448 μm ; c= 21.2-31.0; tail length = 13.0-20.1; d= 1.06-1.78; stylet= 10-14 μm . *Female* : Width of stylet base= 4-5 μm , width base head = 6-7 μm ; stylet=12-1 μm . *Mature female* : Body saccate with fairly thick cuticle, neck short; head end divided into six sectors. Head with one annule behind head cap. Excretory pore about 20 annule (16-22) behind head; anterior margins of spear knobs either concave or backward slopping; cuticular pattern faint, composed of closely spaced, usually smooth, striae forming a distinct tail whorl with low, rounded dorsal arch, phasmids not as close to tail terminus. *Male* : Lip region hemispherical or truncate-cone shape, not offset, with two annules behind head-cap, anterior annule longer than posterior. Lateral fields fully aerolated; tail rather long and apparently concave ventrally; phasmids opposite cloaca. *Larvae* : Head not offset, low truncate-cone shaped. Stylet knobs fairly prominent rounded, anterior margins often back sloped; tail conoid terminus usually blunt, unstriated.

Host & locality : Patel *et al.*, (2002) reported this species from around roots of citrus at Banaskantha district.

Family HETERODERIDAE Filipjev & Schuurman & Stekhovan, 1941 (Skarbilovich, 1947)

30. *Heterodera zae* Koshy, Swarup & Sethi, 1971

Measurements (after Koshy *et al.*, 1971):

Females (10): L= 0.31-0.70 mm; width= 0.19-0.60 mm. *Second stage juveniles* (15): L= 0.36-0.44 mm; a= 17-28; b= 2.7-6.5; b' = 2.1-4.2; c= 7-13; stylet = 19-25m; tail= 31-56m

Description : *Mature female and cyst*: Pearl white to light brown and lemon-shaped, with a projecting neck and vulval cone. Lip region offset, marked by 2 striae. Vulva conspicuous, protruding posteriorly. Reproductive system typical of the genus. Vulval cone ambifemstrate. Bullae present below the under bridge. Arms indistinct. *Second stage juveniles* : Body tapering posteriorly. Head continuous with body, marked by 4-5 striae. Lateral fields marked by four incisures. Stylet with slightly anteriorly directed basal knobs. Tail 32-50 m long (hyaline part 16-30m) with bluntly rounded terminus. Phasmids situated in middle of hyaline tail terminus. *Male* : Not known.

Host & locality : Widely distributed in maize growing areas of Gujarat.

Elsewhere : In India : Arunachal Pradesh, Bihar, Delhi, Haryana, Himachal Pradesh, Jammu & Kashmir, Maharashtra, Punjab, Rajasthan and Uttar Pradesh.

31. *Heterodera cajani* Koshy, 1967

Measurements (after Yadav & Verma, 1983): *Cyst*: L= 360-690 μm ; W= 175-500 μm *Male*: L= 0.48-0.65 mm; a= 20.0-34.8; stylet= 21.0-26.0 μm ; spicule= 21-27 μm ; gubernaculum = 6.5-7.0 μm . *Second stage juveniles* : L= 345-515 μm ; a= 18-29; b= 3.2-5.2; c= 7.8-12.3; c' = 2.7-6.1; stylet= 22-27 μm ; tail length = 31-52 μm .

Description : *Mature Female* : Adult lemon shaped, light to dark brown in colour. Vulva 35-53 μm long slit. Ambifonestrated. *Male*: Stylet 21-26 mm long, spicules 21-22 mm long. Gubernaculum 6.5-7.6 μm long. *Second stage juvenile*: Lateral fields marked by four incisures. Stylet well developed, 22-27 mm long, with anteriorly directed basal knobs. Tail 31.5-52 mm long, hyaline portion 14-30 mm.

Host & locality : Reported from roots of Pigeonpea from Bharuch, Gujarat.

Elsewhere : In India : Delhi, Himachal Pradesh, Haryana, Uttar Pradesh, Rajasthan, Maharashtra,

Madhya Pradesh, Punjab; Tamil Nadu, Andhra Pradesh, Bihar, Karnataka, West Bengal.

Family TELEOTYLENCHIDAE Siddiqi, 1960

32. *Telotylenchus paaloofi* Tikyani & Khera, 1970

Measurements : *Female* (1): L= 0.57 mm; a= 33; b= 5.2; c= 21; c'= 2.07; V= $10^{11}55^{10-11}$ *Male* (1): L= 0.56 mm; a=35; b= 4.9; c= 17; c' = 4.7; T= 53.

Description : *Female*: Body slightly ventrally arcuate upon fixation. Lip region hemispheroid, offset, marked by 6 striae. Stylet 18 μ m long, with backwardly directed basal knobs. Female reproductive system amphidelphic. Spermatheca spheroid with sperms. Tail bluntly conical with a rounded tip, about 2 anal body-width long. Phasmids at one third of the tail. *Male* : Spicules 20 μ m long medially. Gubernaculum 13 μ m long. Bursa completely enveloping the tail. Phasmids at the middle of tail. Tail arcuate, regularly tapering to a pointed terminus.

Habitat & locality : Collected by ZSI party from soil around roots of unidentified plants at Sabarkantha district.

Elsewhere : Rajasthan

Remarks : This species is being recorded for the first time from the State.

Key to species of *Tylenchorhynchus* from Gujarat

1. Lateral lines-3 *divittatus*
– Lateral lines-4 2
2. Stylet 21-23 μ m long..... *nudus*
– Stylet less than 20 μ m long 3
3. Tail elongate, subclavate with characteristic shallow depression on its dorsal side
..... *microcephalus*
– Tail cylindrical to subcylindrical or conoid. 4
4. Lip region marked by 6 striae *latus*
– Lip region marked by 3-4 striae *mashhoodi*

33. *Tylenchorhynchus devittatus* Siddiqi, 1961

Measurements : *Female* (1): L= 0.75 mm; a= 30; b=4.3; c= 17; V= 52.

Description : *Female* : Body curved in posterior half of its length upon fixation. Lip region offset. Stylet 17 μ m long. Female reproductive system amphidelphic. Spermatheca spherical, filled with sperms. Tail cylindrical, 42 μ m long, terminus striated. Phasmids posterior to anus. *Male*: Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of cauliflower at Vatwada village, district Surat.

Remarks : This species is hereby recorded as new record from the State.

34. *Tylenchorhynchus latus* Allen, 1955

Measurements (after Tarjan, 1973) : *Females* : L= 0.58-0.70 mm; a= 30-40; b= 4.9-5.4; c= 18-22, V= 56-61.

Description : *Female* : Lip region offset, marked by 6 annules. Labial framework slightly sclerotized. Stylet 16-17 μ m long, with anteriorly directed basal knobs. Reproductive system amphidelphic. Tail conoid, with bluntly pointed to smooth terminus, marked with 14-15 annules, 2.2 anal body width long. *Male* : Not found.

Habitat & Locality : Singh *et al.* (1964) have reported this species from tobacco growing districts of Gujarat.

35. *Tylenchorhynchus microcephalus*
Siddiqi & Patel, 1990

Measurements (after Siddiqi & Patel, 1990): *Females* (10): L= 0.36-0.81 mm; a= 31-38; b= 4.8-5.8; c= 13-16; c'= 3.8-5.7; V= 50- 50 *Males* (6): L= 0.62-0.71 mm; a= 37-45; b= 4.4-5.3; c=13-15; c'= 3.0-3.5; T=54-58; spicules= 21-25; gubernaculum= 12-14.

Description : *Female*: Body ventrally arcuate. Lip region continuous with body contour, conoid-truncate, smooth but some- times with a single indistinct transverse stria. Cephalic framework moderately sclerotized. Lateral fields marked with four incisures. Stylet 18-24 μ m long, with rounded posteriorly sloping basal knobs. Female reproductive system amphidelphic. Spermatheca often with sperms. Tail 44-58 μ m

long, elongate, subclavate with characteristic shallow depression on its dorsal side and rounded smooth terminus, marked by 25-35 annules ventrally. Phasmids pore-like, anterior to middle of tail. *Male*: Spicules arcuate, cephalated, flanged in distal one-fourth to one-third of their length. Gubernaculum rod-like. Bursa completely enveloping the tail.

Habitat & locality : Siddiqi & Patel (1990) described this species as new to science from around roots of sugarcane at Anand.

36. *Tylenchorhynchus mashhoodi*
Siddiqi & Basir, 1959

1960. *Tylenchorhynchus dactylurus* Das, *Z. Parasitenk.*, 19 : 553-605.

1968. *Tylenchorhynchus zaeae* Sethi & Swarup, *Bull. Ent.* 9 : 76-80

Measurements: Females: L= 0.54-0.72 mm; a= 28-37; b= 4.4-5.8; c= 13-18; V= 53-57. *Males*: L= 0.57-0.66 mm; a= 27-35; b= 4.5-5.6; c= 14-17; T= 36-50.

Description : Female: Body ventrally curved in posterior half of its length. Lip region continuous with body, marked by 3-4 annules. Labial framework lightly sclerotized. Stylet 16-19 μ m long, with rounded basal knobs which may be slightly flattened anteriorly. Female reproductive system amphidelphic. Spermatheca with sperms. Tail cylindrical to subcylindrical in shape, slightly narrowing behind anus. Phasmids in anterior half of tail. *Male* : Spicules 18-20 μ m long medially. Gubernaculum 10-15 μ m long. Tail elongate-conoid, with acute or subacute terminus, 2.3-3.0 anal body-width long. Phasmids in the anterior half of tail.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of brinjal at Dangs district.

Elsewhere : West Bengal, Rajasthan, Delhi, Himachal Pradesh, Orissa, Haryana, Bihar, etc.

Remarks : Reported as new record from the State.

37. *Tylenchorhynchus nudus* Allen, 1955

Measurements : Females (3) : L= 0.67-0.73 mm; a= 30-33; b= 4.3-5.3; c= 13-14; c = 3.3-3.5; V= 54-59. *Male* (1) : L= 0.65 mm; a= 28.47; b= 4.36; c= 11.96; c = 3.93; T= 55; spicules = 24; gubernaculum = 13.

Description: Female : Lip region continuous, marked by two annules. Labial frame work lightly sclerotized. Stylet 21-23 μ m long, with rounded basal knobs. Female reproductive system amphidelphic. Spermatheca spherical, filled with sperms. Tail cylindrical, ending in a clavate terminus, 3.3-3.5 anal body widths long. Phasmids posterior to anus. *Male* : Spicules 24 μ m long. Tail with subacute terminus, 3.9 anal body widths long, enveloped by bursa.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of sugarcane at Rajpipla, district Narmada.

Elsewhere : West Bengal, Maharashtra, Punjab.

Remarks : This species is being recorded for the first time from the State.

38. *Bitylenchus brevilineatus* (Williams, 1960)
Jairajpuri, 1982

1960. *Tylenchorhynchus brevilineatus* Williams, *Plant Pathologist's Pocket Book*, Commonwealth Mycological Institute, U.K. : 119-136 pp.

Measurements (after Tarjan, 1973) : *Females*: L= 0.56-0.65 mm; a= 34; b= 5.6; c= 14; V= 53-56.

Description : Female : Lip region offset, marked by 5-6 striae. Labial sclerotization light. Stylet 16 μ m long, with posteriorly sloping basal knobs. Female reproductive system amphidelphic. Tail subcylindrical with hemispheroid and smooth terminus, 2.9 anal body-width long, marked by 40 striae. Phasmids in the anterior half of tail. *Male* : Not found.

Habitat & Locality : Reported by Patel *et al.* (1987) around roots of tobacco at Anand.

Elsewhere : Delhi, Rajasthan, Bihar.

39. *Bitylenchus vulgaris* (Upadhyay, Swarup & Sethi, 1972) Jairajpuri, 1972

1972. *Tylenchorhynchus vulgaris* Upadhyay, Swarup & Sethi, *Indian J. Nematol.* 2 : 129-138.

Measurements (after Upadhyay *et al.*, 1972) : *Females* (15) : L= 0.56-0.67 mm; a= 25-30; b= 4-6; c= 14-20; V= 52- 57. *Males* (15): L=0.53-0.75 mm; a= 25-36; b= 4-6; c= 14-18; T= 43-60.

Description : Female : Body cylindrical, tapering at both ends. Lip region rounded; offset, marked by 4-7 transverse striae. Stylet moderately developed, 14-16 μ m long with basal knobs. Female reproductive system amphidelphic. Spermatheca oval and continuous with rounded sperms. Rectum more than one body-width long; post anal blind sac reaching upto the anterior third of the tail. Tail 35-45 μ m, conoid, tapering to a bluntly rounded smooth terminus. Tail annules 35-42. *Male*: Spicules arcuate 22-25 μ m long. Gubernaculum trough shaped; 1.3-1.6 μ m long. Phasmids anterior to middle of tail. Bursa finely crenate, enveloping tail tip. Tail 45-50 μ m long with acute terminus.

Remarks : Reported by Sharma *et al.* (1993) from pigeonpea fields at Bharuch, Vadodara, Kheda and Surat districts.

40. *Scutylenchus hexincisus* (Jairajpuri & Baqri, 1968) Siddiqi, 1979

1968. *Tylenchorhynchus hexincisus* Jairajpuri & Baqri, *Nematologica* 14 : 217-222

Measurements (after Jairajpuri & Baqri, 1968): *Females* (4) L= 0.85-1.08 mm; a= 32-39; b= 6.0-8.2; c= 18-23; V= 52-55 *Males* (6): L= 0.80-1.08 mm; a= 32-43; b= 6.0-7.4; c= 13-20; T= 37-46.

Description : Female : Head offset, flat at apex and marked with 6 minute but distinct striae. Stylet 17-19 μ m long, with posteriorly sloping knobs. Reproductive system amphidelphic. Spermatheca small, spherical, without sperms. Tail subcylindrical, 3-4 anal body-width long, tapering towards tip which is distinctly annulated. Phasmids near middle of tail. *Male* : Spicules 28-31 μ m long. Gubernaculum 8-9 μ m, trough-shaped

laterally. Bursa moderately developed, with crenate margins. Cloacal opening with protruding lips. Phasmids near middle of tail.

Type Habitat & locality : This species was described by Jairajpuri & Baqri (1968) as new to science around roots of citrus plants (unidentified from Veraval.

Family PSILENCHIDAE Paramonov, 1967 (Khan, 1969)

41. *Psilenchus hilarus* Siddiqi, 1963

Measurements (after Hussain & Rasheed, 1968) : *Females* (6) : L= 1.17-1.35 mm; a= 31.0-42.3; b= 7.5-8.5; c= 8.5-9.1; V= 46.-48. *Males* (5) : L= 1.00-1.12 mm; a= 33.3-38.6; b=6.2-6.5; c= 7.0-7.7

Description : Female : Lip region elevated anteriorly, offset from body by an abrupt narrowing of the neck contour, marked by five annules. Stylet 15-17 μ m long. Reproductive system amphidelphic. Tail elongate, regularly tapering to large swollen tip, 5-7 anal body width long. Inner mass of tail contracted. *Male* : Spicules 30 m long. Gubernaculum 7m long. Bursa originating anterior to the head of spicules and terminating near phasmids, 6.5 μ m long. Tail elongate, regularly tapering, ending into a clavate terminus.

Habitat & locality : Reported by Husain *et al.*, (1963) from soil around roots in Dohad, Gujarat.

Family PAURODONTIDAE Thorne, 1941 (Massey, 1967)

42. *Paurodontus similis* Siddiqi, 1961

Measurements (after Siddiqi, 1961) : *Females* : L= 0.65-0.89 mm; a= 36-43; b= 6.2-8.1; c= 9-12; c¹=5.1-6.5; V= 81- 83. *Males* : L= 0.62-0.71 mm; a= 37-47; b=5.5-6.5; c= 9.1-9.8; c¹= 5.6-6.5; T= 45-57.

Description : Female : Body almost straight upon fixation. Lateral fields marked by three incisures, outer one aerolated. Lip region continuous. Stylet 8.5-10.0 μ m long, with rounded basal knobs. Female reproductive system mono-prodelphic. Post-vulval uterine sac 1.3-1.8

times body-width at vulva. Vulva-anus distance about one times the tail length. Tail regularly tapering to a minutely rounded terminus, 64-74 mm long. *Male* : Spicules arcuate, anteriorly expanded, 17.5-19.5 μm long. Gubernaculum 4.5-6.5 μm long. Bursa crenate, covering one-third to two-fifth of tail.

Habitat & locality : Siddiqi (1990) described this species as new from around roots of garlic at Panchmahal district.

Order APHELENCHIDA Siddiqi, 1980

Family APHELENCHIDAE Fuchs, 1937
(Steiner, 1919)

43. *Aphelenchus avenae* Bastian, 1865

1881. *Aphelenchus agricola* de Man, *T. der. Nederlandsche dierk., vereeniging* 5 : 138-143.

1960. *Aphelenchus maximus* Das, *Z. Parasitenk* 19 : 553-605.

Measurements : *Females* (15): L= 0.55-0.86 mm; a= 25-39; b= 4.9-6.9; c= 27-35; V= 74-78. *Males* (5): L= 0.63-0.81 mm; a= 27-33; b= 5.5-5.9; c= 24-29; T= 48-57.

Description : *Female*: Lip region bluntly rounded to flattened, not offset from body, with 3-4 very faint annules. Lateral fields marked by 10-14 incisures. Stylet 10-12 μm long, slightly thickened at base. Oesophagus typical of the genus. Reproductive system mono-prodelphic. Post uterine sac reaching about half way from vulva to anus. Tail bluntly rounded, 16-33 μm long, about 0.7-1.0 anal body width long. *Male*: Spicules slender, 28-30 μm long. Gubernaculum 14-16 μm long. Tail conical and enveloped by a bursa.

Habitat & locality : Collected by ZSI party from soil around roots of maize, wheat, sugarcane, groundnut, chilli, brinjal etc. at all the districts of State.

Elsewhere : Throughout India, cosmopolitan in distribution.

Remarks : This species is being recorded for the first time from Gujarat.

Family APHELENCHOIDIDAE

Skarbilovich, 1947 (Paramonov, 1953)

44. *Aphelenchoides besseyi* Christie, 1942

1948. *Aphelenchoides oryzae* Yokoo, *Annals of the Phytopathology Society of Japan*, 13 : 40-43.

Measurements (after Allen, 1952) : *Females* : L= 0.66-0.75 mm; a= 32-42; b= 10.2- 11.4; c= 17-21; V= 68-70. *Males*: L= 0.44-0.72 mm; a= 36-47; b= 9-11; c= 14-19; T= 28-52; spicules= 18-21 mm.

Description (after Franklin & Siddiqi, 1973) : *Female*: Body slender. Lip region rounded, unstriated, slightly offset and wider than body at lip base. Labial framework slightly sclerotized. Stylet 10 μm long, with slight basal swellings. Oesophagus typical of the genus. Reproductive system monoprodelfic. Spermatheca elongate oval usually packed with sperms. Post uterine sac narrow, inconspicuous, not containing sperms, 2.5-3.5 times anal body-width long. Tail conoid, 3.5-5.0 anal body width long, terminus bearing a mucro of diverse shape, with three to four pointed processes. *Male* : Spicules typical of the genus. First pair of ventromedian papillae adanal, second slightly behind middle of tail and third subterminal. Tail conoid, with terminal mucro having two to four pointed processes.

Habitat & locality : Thakur *et al.* (1987) reported this species from Sabarkantha district.

Elsewhere : Himachal Pradesh, Tamil Nadu.

Remarks : Its report from Gujarat is alarming because it causes a serious disease (white tip) in rice.

45. *Aphelenchoides parascalacaudatus*

Chawla, Bhamburkar, Khan & Prasad, 1968

Measurements (after Chawla, Bhamburkar, Khan & Prasad, 1968) : *Females* : L= 0.4-0.5 mm; a= 28-32.0; b= 10-11; c= 13-16; V= 66-70.

Description : *Female* : Body ventrally arcuate. Lateral fields marked by three incisures. Lip region offset from body. Stylet 10-11 μm long, without thickenings at its base. Oesophageal gland lobe

overlapping intestine dorsally. Female reproductive system mono-prodelphic. Spermatheca 6 times as long as wide, packed with sperms. Post-vulval uterine branch an elongate pouch, 4 times vulval body-width. Female tail narrows sharply on ventral side after anus, conoid, concave ventrally, 3 times anal body-width long, with a small and sharply pointed mucro at its tip. *Male* : Not found.

Remarks : Reported by Patel *et al.* (1987) from roots of tobacco at Anand.

Order DORYLAIMIDA Pearse, 1942

Family DORYLAIMIDAE de Man, 1876

**Key to suborders of DORYLAIMIDA
represented in Gujarat**

1. Feeding apparatus provided with odontostyle DORYLAIMINA
- Feeding apparatus provided with mural tooth on subventral wall of pharyngeal cavity NYGOLAIMINA

**Key to superfamilies of DORYLAIMINA
represented in Gujarat**

1. Cheilostome strongly sclerotized, provided with plate or basket-like structures, frequently accompanied by large onchia with or without denticles ACTINOLAIMOIDEA
- Cheilostome usually thin walled, without onchia or denticles 2
2. Odontostyle long and attenuated; oesophagus with only three glands LONGIDOROIDEA
- Odontostyle comparatively much smaller; oesophagus with five glands 3
3. Expanded part of oesophagus enclosed in spiralmuscularsheath BELONDIROIDEA
- Expanded part of oesophagus not enclosed in spiral muscular sheath 4
4. Sub-cuticle coarsely striated, provided with abundant radial striae; expanded part of oesophagus usually a small basal bulb TYLENCHOLAIMOIDEA

- Sub-cuticle not striated, radial striae few, if present; expanded part of oesophagus usually about half of total oesophageal length DORYLAIMOIDEA

**Key to Families of DORYLAIMOIDEA
represented in Gujarat**

(Modified after Jairajpuri & Ahmad, 1992)

1. Odontostyle with wide aperture occupying usually more than 50% of its length; guiding ring not sclerotized, plicated APORCELAIMIDAE
- Odontostyle with smaller aperture, usually one third or less of its length; guiding ring sclerotized 2
2. Odontostyle attenuated, usually longer than width of lip region NORDIIDAE
- Odontostyle not attenuated and usually about as long as width of lip region 3
3. Large and stout nematodes, usually with long filiform tail exhibiting sexual dimorphism .. DORYLAIMIDAE
- Medium-sized nematodes, with short tail similar in sexes QUDSIANEMATIDAE

**Key to Subfamilies of DORYLAIMIDAE
represented in Gujarat (Modified after
Jairajpuri & Ahmad, 1992)**

1. Vestibule provided with minute to strongly developed plates; S₂N located much anterior to oesophageal base THORNENEMATINAE
- Vestibule not provided with sclerotized plates; S₂N close to oesophageal base LAIMYDORINAE

Subfamily LAIMYDORINAE Andrassy, 1969

Key to species of *Laimydorus* from Gujarat

1. Body 4.1 mm long; odontostyle about 49 m long; *L. finalis*
- Body less than 4.0 mm long; odontostyle less than 35m 2
2. Stylet 30-33m long *L. kherai*

— Stylet 24-29 m long *L. baldus*

46. *Laimydorus baldus* Baqri & Jana, 1982

Measurements : Females (5) : L= 2.11-2.44 mm; a= 34-36; b= 4.8-5.1; c= 10.8-11.8; V= ¹²⁻¹⁴43-48¹³⁻¹⁵ Males (5): L= 2.37-2.41 mm; a= 33-35; b= 4.7-4.9; c= 115-118; T= 50-55

Description : Female : Lip region marked by a depression from body. Odontostyle 24-25 m long, aperture 42-46% of odontostyle length. Guiding ring 14-15 µm from anterior end. Odontophore 29-30 m. Basal part of oesophagus occupies 46-52% of neck region. The 'Z' organs observed in middle of uteri. Tail elongate-filiform, 190-224 µm or 7-8 anal body width long. Male : Spicules 53-55 µm long. Lateral guiding pieces rod-shaped, 8-9 µm long. Prerectum 230m or 8 anal body width long. Supplements consist of an adanal pair and a series of 24 contiguous ventromedians. Tail bluntly rounded, 21-22 µm or 0.8 anal body widths long.

Habitats & localities : Collected by ZSI party during September, 2000-December, 2001 from soil around roots of maize; groundnut, brinjal, from almost all the localities surveyed in Junagarh, Jamnagar, Surendranagar, Rajkot, Dangs districts during the course of investigations.

Elsewhere : Rajasthan, West Bengal.

Remarks : This species is being reported for the first time from the State.

47. *Laimydorus finalis* Thorne, 1975

Measurements : Female (1) : L= 4.15 mm; a= 38; b= 5.4; c= 16; V= ⁸⁻⁹41⁸⁻⁹. Male (1) : L= 3.91 mm; a= 35; b= 6.3; c= 97; T=45

Description : Female: Lip region marked by a depression. Odontostyle 49 µm long; its aperture 18 m wide. Odontophore 50 µm long. Guiding ring at 29 µm from anterior end. Basal expanded portion of oesophagus occupies 49% of oesophageal length. Prerectum 350 µm or 7.6 anal body width long. Tail elongate filiform, 250 µm or 5.4 anal body-width long. Male : Spicules 83 m long. Guiding pieces 15 µm long. Supplements consist of an adanal pair and 42 contiguous

ventromedians. Tail bluntly rounded, 40 µm long or 0.7 anal body width long.

Habitat & locality : Collected by ZSI party in January, 1998 from soil around roots of maize at Godra, district Panchmahal.

Elsewhere : West Bengal.

Remarks : This species is being reported for the first time from the State.

48. *Laimydorus kherai* Baqri, 1985

Measurements: Females (3): L= 2.64-3.0 mm; a= 40-45; b= 4.6-5.0; c= 12-13; V= ¹⁵⁻¹⁷45-47¹⁵⁻¹⁷. Males (4): L= 2.38-2.56 mm; a= 33-36; b= 4.6-4.7; c= 102-103; T= 52-59

Description : Female : Lip region marked by slight depression. Odontostyle 30-33 µm, its aperture 13-15 µm. Guiding ring at 17-18 µm from anterior end. Odontophore 35-37 µm long. Prerectum 125-135 µm or 4 anal body-width long. Male : Spicules 59-60 µm long, lateral guiding pieces 10-12 µm long. One adanal and 25-26 contiguous ventromedian supplements present. Prerectum 130-135 µm or 4.8-5.0 anal body-width long. Tail bluntly rounded 23-25 µm long or 0.8 anal body-width long.

Habitat & locality : Collected by ZSI party in January, 1998 from soil around roots of maize at Godra, district, Panchmahal.

Elsewhere : Rajasthan.

Remarks : This species is being reported for the first time from the State.

Key to species of *Mesodorylaimus* from Gujarat

1. Body less than 0.9 mm long *szunyoghyi*
- Body 1 mm or more 2
2. Body 1 mm long; males with 11 contiguous supplements *adalbarti*
- Body 1.5 mm long or more 3
3. Female tail bent dorsally in posterior third ..
..... *margeritus*
- Female tail straight, not bent dorsally 4

4. Female tail about 1.6 anal body-width long.
..... *brassicus*

— Female tail 3-4 anal body-width long 5

5. Female tail gradually narrowing to an acute terminus *caudatus*

— Female tail first dorsally convex than conoid with rounded tip *mesonyctius*

49. *Mesodorylaimus adalbarti* Andrassy, 1963

Measurements : Females(3) : L= 0.99-1.09 mm; a= 21-27; b= 4.4-4.7; c= 16-18; V= ¹⁷⁻¹⁸ 50¹⁴⁻¹⁸. Males (2): L= 0.93-0.97 mm; a= 21-28; b= 4.2-5.1; c= 54-60; T=49-52.

Description : Female: Lip region marked by depression. Odontostyle 10-11 μ m long. Guiding ring single at 7-8 μ m from anterior end. Odontophore 14-15 μ m long. Basal part of oesophagus occupies 35-38% of oesophageal length. Female reproductive system amphidelphic. Prerectum 75-80 μ m or 4.0-4.5 anal body width long. Tail 55-65 μ m long, elongate conoid or 3.2-3.5 anal body-width. Male : Spicules 31-32 μ m long. Supplements consists of one adanal and 15-20 contiguous ventromedians. Tail short, rounded, conoid 16-17 μ m long.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of maize at Dhokpur, district Rajkot.

Remarks : First time reported from India.

50. *Mesodorylaimus brassicus*

Soni & Nama, 1981

Measurements : Female (1) : L= 1.37 mm; a= 27; b= 4.3; c=37; V= ¹⁴53¹⁴ Male (1): L= 1.01 mm; a=24; b= 3.7; c=53; T=50.

Description : Female : Lip region continuous with body. Odontostyle 13 μ m long. Guiding ring at 8 mm from anterior end. Odontophore 19 μ m long. Basal expanded part of oesophagus occupies 46% of neck length. Reproductive system amphidelphic. Prerectum 75 μ m or 3.2 anal body-width long. Tail 37 μ m or 1.6 anal body width elongate conoid with rounded terminus. Male: Spicules 38 μ m long. Lateral guiding pieces

12 mm long. Besides one adanal, 15 regularly spaced ventromedian supplements present. Tail 19 μ m or 0.8 anal body-width long, bluntly conoid.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of barley at Godra, district Panchmahal.

Remarks : This species is being reported for the first time from the State.

51. *Mesodorylaimus caudatus* Ahmad, 1993

Measurements (after Ahmad, 1993) : Females : L= 1.0-1.29 mm; a= 25-40; b= 4.0-5.2; c= 14-20; c¹=3-4; V= ¹⁰⁻¹⁵39-51¹¹⁻¹⁷

Description : Female: Lip region offset by slight depression. Odontostyle 12-13 μ m long; aperture about one third of its length. Guiding ring single at 8-9 μ m from anterior end. Odontophore rod-like, 16-17 μ m long. Expanded portion of oesophagus occupies 36-40% of neck length. Prerectum 54-84 μ m or 3-4 anal body-width long. Tail 60-72 μ m or 3-4 anal body-width long, elongate, almost straight, gradually narrowing to an anacute terminus. Male : Not found.

Type Habitat & locality : Soil around roots of aquatic weeds (unidentified) from Khadra, Bhuj, district Kutch.

Remarks: This species has been reported by Ahmad, 1993 as new to science from above mentioned locality of Gujarat.

52. *Mesodorylaimus margeritus*

Basson & Heyns, 1974

Measurements : Females (3) : L= 1.47-1.54 mm; a= 48-49; b= 4.2-4.8; c= 18-19; V= ⁷⁻⁸58- 59⁷⁻⁸.

Description : Female : Lip region distinctly offset. Odontostyle 12-13 μ m long; aperture 4-5 mm. Odontophore 18-19 μ m long. Guiding ring 8-9 mm from anterior end. Basal expanded part of oesophagus occupies 45-47% of oesophageal length. Female tail elongate conoid, 78-80 μ m or 3.0 anal body-width long, dorsally bent in posterior half. Male : Not found

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Sasan Gir, district, Junagarh.

Elsewhere : Rajasthan

Remarks : This species is being recorded for the first time from the State.

53. *Mesodorylaimus mesonyctius*
(Kreis, 1930) Andrassy, 1959

1930. *Dorylaimus mesonyctius* Kreis, *Zool. Anz. Leipzig* **87** (3-6) : 67-87.

1936. *Dorylaimus subulatus* Thorne & Swanger, *Capita Zool.* **6** : 223 pp.

Measurement : *Females* (3): L=1.30-1.37 mm; a=27-32; b= 4.8-5.4; c= 16-19; V= ¹¹⁻¹² 49-52¹¹⁻¹²
Males (2): L= 1.23-1.25 mm; a= 27-28, b= 4.4-5.0; c= 44-45; T=45-50.

Description : *Female*: Lip region marked by a constriction. Odontostyle 12-14 μ m long, its aperture 3-4 mm. Odontophore 16-18 μ m long. Guiding ring at 7-8 μ m from anterior end. Basal portion of oesophagus 39-45% of oesophageal length. Prerectum 80-105 μ m or 4.0-4.3 anal body-width long. Tail 60-75 μ m or 3.0-3.5 anal body-width long, conoid then spicate. *Male*: Spicules 38-43 μ m long. Ventromedian supplements nine, spaced irregularly. Tail short, rounded conoid, 27-28 μ m long or 0.9-1.2 anal body-width long.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of Castor at Dhokpur, Junagarh-Rajkot Road, district Rajkot.

Elsewhere : Rajasthan.

Remarks : This species is hereby reported as new record from the State.

54. *Mesodorylaimus szunyoghyi* Andrassy, 1968

Measurements : *Females* (2) : L= 1.04-1.08 mm; a= 38-40; b=3.2-3.7; c= 10-11; V= ⁹⁻¹⁰54-54¹⁰⁻¹¹.

Description : *Female* : Lip region marked off by slight constriction. Odontostyle 13-15 μ m long,

aperture 3-4 μ m. Guiding ring 6-7 μ m from anterior end. Odontophore 15-17 μ m long. Basal part of oesophagus occupies 37-45% of oesophageal length. Tail 96-102 μ m long, elongate conoid. *Male* : Not found

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of barley at Sabarkantha.

Remarks : First time reported from India.

Subfamily THORNENEMATINAE Siddiqi, 1969

55. *Thornenema mauritianum* (Williams, 1959) Baqri & Jairajpuri, 1967

1958. *Thornenema viriosum* Williams, *Maurit. Sug. Ind. Res. Inst. Occ. Paper* **2** : 9

1965. *Thornenema africanum* Andrassy, *Opusc. Zool. Budapest* **5** : 9-23.

Females (20): L= 1.02-1.65 mm; a= 26-36; b= 5.2-6.0; c= 6.3-7.1; V= 32-34¹⁰⁻¹³.

Description : *Female* : Lip region rounded, narrower than body, marked by a slight depression, moderately sclerotized. Odontostyle 13-16 μ m long, aperture 4-5 μ m. Odontophore 22-25 μ m. Basal expanded part of oesophagus occupies 38-46% of oesophageal length. Female reproductive system mono- opisthodelphic. Tail filiform with smooth rounded terminus, 143-260 μ m or 8-10 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 & December, 2001 from soil around roots of maize, barley, groundnut, brinjal, sugarcane, chilli at Junagarh, Jamnagar, Rajkot, Surendranagar, Vadodara, Dangs, Bharuch and Valsad districts.

Elsewhere : Delhi, Rajasthan, West Bengal, Uttar Pradesh.

Remarks : This species has been found by the authors as widely distributed species in Gujarat. This species is being reported here for the first time from the State.

56. *Sicaguttur sartum* Siddiqi, 1971

1974. *Sicaguttur indicum* Ali & Prabha, *Nematologica* **19** : 481-490.

1980. *Sicaguttur longicaudatum* Baqri & Jana, *Nematologica* 26 : 83-107.

Measurements : Females (15): L= 1.09-1.97 mm; a= 23-30, b=5.5-6.6; c= 6.1-6.4; V= 8-9³⁶-42⁹⁻¹¹.

Description : Female : Lip region rounded, narrower than adjoining body, marked by depression. Labial sclerotization prominent. Odontostyle 15-18 μ m; aperture 4-5 μ m. Odontophore 20-24 μ m. Basal expanded part of oesophagus 42-44% of oesophageal length. Prerectum 80-97 μ m or 2.0-2.5 anal body-width long. Tail 177-305 μ m or 4.2-6.7 anal body-widths long, tapering to an acute or subacute tip. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 & December, 2001 from soil around roots of maize, til, barley, sugarcane, groundnut, brinjal, chilli at Junagarh, Jamnagar, Surendranagar, Rajkot, Narmada, Bhaurach, Dangs.

Elsewhere : Rajasthan, West Bengal.

Remarks : This has been found as widely distributed species. Reported as new record from the State.

Family APORCELAIMIDAE Heyns, 1965

57. *Aporcelaimellus heynsi* Baqri & Jairajpuri, 1968

Measurements : Females (10) : L= 1.02-1.33 mm; a= 24-26; b=3.0-4.6; c= 26-33; V= 10-11⁵⁰-53¹⁰⁻¹¹.

Description : Female : Lip region offset from body by constriction. Lips separate, subangular. Odontostyle 13-15 μ m long, aperture 9-10 μ m. Odontophore 18-20 μ m long. Guiding ring 6-7 μ m from anterior end. Basal expanded portion of oesophagus occupies 50-53% of neck region. Tail conoid with rounded terminus, 38-40 μ m long or 1.5-1.6 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party during September, 2000 & December, 2001 from soil around roots of maize, barley, wheat, groundnut, sugarcane, brinjal, chilli at Junagarh, Jamnagar, Surendranagar, Rajkot, Bhaurach and Dangs.

Elsewhere : Rajasthan, West Bengal, Uttar Pradesh.

Remarks : Widely distributed species. This species is being recorded here for the first time from the State.

58. *Turbixaba parva*

Pretorius Kruger & Heyns, 1987

Measurements : Females (10) : L = 3.12- 3.78 mm; a= 45-52; b= 4.0 ? 4.6; c= 89-96; V ⁷⁻⁸54-55⁷⁻⁸

Description : Female : Lip region distinctly offset by deep constriction. Lips twice as wide as high, separated. Odontostyle 15-17 μ m; aperture 5-6 μ m. Odontophore 26-30 μ m, Guiding ring 9-10 μ m from anterior end. Basal expanded part of oesophagus occupies 51-54% of oesophageal length. Female reproductive system amphidelphic. Tail bluntly conoid, 32-34 μ m or 0.7-1.1 and body width-long. *Male* : Not found.

Habitat & locality : Collected by ZSI party during September, 2000 and December, 2001 from soil around roots of maize, wheat, ground nut, sugarcane, bringal, chilli at Junagarh, Jamnagar, Surendranagar, Rajkot, Vadodara, Bhaurach and Dangs.

Elsewhere : Rajasthan.

Remarks : This species is widely distributed and recorded for the first time from the State.

Family QUDSIANEMATIDAE Jairajpuri 1965

59. *Labronema confusum* (Jana & Baqri, 1983) Andrassy, 1991

Measurements : Female (10) : L = 0.94-1.18 mm; a= 29-37; b= 4.1-4.5; c= 43-54; V ⁹⁻¹⁰48-54⁹⁻¹⁰.

Description : Female : Lip region offset by constriction. Odontostyle 13-15 μ m long; its aperture 5-6 μ m. Odontophore 19-22 μ m long. Guiding ring sclerotized double. Basal expanded part of oesophagus occupies 37-39% of neck region. Female reproductive system amphidelphic. Tail 23-24 μ m long, obtusely rounded, about 0.8 anal body width long. *Male*: Not found.

Habitat & locality : Collected by ZSI party in September-December, 2000-2001 from soil around roots of maize, wheat, groundnut, sugarcane at Junagarh, Jamnagar, Surendranagar, Rajkot, Narmada and Dangs.

Elsewhere : West Bengal.

Remarks : This species is being reported here as new record from the State.

60. *Ecumenicus monohystera*
(deMan, 1880) Thorne, 1974

Measurements : Females (7) : L= 1.07-1.64 mm; a= 27-30; b= 5.0-5.7; c= 35-43; V= 36-38⁷⁻¹¹

Description : Female : Lips offset. Odontostyle 12-15 μ m long; aperture 3-4 μ m. Guiding ring 6-7 μ m long. Basal expanded part of oesophagus occupies 41-42% of neck region. Female reproductive system mono-opisthodelphic. Tail convex-conoid, 30-38 μ m or 1.6-1.7 anal body-width long. *Male* : Not found.

Habitats & localities : Collected by ZSI party during September, 2000 and December, 2001 from soil around roots of maize, barley, brinjal, wheat, lady's finger, etc. at Junagarh, Jamnagar, Rajkot, Surendranagar, Dangs, Surat districts.

Elsewhere : West Bengal, Rajasthan.

Remarks : Reported as new record from the State.

61. *Allodorylaimus kosambaensis* Khan,
Ahmad & Jairajpuri, 1995

Measurements : Females (10) : (after Khan, Ahmad & Jairajpuri, 1995): L= 1.6-1.9 mm; a= 26-30; b= 4.1-4.6; c= 28-35; V= ⁹⁻¹³48-50¹⁰⁻¹⁴
Male (1): L= 1.5 mm; a= 29; b=3.9; c=27; T=54.

Description : Female : Lip region distinctly offset by constriction, wider than adjoining body. Odontostyle 19-21 μ m long; aperture about 40-50% of odontostyle length. Guiding ring at 9-10 μ m from anterior end. Odontophore 30-33 μ m long. Basal expanded part of oesophagus 52-57% of neck region. Tail 49-59 μ m, short conoid, slightly dorsally bent with sharply pointed tip, 1.5-1.8 anal body-width long. *Male* : Spicules 54 μ m long. Lateral guiding pieces 12 μ m long. Supplements an adanal pair and 10 ventromedians arranged in series. Prerectum 98 μ m or 2.6 anal body-widths long. Tail 56 μ m conoid, 1.5 times anal body-width long, slightly dorsally bent with a pointed tip.

Type Habitat & locality : From Soil around roots of mango tree (*Mangifera indica* L.) from Kosamba, Surat district, Gujarat.

Remarks : This species was described by Khan, Ahmad & Jairajpuri (1995) as new to science from above mentioned locality from Gujarat State.

62. *Discolaimus major* Thorne, 1939

Measurements : Females (15) : L= 1.4-2.63 mm; a= 32-36; b= 3.9-4.5; c= 46-58; V= ¹¹⁻¹²47-48¹¹⁻¹².

Description : Female : Lip region discoid. Lateral hypodermal chords with well developed 70-80 glandular bodies. Odontostyle 22-25 μ m long; aperture 50-52% of odontostyle length. Guiding ring single. Odontophore 30-35 μ m long. Basal expanded part of oesophagus occupies 50-55% of oesophageal length and surrounded by a conspicuous muscular sheath. Female reproductive system amphidelphic. Tail 30-35 μ m or 1.2-1.5 anal body-width long, conoid. *Male*: Not found.

Habitats & localities : Collected by ZSI party in October, 2000 from soil around roots of grasses, maize, wheat, groundnut, sugarcane at Junagarh, Jamnagar, Surendranagar and Rajkot districts.

Elsewhere : Rajasthan

Remarks : This species is a new record from the State.

63. *Discolaimium mukhtarpuriense* Baqri &
Jairajpuri, 1969

Females (5): L= 0.80-0.87 mm; a= 25-32; b= 3.8-4.2; c= 28-29; V= ¹⁰⁻¹¹53-55¹⁰⁻¹¹.

Description : Female : Lip region offset. Lateral chords with well developed, 60-70 glandular bodies. Odontostyle 14-16 μ m long; its aperture 5-6 μ m. Guiding ring single. Odontophore 15-17 μ m long. Basal expanded part of oesophagus occupies 33-36% of neck region. Female reproductive system amphidelphic. Tail 28-30 μ m or 1.2 anal body-width long, convex-conoid, with a rounded terminus. *Male*: Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of

unidentified grasses at Sasan Gir, district Junagarh.

Elsewhere : Rajasthan and Uttar Pradesh

Remarks : This species is being reported here as new record from the State.

64. *Discolaimoides bulbiferus* (Cobb, 1906)
Heyns, 1963

1936. *Discolaimus bulbiferus* (Cobb, 1906) Thorne & Swanger, *Capita Zool.* 6 : 223.

Measurements : Females (5) : L= 1.40-1.65 mm; a= 46-55; b= 4.0-5.2; c= 35-36; V= $8-10^{45-53^{8-10}}$.

Description : Female : Lip region expanded, offset by constriction. Lateral glandular bodies 80-90 in entire length. Odontostyle 15-17 μ m long; aperture about half of odontostyle length. Odontophore 22-25 μ m long. Basal expanded part of oesophagus occupies 52-56% of oeso-phageal length. Female reproductive system amphidelphic. Tail 40-45 μ m or 1.8 anal body-width long, conoid with rounded terminus. *Male* : Not found.

Habitats & localities : Collected by ZSI party in September-October, 2000 from soil around roots of unidentified grasses and maize at Sasan Gir and Lakhtar in Junagarh and Jamnagar districts respectively.

Elsewhere : Rajasthan, West Bengal and Maharashtra.

Remarks : This species is reported here as new record from the State.

65. *Latocephalus gracile* Patil & Khan, 1982

Measurements: Female (1) : L= 1.19 mm; a= 44.40; b= 4.28; c= 51-55; V= 38^{7-5} .

Description : Female : Lip region expanded; 8 mm wide and 5 μ m high. Odontostyle 9 mm long. Odontophore 20 μ m long. Guiding ring 5 mm from anterior end. Basal expanded part of oesophagus occupies about 46% of neck region. Female reproductive system mono-opisthodelphic. Anterior uterine sac 10 μ m. Prerectum about 45 μ m or 3 anal body-width long. Tail elongate conoid, 38 μ m long or 2.5 anal body-width long. *Male* : Not found

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of barley at Sabarkantha district.

Elsewhere : Maharashtra.

Remarks : The species is hereby reported from Gujarat for the first time.

Family NORDIIDAE Jairajpuri & A.H. Siddiqi, 1964

66. *Longidorella xenura* Khan & Siddiqi, 1963

Measurements : Female (1) : L= 0.75 mm; a=23; b=3.1; c= 10.60; V= $11^{56^{11}}$.

Description : Female : Body short, robust. Lip region rounded, continuous with body. Odontostyle 45 μ m long, attenuated, Guiding ring 21 μ m from anterior end. Odontophore 40 μ m long, rod-shaped. Basal expanded part of oesophagus occupies 38% of the neck region, separated from anterior slender part by a constriction. Reproductive system amphidelphic. Prerectum 25 μ m or about one anal body-width long. Tail 71 mm or 3.2 anal body-width long, elongate-conoid, slightly bent dorsally. *Male* : Not found

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of wheat at Jakhana, Taluka Ahwa, district, Dangs.

Elsewhere : Himachal Pradesh and Maharashtra.

Remarks : This species is being reported for the first time from the State.

67. *Kochinema farodai* Baqri & Bohra, 2001

Measurements : Females (10) : L= 0.96-1.08 mm; a= 29-32; b= 4.1-4.5; c= 30-33; V= $10-11^{52-54^{10-11}}$.

Description : Female : Lip region distinctly offset from body, wider than adjoining body. Odontostyle 17-19 μ m long. Odontophore 19-22 mm long, rod-like. Guiding ring 10-11 mm from anterior end. Expanded part of oesophagus occupies 41-44% of the neck length. Female reproductive system amphidelphic. Tail 32-35 μ m long, 1.4-1.6 anal body-width, convex-conoid with rounded terminus. *Male* : Not found.

Habitats & localities : Collected by ZSI party in September-October, 2000 from soil around roots of maize, sugarcane, groundnut at Junagarh, Jamnagar and Rajkot districts.

Elsewhere : Rajasthan.

Remarks : This species is reported for the first time from Gujarat.

68. *Kochinema caudatum* Baqri & Bohra, 2001

Measurements : *Females* (5) : L= 0.81-0.95 mm; a= 25-30; b= 3.7-4.2; c= 24-27; V= ¹²⁻¹³54-57¹²⁻¹³.

Description : *Female* : Lip region offset from body, wider than adjoining body. Odontostyle 36-38 μ m long. Odontophore 30-32 μ m long. Guiding ring 28-30 μ m. Basal expanded part of oesophagus occupies 37-40% of oesophageal length. Female reproductive system amphidelphic. Tail 32-35 μ m long, conoid with rounded tip, 1.6-1.7 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of maize at Godra, district Panchmahal.

Elsewhere : Rajasthan.

Remarks : This species is being reported for the first time from the State.

69. *Oriverutus labiatus* Ahmad & Jairajpuri, 1987

Measurements : *Females* (2): L= 0.79-0.82 mm; a= 25-26; b= 3.4-3.6; c= 15-17; V= ¹³⁻¹⁵52-56¹³⁻¹⁵

Description : *Female*: Lip region offset, lips lobe-like with distinct labial papillae. Odontostyle attenuated, 15-17 μ m long; its aperture 2-3 μ m. Guiding ring 6-8 μ m from anterior end. Odontophore 19-20 μ m long. Basal part of oesophagus 45-46% of oesophageal length. Female reproductive system amphidelphic. Prerectum 35-48 μ m or 2-3 anal body-width long. Tail elongate conoid, dorsally bent, 45-53 μ m or 2.3-2.6 anal body-width long. *Male*: Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of wheat at Rajpipla, district Narmada.

Elsewhere : Nainital (Uttaranchal)

Remarks : This species is being reported for the first time from the State.

Family ACTINOLAIMIDAE Thorne, 1939

70. *Neoactinolaimus kosambus* Khan, Ahmad & Jairajpuri, 1994

Measurements (after Khan, Ahmad & Jairajpuri, 1994) : *Females* : L= 2.00-2.10 mm; a= 31-39; b= 3.8-4.3; c= 10-12; V= ¹⁸⁻²²47-57¹⁷⁻²⁶. *Males* : L= 1.99-2.02 mm; a= 38-39; b= 3.8-4.3; c= 132-149; T= 66-68.

Description : *Female*: Lip region offset by slight depression, slightly narrower than adjoining body. Cheilostome armed with four large onchia; each onchium provided with a secondary tooth. Odontostyle 25 μ m long; its aperture occupying about two-fifth of odontostyle length. Odontophore 24-26 mm long. Guiding ring at 18.0-19.5 μ m from anterior end. Basal expanded part of oesophagus 51-55% of neck region. Reproductive system amphidelphic. Prerectum 137-171 μ m or 5.7-6.3 anal body width long. Tail 163-190 mm or 5.7-5.9 anal body width long, uniformly tapering to become attenuated with pointed tip. *Male* : Spicules 48-51 μ m long. Lateral guiding pieces 11-12 μ m long. The ventromedian supplements arranged in two groups (fascicles), each with 6-7 innervations. A solitary supplement present between the fascicles. Prerectum 220-231 μ m or 7.7 anal body-widths long. Tail 13.5-15.0 μ m, about 0.5 anal body-width long, bluntly rounded.

Type Habitat & locality : Soil around roots of mango Tree from Kosamba village, District Surat.

Remarks : This species was reported by Khan, Ahmad & Jairajpuri, 1994 as new to science from above mentioned locality from Gujarat State.

71. *Neoactinolaimus attenuatus* Khan, Ahmad & Jairajpuri, 1994

Measurements (after Khan, Ahmad & Jairajpuri, 1994) : *Females* (3): L= 2.20-2.40 mm; a= 53-65; b= 4.4-4.7; c= 18-21; V= 7-8-8-9

Description : *Female* : Lip region rounded,

expanded, offset by deep constriction. Vestibular ring corrugated. Cheilostome armed with four large onchia, each onchium provided with secondary tooth. Odontostyle 21-24 μm long, with aperture about two-fifth of its length. Guiding ring at 15-16 μm from anterior end. Odontophore 18-20 μm long. Basal expanded part of oesophagus 42-46% of neck region. Reproductive system amphidelphic. Prerectum 109-157 μm or 5-7 anal body width long. Tail elongate-conoid, 106-129 μm , or 4.4-5.7 anal body-width long, terminus uniformly conoid. *Male* : Not found.

Type Habitat & locality : Residue from bio-gas plant from Kosamba village, district Surat

Remarks : The species was added to science by Khan *et al.* (1994) from Kosamba, district Surat.

Superfamily LONGIDOROIDEA Thorne, 1935

Key to Superfamily LONGIDOROIDEA represented in Gujarat

- Guiding ring double; odontophore flanged ..
..... XIPHINEMATIDAE
- Guiding ring single; odontophore not flanged
..... LONGIDORIDAE

Family LONGIDORIDAE Thorne, 1935

72. *Longidorus elongatus* (de Man, 1876) Micoletzky, 1922

1876. *Dorylaimus elongatus* de Man, *Tij. der Neder lansche dierkundige veereeniging* 2 : 78-196.

1953. *Longidorus monohystera* Altherr, *Bull. de la Soc. Vaudoise des scie. Natur.* 65 : 429-460.

Measurements : *Females* (4): L= 4.5-5.6 mm; a= 76-123; b= 9.7-12.5; c= 73-133 V= $6^{10}45-52^{6-10}$

Description : *Female* : Body long and narrow, open c-shaped upon fixation. Lip region flattened anteriorly. Amphids large, pouch-like. Odontostyle 82-100 μm long. Odontophore 35-65 mm long. Guiding ring 30-32 μm from anterior end. Prerectum 122-124 μm or about 10 anal body-width long. Tail dorsally convex, ventrally flattened or very slightly concave, 28-32 μm or about 1.3 anal body-width long with roundly

conoid terminus.

Habitats & localities : Collected by ZSI party during October, 2000 from soil around roots of jowar and rizka at Motiwanagar and Falla village of Jamnagar.

Remarks : This species is being reported for the first time from the State.

Key to species of *Paralongidorus* from Gujarat

- 1. Body more than 5 mm long *major*
— Body less than 5 mm long 2
- 2. Lip region button-like; odontostyle 65-70 μm long *citri*
— Lip region rounded, odontostyle more than 75 μm long 3
- 3. Odontostyle 76 μm long *microlaimus*
— Odontostyle 84-90 μm long *beryllus*

73. *Paralongidorus citri* (Siddiqi, 1959) Siddiqi, Hooper & Khan, 1963

1959. *Xiphinema citri* Siddiqi, *Proc. Helminth. Soc. Wash.* 26 : 151-163.

Measurements : *Females* (5): L= 2.71-3.41 mm; a= 106-115; b= 12.5-13.9; c= 79-89; V= $6^{750-547-9}$

Description : *Female* : Lip region button-like, offset from body. Odontostyle 65-70 μm long, aperture small. Guiding ring at 27-30 μm or 2.7-3.0 head width from anterior end. Odontophore 43-50 μm long. Basal expanded part occupies 25-26% of neck region. Reproductive system amphidelphic. Prerectum 170-200 μm or 11-12 anal body-width long. Tail dorsally convex, conoid, 34-38 μm or 1.9-2.0 anal body width long. *Male*: Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of cotton at Hadmata, Taluka Gondal, district Rajkot.

Elsewhere : Rajasthan, West Bengal, Bihar, Punjab.

Remarks : This species has been reported for the first time from the State.

74. *Paralongidorus major* Verma, 1973

Measurements : Females (2) : L= 5.95-6.41 mm; a= 116-238; b= 10.3-12.1; c= 192-206; V=⁸⁻⁹ 42-44⁸⁻⁹

Description : Female : Body ventrally curved upon fixation. Lip region broadly rounded, offset from body by a constriction. Amphidial apertures slit like. Amphidial pouch short, cup like. Odontostyle 120-122 µm long. Odontophore 63-65 µm long. Guiding ring 32-33 mm from anterior end. Basal expanded part of oesophagus 120-121 µm long. Reproductive system amphidelphic. Prerectum 165-170 µm long or about 7.5-7.7 anal body-width long. Tail 31 µm, with convex-conoid terminus, less than one anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of millet at Rambhas farm, Taluka Ahwa, district Dangs.

Remarks: This species is reported for the first time from the State.

75. *Paralongidorus microlaimus* Siddiqi, 1964

Measurements: Female (1): L= 3.27 mm; a= 91.0; b= 10.9; c= 109.2; V=⁷⁻⁸53⁷⁻⁸.

Description: Female: Lip region offset from body. Odontostyle 76 µm long. Odontophore 35 µm long. Guiding ring 27 µm from anterior end. Basal expanded part of oesophagus occupies 25% of neck region. Reproductive system amphidelphic. Prerectum 175 µm or 6.4 anal body-width long. Tail 26 µm or about one anal body-width long, rounded conoid. *Male*: Not found.

Habitat & locality: Collected by ZSI party from around roots of jowar at Dhrol, district Jamnagar.

Remarks: This species is reported for the first time from the State.

76. *Paralongidorus berryllus*

(Siddiqi & Husain 1965) Hunt, 1993

Measurements: Females (2) : L= 3.77-4.47 mm; a= 86-89; b= 10.8-11.6; c= 86-94; V=⁶⁻⁷47-48⁶⁻⁷.

Description : Female: Lip region expanded. Amphid apertures half of corresponding body-

width. Odontostyle 84-85 µm long. Odontophore 55-60 mm long. Guiding ring 28-30 µm from anterior end. Basal expanded part of oesophagus occupies 22-27% of neck region. Reproductive system amphidelphic. Tail 45-50 µm or 1.2-1.6 anal body-width long, conoid. *Male*: Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from around roots of castor at Dhrol, district Jamnagar.

Remarks : This species is reported for the first time from the State.

Family XIPHINEMATIDAE Dalmasso; 1969

Key to species of *Xiphinema* from Gujarat

1. Both female sexual branches well developed 2
 - Female anterior sexual branch with reduced ovary *orbum*
2. Tail less than 3 anal body-width long 3
 - Tail more than 3 anal body-width long *insigne*
3. Odontostyle 74-76 µm long *americanum*
 - Odontostyle more than 100 µm long 4
4. Tail conoid digitate *basiri*
 - Tail elongate, conoid with subdigitate terminus *elongatum*

77. *Xiphinema basiri* Siddiqi, 1959

1971. *Xiphinema basiri* Loof & Yassin, *Nematologica*, **16** : 537-546.

1972. *Xiphinema basiri* Cohn & Sher, *J. Nematol.*, **4** : 36-65.

Measurements : Female (1) : L= 2.01 mm; a=44; b= 5.0; c= 41; c=1.6; V= ¹¹⁻¹³47¹¹⁻¹³.

Description : Female : Lip region rounded, offset from body. Odontostyle 106 µm. Odontophore 63 µm or nearly one half of the odontostyle length. The guiding ring at 80 µm or about 8 lip region-width from anterior end. Female reproductive system amphidelphic. Z-organs present in the uteri. Prerectum 321 µm or about 13 anal body-width long. Tail conoid, digitate,

about 1.6 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of castor at Bhojpur village, 36 kms from Rajkot on Junagarh Road, district, Rajkot.

Elsewhere : Rajasthan, Tamil Nadu, Maharashtra.

Remarks : This species is being reported for the first time from the State.

78. *Xiphinema elongatum* Schuurmans Stekhoven & Teunissen, 1938

1949. *Xiphinema pratensis* Loos, *J. Zool. Soc. India*, 1 : 30-36

1974. *Xiphinema elongatum* Heyns, *Phytophylactica*, 6 : 157-164.

Measurements : Females (11): L= 2.13-2.42 mm; a= 47-60; b= 5.4-6.7; c= 40-44; V= ¹⁰⁻¹²43-47¹⁰⁻¹¹.

Description : *Female*: Lip region rounded, offset from body. Odontostyle 105-107 μ m or about 8.7-8.9 head-width long. Odontophore 57-59 μ m long. Guiding ring at 90-95 μ m or 8-9 lip region-width from anterior end. Female reproductive system amphidelphic. Prerectum 50-72 μ m or 2-3 anal body width long. Tail 45-56 μ m or about 2.0-2.1 anal body-width long, elongateconoid with subdigitate terminus. *Male* : Not found.

Habitats & localities : Collected by ZSI party in September, 2000 and December, 2001 from soil around roots of castor at Bhojpur village 36 km from Rajkot on Jamnagar Road, district Rajkot; brinjal at Rajpipla, district Narmada and barley at Sabarkantha.

Elsewhere : Karnataka.

Remarks : This species is reported for the first time from the State.

79. *Xiphinema orbum* Siddiqi, 1963

Measurements : *Females* (2): L=2,19-2.24 mm; a= 43-48; b= 6.0-6.4; c= 29-32; V=¹⁻⁵31-33¹⁰⁻¹²

Description : *Female* : Lip region rounded, distinctly offset from body. Odontostyle 100-103

μ m long. Odontophore 57-60 μ m long. Guiding ring at 83-85 μ m or about 8 lip region width from anterior end. Basal expanded part of oesophagus 20% of neck length. Female reproductive system amphidelphic, but the anterior genital branch and the ovary is greatly reduced. Prerectum 63-75 μ m or 2.3-2.5 anal body-width long. Tail elongate conoid, 67-77 μ m or 2.3-2.7 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of Jowar at Sasan Gir district, Junagarh.

Remarks : This species is reported as new record from the State.

80. *Xiphinema americanum* Cobb, 1913

Measurements : *Females* (2) : L= 1.61- 1.72 mm; a=42; b=5.4; c= 45-55; V= ¹³⁻¹⁵50¹²⁻¹³

Description : *Female* : Body 'C' shaped upon fixation. Lip region offset from body. Odontostyle 74-76 μ m long. Odontophore 50-52 mm long. Fixed guiding ring at 63-66 μ m or 6-8 lip region width from anterior end. Basal expanded part of oesophagus 25-26% of neck region. Reproductive system amphidelphic, each sexual branch consists of a reflexed ovary. Tail short, convex-conoid, 30-32 μ m or 1.4-1.6 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of chilli at Kalipat, district Rajkot.

Elsewhere : West Bengal, Uttar Pradesh and Punjab.

Remarks : This species is reported for the first time from the State.

81. *Xiphinema insigne* Loos 1949

Measurements : *Females* (4): L=2.21-2.41 mm; a= 58-79; b= 6.1-7.0; c= 27-33; V= 30-33.

Description : *Female* : Lip region almost flat or rounded at apex, and slightly offset from body. Odontostyle 105-108 μ m long. Fixed guiding ring 86-90 μ m or 7.8-8.0 lip region width from anterior end. Odontophore 58-67 μ m long. Basal expanded

part of oesophagus 23-28% of neck length. Vulva transverse. Reproductive system amphidelphic, each sexual branch consisting of a reflexed ovary. Tail 72-81 μm , narrow, elongate conoid, 3.1-3.6 anal body-width long. *Male*: Not found

Habitats & localities : Collected by ZSI party in October, 2000 from soil around roots of brinjal, jowar and til at Rajpipla, district Valsad; Marendra, district Junagarh; and Dhrol, district Jamnagar respectively.

Elsewhere : West Bengal, Punjab, Sikkim, Uttar Pradesh, etc.

Remarks : This is a widely distributed species in India. However, it is being recorded for the first time from Gujarat.

Superfamily BELONDIROIDEA Thorne, 1939

FAMILY BELONDIRIDAE Thorne, 1939

**Key to subfamilies of BELONDIRIDAE
represented in Gujarat**

- Cuticularised pieces present around oral aperture, Odontophore flanged
..... DORYLAIMELLINAE
- Cuticularised pieces not present around oral aperture, Odontophore rod-like
..... BELONDIRINAE

Subfamily BELONDIRINAE, Thorne, 1939

82. *Belondira porta* Thorne, 1964

Measurements : *Female* (1) : L= 1.51 mm; a= 43; b= 4.7; c= 65; V= $^{44}44^{13}$. *Male* (1): L= 1.50 mm; a=46; b= 4.7; c=65; T=54.

Description : *Female* : Odontostyle 8 μm long or about one head-width long. Odontophore 16 μm long. Basal expanded part of oesophagus about 55% of oesophageal length; surrounded by typical muscular sheath. Anterior uterine branch about 2.5 corresponding body-width long. Posterior genital branch normal. Prerectum 106 μm long or about 5 anal body-width long. Tail bluntly conoid, 23 μm long or one anal body-width long. *Male* : Spicules 34 μm long medially, arcuate. Lateral guiding pieces 12 μm long. Besides adanal pair of

supplements, 2 ventro-submedian supplements present. Tail bluntly conoid.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of Jowar at Hadmata, district Rajkot.

Remarks : This species is reported as new record from the State.

83. *Belondira bulbosa* Siddiqi, 1966

Measurements : *Females* (2): L= 1.16-1.19 mm; a= 39-46; c=24; V= $^{5-6}43^{11-12}$. *Male* (1): L=1.02 mm; a= 44; b= 4.4; c= 25; T=50.

Description : *Female* : Body straight. Lip region conoid with internal sclerotization. Odontostyle 9-9.5 μm long, its aperture 2-3 μm . Odontophore 8-9 μm long. Basal expanded part of oesophagus occupies 49% of oesophageal length, enveloped by dextral spiral muscles. Anterior uterine branch 60-70 μm or 2.3-2.4 body-width long. Posterior genital branch normal. Prerectum 60-65 μm or 3.1-3.9 anal body-width long. Tail 43-45 μm , 2.0 anal body-width long; tail terminus swollen, distinctly striated. *Male* : Spicules 36 μm long. Lateral guiding pieces 8 μm long. Tail 40 μm or 1.7 anal body width-long.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of groundnut at Paidi Taluka, district, Rajkot.

Remarks : This species is reported for the first time from the State.

84. *Belondira tenuidens* Thorne, 1964

Measurements : *Females* (4): L= 1.25-1.36 mm; a= 40-41; b=6.34-6.63; c= 46-48; V= $^{2-3}36^{10-12}$

Description : *Female* : Lip region rounded, 6-7 μm wide. Labial framework faint. Odontostyle 5-6 μm long. Odontophore 10-12 μm long. Guiding ring 5-6 μm from anterior end. Basal expanded part of oesophagus 33-39% of oesophageal length, surrounded by distinct muscular sheath. Anterior uterine branch about one anal body-width long. Posterior genital branch normal. Prerectum 63-70 μm or about 3.0-3.3 anal body-width long. Tail cylindroid 26-29 mm or 1.1-1.5 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Sasan Gir, Junagarh.

Remarks : This species has been reported for the first time from the State.

85. *Axonchium (Axonchium) bulbosum*
Williams, 1958

Measurements : Females (4) : L= 1.80-2.03 mm; a= 32-33; b= 2.02-2.61; c=60-63; V= ¹⁷⁻²⁰51-55⁷⁻¹⁰.

Descriptions : Female : Lip region offset, lips rounded. Amphid apertures occupying 20-21% of the corresponding body-width. Odontostyle 8-10 μ m long; its aperture about one third of odontostyle length. Guiding ring 7-8 μ m from anterior end. Odontophore 10-12 μ m long. The constriction between two parts of oesophagus is deep. The muscle bundles of the oesophageal sheath are straight. Anterior genital branch smaller than the corresponding body diameter. Posterior genital branch normal. Prerectum 200-210 μ m or about 5-6 anal body-width long. Tail bulboid, 30-32 μ m long or about 0.72-0.78 anal body-width long; the inner cuticle is very thick, especially at the extremity. *Male*: Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of banana at Jakhana, district Dangs.

Remarks : This species is a new record from the State.

86. *Axonchium (Axonchium) nitidum*
Jairajpuri, 1964

Measurements : Female (1) : L= 1.91 mm; a=31.93; b=2.64; c= 63-86; V=¹²55²⁰.

Description : Female : Lip region offset. Odontostyle 10 μ m long, slightly longer than lip region-width; its aperture about one third of odontostyle length. Odontophore 11 μ m long. Guiding ring 8 μ m from anterior end. Oesophagus typical of the genus. The muscle bundles of the oesophageal sheath are straight. Anterior genital branch 12 μ m, a simple sac-like, less than the body diameter long. Posterior sexual branch normal.

Prerectum 185 μ m or about 4.5 anal body diameter. Tail cylindroid with a rounded terminus or about 0.75 anal body diameter long. Three caudal pores present on each side. *Male*: Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of Lady's finger at Jhangirpur, district Surat.

Elsewhere : Manipur.

Remarks: This species is reported for the first time from the State.

Subfamily DORYLAIMELLINAE
Jairajpuri, 1964

87. *Dorylaimellus (Dorylaimellus) demani*
Goodey, 1963

Measurements : Females (2) : L= 0.78-0.79 mm; a= 31-32; b= 4.1-4.2; c= 24; V= ⁶⁻⁷48-51⁶⁻⁷

Description : Female: Lip region offset from body. Peri-oral disc absent. Peri-oral sclerotization distinct. Odontostyle 9-10 μ m long. Odontophore 15-18 μ m long. Basal expanded portion of oesophagus occupies 51-52% of neck region. Female reproductive system amphidelphic. Tail 24-28 μ m long, digitate, conoid, 1.8 anal body-width long. *Male*: Not found.

Habitat & locality : Collected by ZSI party in October, 1997 from soil around roots of coconut at Khojra, district Kutch.

Remarks : This species is reported for the first time from the State.

88. *Dorylaimellus (Axodorylaimellus) parvulus*
Thorne, 1939

Measurements : Females (7) : L= 0.48-0.54 mm; a= 24-31; b= 2.6-2.7; c= 28-33; V= ⁵⁻⁶56-58⁵⁻⁶

Description : Female : Body cylindrical, almost straight upon fixation. Lip region offset by slight depression, small labial disc present. Odontostyle 6-7 μ m. Odontophore 8-9 μ m with typical flanges. Female reproductive system amphidelphic. Prerectum 60-65 μ m or about 4.0-4.1 anal body-width long. Tail 16-22 μ m or 1-1.6 anal

body-width long. *Male* : Not found.

Habitats & localities : Collected by ZSI party in September, 2000 and December, 2001 from soil around roots of chilli at Bojpura village, Taluka Gondal, district, Rajkot; from wheat at Babari, district Narmada; from garlic at Jamla, district Dangs.

Elsewhere : West Bengal.

Remarks : This species is reported for the first time from the State.

89. *Dorylaimellus (Belondorylaimellus) discocephalus* Siddiqi, 1964

Measurements : *Females* (5): L= 1.03-1.31 mm; a= 37-38; b= 4.2-4.5; c= 39-46; V= ⁷⁻⁸ 50-52⁷⁻⁸

Description : *Female* : Lip region well offset. Lateral glandular organs conspicuous, 70-72 in number, variable in size and irregular in arrangements. Odontostyle 6-7 μ m, its aperture 2-3 mm. Odontophore 9-11 μ m long, with typical flanges. Basal expanded part of oesophagus occupies 55-57% of neck length. Female reproductive system amphidelphic. Prerectum 50-60 μ m or about 2-3 anal body-width long. Tail 26-28 μ m, cylindrical with bluntly rounded terminus, about 1.4 anal body-width long. *Male*: Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of grasses at Sasan Gir, district, Junagarh.

Elsewhere : Rajasthan, West Bengal, Uttar Pradesh, etc.

Remarks : This species is reported for the first time from the State.

Superfamily TYLENCHOLAIMOIDEA
Filipjev, 1934

Key to families of TYLENCHOLAIMOIDEA represented in Gujarat

1. Odontostyle usually well developed; expanded part of oesophagus about one half of oesophageal length
..... TYLENCHOLAIMIDAE
- Odontostyle usually slender; expanded part of

oesophagus short cylindroid or Pyriform bulb 2

2. Odontostyle asymmetrical with distinct aperture; oesophageal bulb cylindroid
..... MYDONOMIDA

– Odontostyle symmetrical, attenuated, often solid, needle-like; oesophageal bulb usually pyriform LEPTONCHIDAE

Family TYLENCHOLAIMIDAE Filipjev, 1934

Key to species of *Tylencholaimus* from Gujarat

1. Female reproductive system amphidelphic....
..... *annulatus*

– Female reproductive system monodelphic ... 2

2. Female reproductive system mono-opisthodelphic
..... *gertii*

– Female reproductive system prodelphic 3

3. Tail conical-conoid with rounded terminus; 1.0 -1.2 and body with long *nagauriensis*

– Tail conical, elongate with rounded tip and ventrally curved; 2.7 - 3.0 anal body-width long
..... *leptonchoides*

90. *Tylencholaimus leptonchoides* Loof, 1964

Measurements : *Females* (2): L= 0.72-0.81 mm; a= 32; b= 4.0-4.4; c= 12.4-12.7; V=¹⁷⁻¹⁸ 59-61

Description : *Female* : Lip region offset from body by a constriction. Odontostyle 6-7 μ m long. Odontophore 8-9 μ m long with basal knobs. Guiding ring 3-4 μ m from anterior end. Basal expanded part of oesophagus occupies 37-39% of neck length. Reproductive system mono-prodelphic. Post uterine sac absent. Prerectum 55-57 μ m or 3.0 anal body-width long. Tail 58-64 μ m, conical, elongated with rounded tip and ventrally curved, 2.7-3.0 anal body-width long. *Male*: Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of brinjal at Sogbara, district Narmada.

Remarks : This species has been reported for the first time from the State.

91. *Tylencholaimus nagauriensis* Baqri & Bohra, 2001

Measurements : Females (4): L= 0.64-0.74 mm; a= 19-22; b= 3.6-4.0; c= 32-33; V= ¹⁹⁻²⁰64-67

Description : Female : Lip region cap-like, marked off from body by a constriction, twice as wide as high. Lips amalgamated with their inner parts elevated forming a marked perioral disc. Odontostyle 8-9 μ m long. Odontophore 10-11 μ m, with small basal thickenings. Basal expanded portion of oesophagus 37-39% of neck region. Female reproductive system mono -prodelphic. Prerectum 40-42 μ m or about 2.2-2.5 anal body-width long. Rectum 20-22 μ m or about one anal body-width long. Tail convex-conoid with rounded terminus, 20-22 μ m or about 1.0-1.2 anal body width-long. *Male* : Not found

Habitat & locality : Collected by ZSI party in September, 1998 from soil around roots of barley at Sabarkantha, district Sabarkantha.

Elsewhere : Rajasthan.

Remarks: This species is reported for the first time from the State.

92. *Tylencholaimus gertii* Kruger, 1965

Measurements : Females (2): L= 0.76-0.80 mm a= 27-28; b=4.4-4.7; c= 30-31; V=43¹⁸⁻¹⁹

Description : Female : Lip region offset by a deep constriction. Odontostyle 8-9 μ m long, aperture 3 mm. Odontophore 9-10 μ m long, with basal thickenings. Basal expanded portion of oesophagus 35-36% of neck region. Reproductive system mono-opisthodelphic. Tail 23-25 μ m, bluntly convex-conoid, about one anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Sasan Gir, district, Junagarh.

Elsewhere : West Bengal, Rajasthan, Bihar and Maharashtra.

Remarks : This species is reported as new record from the State.

93. *Tylencholaimus annulatus* Baqri & Bohra, 2001

Measurements : Females (5) : L= 0.50-0.59 mm; a= 14-19; b=3.1-3.9; c= 17-19; V=¹⁰⁻¹¹48-54¹⁰⁻¹¹.

Description : Female : Lip region marked off from body by a constriction. Odontostyle 10-12 μ m long. Odontophore, 13-15 μ m long, with small basal thickenings. Basal portion of oesophagus 30-33% of neck region. Female reproductive system amphidelphic. Prerectum 53-60 μ m long or about 2 anal body-width long. Tail 28-32 μ m, conical with rounded tip, 1.5-1.6 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 1998 from soil around roots of til at Sabarkantha, district Sabarkantha.

Elsewhere : Rajasthan

Remarks : This species is reported for the first time from the State.

94. *Utahnema tenuidens* Thorne, 1939

Measurements : Female (1): L= 0.54 mm; a= 24; b= 3.9; c= 30; V= ¹³55¹⁵.

Description : Female : Lips rounded, amalgamated. Odontostyle slender, 20 μ m long, its aperture 2 μ m. Odontophore 15 μ m long. Guiding ring single, 9 mm from anterior end. Basal part of oesophagus occupies 25% of neck region. Female reproductive system amphidelphic. Tail short 18 μ m, convex conoid, 1.1 anal body-width long. *Male* : Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of cotton at Motiwana village, Taluka Lakhtar, district Surendranagar.

Remarks : This genus is reported for the first time from India.

Family LEPTONCHIDAE Thorne, 1935

Key to Subfamilies of LEPTONCHIDAE from Gujarat

1. Odontostyle slender; inner cuticular lining of oesophageal bulb not prominently thickened

..... LEPTONCHINAE

— Odontostyle robust; inner cuticular lining of oesophageal bulb prominently thickened.....

..... TYLEPTINAE

95. *Leptonchus granulatus* Cobb, 1920

Measurements : Females (5): L= 0.9- 1.14 mm; a= 24-30; b= 5-6; c= 57; V= ⁶⁻⁹59-60⁶⁻⁹

Description : Female: Body almost straight upon fixation. Lip region offset by constriction, lips and papillae distinct. Labial framework prominent. Odontostyle 9-10 μ m long, with narrow lumen and small aperture. Odontophore 10-12 μ m long, arcuate. Basal pyriform bulb which occupies 18-25% of neck region. Female reproductive system amphidelphic. Intestine- prerectum junction located anterior to vulva, prerectum 420-450 μ m or 16-21 anal body-width long. Tail bluntly conoid, 17-20 μ m or one anal body-width long. *Male:* Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of maize and grasses at Godra, district Panchmahal and Junagarh respectively.

Elsewhere : Rajasthan and Uttar Pradesh.

Remarks : This species has been reported for the first time from the State.

96. *Proleptonchus clarus* Timm, 1964

Measurements : Females (2): L= 1.24-1.39 mm; a= 41-42; b= 7.2-7.6; c= 69-77; V= ¹⁸⁻¹⁹55-56

Description : Female: Lip region slightly offset from body. Odontostyle slender, 8-9 μ m long. Odontophore 11-12 μ m long. Oesophagus slender, terminating in a constricted bulb. Female reproductive system mono-prodelphic. Prerectum 120-130 μ m or 4-5 anal body-width long. Tail rounded, 16-20 μ m or 0.5-0.6 anal body-width long. *Male :* Not found.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of cotton at Hadmata, Taluka Gondal, district Rajkot.

Elsewhere : West Bengal and Sikkim.

Remarks : This species is reported for the first time from the State.

Subfamily TYLEPTINAE Jairajpuri, 1964

97. *Tyleptus projectus* Thorne, 1939

Measurements : Female (1): L= 1.06 mm; a=42; b= 5.0; c= 50; V= ⁴³38²¹.

Description : Female : Lip region offset from body. Liplets projecting around oral aperture. Odontostyle 9 μ m long. Odontophore 11 μ m long. Oesophagus slender, terminating in short pyriform bulb, 32 μ m x 15 mm. Inner cuticular lining of basal bulb forming thickened valvular chamber. Female reproductive system opisthodelphic. Anterior uterine sac 27 μ m or 2.7 body-width long. Prerectum 66 mm long. Tail 21 mm long, hemispheroid. *Male :* Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of groundnut at Sasan Gir, district Junagarh.

Elsewhere : West Bengal, Himachal Pradesh.

Remarks : This species is reported for the first time from the State.

Family MYDONOMIDAE Thorne, 1964

98. *Dorylaimoides (Dorylaimoides) parateres* Siddiqi, 1964

Measurements : Female (1) : L= 1.50 mm; a= 35; b= 6.8; c= 50; V= ¹⁴⁻¹⁵42¹⁴⁻¹⁵.

Description : Female : Lip region slightly offset. Odontostyle dorylaimoid, ventral side 8 μ m long, dorsal side extending further posteriorly. Odontophore 19 μ m long, arcuate, sclerotized. Basal expanded part of oesophagus occupies 28% of neck region. Reproductive system amphidelphic. Prerectum 164 μ m or about 6.5 anal body-width long. Tail 30 μ m or about 1.2 anal body-width long, obtusely rounded. *Male :* Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of Guava at Godak, district Navsari.

Elsewhere : Uttar Pradesh

Remarks : This species is reported for the first time from the State.

99. *Dorylaimoides (Digidorylaimoides)*

micoletzkyi (de Man, 1921)

Thorne & Swanger, 1936

Measurements : *Female* (1): L= 1.33 mm; a= 36; b= 6.4; c= 11.9; V= ¹²⁻¹³42¹³⁻¹⁴. *Male* (1): L= 1.22 mm; a= 43; b= 6.70; c= 75; T=49.

Description : *Female* : Lip region offset by a slight depression from body. Odontostyle 9 µm ventrally and 13 µm dorsally. Odontophore typical to the genus, 16 µm long. Female reproductive system amphidelphic. Prerectum 115 µm or 5.5 anal body-width long. Tail elongate conoid 112 µm or 5.0 anal body-width long, terminus bent dorsally. *Male* : Spicules 35 µm long. Lateral guiding pieces 8 µm long. In addition to the adanal pairs, 5 irregularly spaced ventromedian supplements. Tail elongate-conoid, 79 µm or 3.4 anal body-width long.

Habitat & locality : Collected by ZSI party in October, 2000 from soil around roots of Jowar at Taluka Lakhtar, district Surendranagar.

Elsewhere : West Bengal and Sikkim.

Remarks : This species is reported as new record from the State.

100. *Dorylaimoides (Longidorylaimoides)*

leptura Siddiqi, 1965

Measurements : *Female* (4) : L= 1.70-2.17 mm; a= 40-55; b= 6.3-7.9; c=9-11; V=¹⁰⁻¹¹38-40¹¹⁻¹²

Description : *Female* : Body ventrally arcuate. Lip region slightly offset from body. Odontostyle asymmetrical, ventral side 4-5 µm and 8-9 µm long dorsally. Odontophore arcuate, 16-17 µm long. Basal expanded part of oesophagus 29-32% of neck region. Female reproductive system amphidelphic. Prerectum 203-210 µm long or 9.2-10 anal body-width long. Tail 189-230 µm elongate filiform, 189-230 µm or about 9-11 anal body-width long, dorsally bent posteriorly. *Male* : Not found.

Habitats & localities : Collected by ZSI party

in December, 2001 from soil around roots of lobia, cotton and wheat at Papari, district Dangs, Bharuch and Surat districts.

Elsewhere : West Bengal and Maharashtra.

Remarks : This species is reported for the first time from the State.

101. *Dorylaimoides (Tarjania) constrictoides*

Goseco, Ferris & Ferris, 1976

Measurements : *Females* (2): L= 0.72-0.79 mm; a= 34-37; b= 4.3-4.6; c= 11-13; V= ²⁻³36-38¹⁴⁻¹⁵

Description : *Female*: Lip region slightly offset, rounded. Odontostyle 6-7 µm long ventrally. Odontophore 15-16 µm long, angular. Basal expanded part of oesophagus 24% of total oesophageal length, offset from cylindrical part by slight constriction. Reproductive system mono-opisthodelphic. Prerectum 83-86 µm or 5.1-5.3 anal body-width long. Tail 60-62 µm long, elongate conoid with rounded terminus, dorsally bent. *Male*: Not found.

Habitat & locality : Collected from soil around roots of banana at village Jakhana, district Dangs.

Remarks : This species is being reported for the first time from the State.

Suborder NYGOLAIMINA Ahmad &

Jairajpuri, 1973

Superfamily NYGOLAIMOIDEA Thorne, 1935

Family NYGOLAIMIDAE Thorne, 1935

102. *Aquatides aquaticus* (Thorne, 1930)

Thorne, 1974

1930. *Nygolaimus aquaticus* Thorne, *J. Agric. Res. U.S. Dept. Agric.* **41** : 445-466

1974. *Aquatides aquaticus* (Thorne, 1930) Thorne, *Tech. Bull. Exp. Sta. South Dakota State Univ.* **41** : 120.

Measurements : *Females* (10): L= 1.80-2.06 mm; a=39-42; b= 5.0-5.2; c= 81-82; V=¹³⁻¹⁴47-52¹³⁻¹⁵. *Male* (1): L= 2.04 mm; a=40; b=4.0; c=56; T=65.

Description : *Female* : Body almost straight upon fixation. Lip region continuous with body,

labial papillae elevated. Tooth linear, 15-18 μm or equal to lip region width. Basal expanded part of oesophagus occupies 45-48% of oesophageal length, enclosed in a conspicuous sheath forming basal pockets. Cardiac glands well developed. Female reproductive system amphidelphic. Prerectum 65-75 μm or 2-3 anal body-width long. Tail 22-25 μm long, shorter than anal body-width, convex-conoid or bluntly rounded. *Male*: Spicules massive, arcuate, 50-58 μm medially. Gubernaculum 9-10 μm long. Lateral guiding pieces well developed, 11-13 μm long. In addition to adanal pair, 5-6 ventromedian supplements present. Tail 36 μm long, convex-conoid.

Habitat & locality: Collected by ZSI party in January, 1998 from soil around roots of maize at Godra, district Panchmahal.

Elsewhere: Himachal Pradesh.

Remarks: This species is reported for the first time from the State.

103. *Aquatides thornei* (Schneider, 1937)
Ahmad & Jairajpuri, 1982

1937. *Nygolaimus thornei* Schneider, *Arch. Hydrobiol. Planktonk Suppl.* 15 : 30-108.

1968. *Nygolaimus (Aquatides) thornei* (Schneider, 1937)
Heyns, *Entomol. Mem. S. Africa*, 19 : 1-144.

Measurements: Females (5): L= 1.66-1.76 mm; a= 32-55; b= 4.1-4.5 c= 65-66; V= $^{12-13}47-49^{12-13}$.
Male (1): L= 1.44 mm; a= 33; b=4.0; c=53; T=52.

Description: *Female*: Lip region continuous with body. Labial papillae not elevated. Tooth linear, 12-13 μm or equal to lip region-width. Basal expanded part of oesophagus enclosed in a conspicuous sheath forming basal pockets. Cardia hemispherical. Cardiac glands rounded. Female reproductive system amphidelphic. Prerectum 65-70 μm or two anal body-width long. Tail hemispheroid, slightly clavate, 25-27 μm or about one anal body width long. *Male*: Similar to female in general morphology. Spicules 45 μm long, lateral guiding pieces 9 μm long. Gubernaculum 8 μm long. Ventromedian supplements 5. Tail hemispherical, 27 μm long.

Habitat & locality: Collected by ZSI party in October, 2000 from soil around roots of cotton and jowar at Lakhtar district Surendranagar.

Elsewhere: Bihar.

Remarks: Reported for the first time from the State.

Order MONONCHIDA Jairajpuri, 1969

Suborder MONONCHINA Kirjanova
& Krall, 1969

Superfamily MONONCHOIDEA,
Chitwood, 1937

Family MONONCHIDAE Chitwood, 1937

104. *Mononchus aquaticus* Coetzee, 1968

Measurements: *Female* (1): L= 1.77 mm; a=42.19; b= 5.77; c= 18.65; V= $^{10-11}55$

Description: *Female*: Lip region 21 μm wide and 9 mm high. Amphidial apertures 3 μm wide, located at 8 mm from anterior end. Buccal cavity 36x14 μm . The apex of dorsal at 24 mm or 66% of buccal cavity from base. Female reproductive system amphidelphic. Tail elongate conoid with clavate tip, 94 μm or 3.7 anal body-width long. Caudal glands well developed, spinneret terminal. *Male*: Not found.

Habitat & locality: Collected by ZSI party in October, 2000 from around roots of cotton at Nainikotta village, district Surendranagar.

Elsewhere: West Bengal.

Remarks: This species is being reported for the first time from Gujarat.

Family MYLONCHULIDAE Jairajpuri, 1969

Key to species of *Mylonchulus*

1. Spinneret absent *subsimilis*
- Spinneret present 2
2. Spinneret subterminal dorsally, intestine pushed dorsally in female genital region
..... *contractus*
- Spinneret terminal, intestine not pushed dorsally 3
3. Tail elongate-conoid with rounded tip
..... *hawaiiensis*
- Tail arcuate-conoid 4

4. Denticless arranged in 5-6 definite rows.
 *minor*
 — Denticles arranged in 7 transverse rows... ..
 *lacustris*

105. *Mylonchulus contractus* Jairajpuri, 1970

Measurements : Females (5) : L= 0.95-0.98 mm; a= 21-25; b= 3.4-3.7; c= 30-31; V= ⁷⁻⁸54-55⁷⁻⁸

Description : Female : Lip region 22-25 x 7-10 µm. Buccal cavity 21-22x14-15 µm. Apex of dorsal tooth 17-18 µm or 80-81% of the buccal cavity from base. Subventral walls with 5 transverse rows of denticles. Reproductive system amphidelphic. The intestine distinctly contracted and pushed dorsally in the region of gonads. Tail conoid with blunt terminus, 30-32 µm or one anal body-width long. Caudal glands grouped. Spinneret subterminal dorsally. *Male*: Not found

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Sasan Gir, district Junagarh.

Elsewhere : Rajasthan, Sikkim, Kerala, Assam, Himachal Pradesh and Uttar Pradesh.

Remarks : This species is being reported for the first time from Gujarat.

106. *Mylonchulus hawaiiensis* (Cassidy, 1931)
 Andrassy, 1958

Measurements : Females (5): L= 1.00-1.07 mm; a= 25-27; b= 2.83-3.48; V= ⁷⁻⁸59-64⁷⁻⁸

Description : Female : Lip region 18-20x5-6 µm. Amphidial apertures 3-5 µm wide located at 7-10 mm from anterior end. Buccal cavity 21-22 x 13-14 µm. Dorsal tooth large, situated in anterior half of buccal cavity, its apex at 16-17 µm or 63-77% of buccal cavity from base. Subventral walls bearing 5 or 6 transverse rows of denticles. Submedian teeth present. Female reproductive system amphidelphic. Tail tip slightly clavate, 30-42 µm or about 1.0-1.8 anal body-width long. Caudal glands tandem, rarely grouped. Spinneret terminal. *Male* : Not found.

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of brinjal

at Nargol, district Valsad.

Elsewhere : Andaman Nicobar, Sikkim, Ja mmu & Kashmir, Himachal Pradesh and Uttar Pradesh.

Remarks : This species is reported for the first time from the State.

107. *Mylonchulus lacustris* (N.A. Cobb in
 M.V. Cobb, 1915) Andrassy, 1958

Measurements : Females (5): L= 1.36-1.44 mm; a= 36-44; b= 3.66-4.18; c= 31-34; V= ⁶⁻⁷60-65⁶⁻⁷

Description : Female : Lip region offset, 21-23 x 7-8 µm. Amphidial apertures 4-5 mm wide, located at 9-12 µm from anterior end. Buccal cavity 28-29x17-18 µm. Dorsal tooth massive, its apex 75% of the buccal cavity from base. Subventral walls bearing 6-7 transverse rows of denticles. Submedian teeth well developed. Female reproductive system amphidelphic. Tail conoid, arcuate, 42-45 µm or more than one anal body-width long. Caudal gland tandem. Spinneret terminal. *Male* : Not found.

Haitat & locality : Collected by ZSI party in October, 2000 from soil around roots of cotton at Samoid, district Ahmedabad.

Elsewhere : West Bengal, Rajasthan, Uttaranchal, Uttar Pradesh.

Remarks : This species is reported for the first time from the State.

108. *Mylonchulus minor* (Cobb, 1893)
 Andrassy, 1958

Measurements : Females (3): L= 0.74-0.89 mm; a= 28-32; b= 3.23-3.52; c= 24-28; V= ⁸⁻⁹59-60⁸⁻⁹

Description : Female: Lip region 20-22x5-6 mm. Amphidial apertures 3-4 µm wide, located at 8-9 mm from anterior end. Buccal cavity 23-25x14-15 µm. Dorsal tooth situated in anterior half of buccal cavity, its apex at 17-18 µm or 72-73% of the buccal cavity from base. Subventral walls with 5-6 transverse rows of denticles. Submedian teeth present. Reproductive system amphidelphic. Tail arcuate conoid with rounded terminus, 30-32 µm or 1.0-1.2 anal body-width long. Caudal glands tandem.

Spinneret terminal. *Male*: Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of til at Bagdu; Sasan Gir, district Junagarh.

Elsewhere : Rajasthan, Maharashtra, Andhra Pradesh and Uttar Pradesh.

Remarks : This species is being reported here for the first time from Gujarat.

109. *Mylonchulus subsimilis* (Cobb, 1917)
Meyl, 1957

Measurements : *Female*: L= 1.00 mm; a= 26-55; b= 3.64; c=36-03; V= ⁸58⁸

Description : *Female*: Lip region 20 x 5 μ m. Amphidial apertures 3 μ m wide, located at 8 mm from anterior end. Buccal cavity 22 x 13 μ m. Apex of dorsal tooth at 16 μ m or 72% of the buccal cavity from base. Subventral walls bearing 5 rows of denticles. Submedian teeth present. Reproductive system amphidelphic. Tail conoid, with tip bluntly rounded, 26 μ m or about one anal body-width long. Caudal glands and terminal opening absent. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Bagdu, Sasan Gir, district Junagarh.

Elsewhere : Uttar Pradesh.

Remarks : This species is reported for the first time from the State.

110. *Sporonchulus vagabundus* Jairajpuri, 1971

Measurements : *Female* (1): L= 1.19 mm; a= 35-14; b= 3.98; c=25.97; V= ⁶63⁶

Description : *Female* : Lip region 22 x 7 μ m. Amphidial apertures 4 μ m wide, located at 8 μ m from anterior end. Buccal cavity 22 x 12 μ m. Dorsal tooth medium sized, its apex at 17 μ m or 77% of buccal cavity from base. Subventral walls with 4 rows of irregularly arranged denticles. Reproductive system amphidelphic. Tail elongate conoid, 48 μ m or about two anal body-width long. Caudal glands present. Spinneret terminal. *Male* : Not found.

Habitat & locality : Collected by ZSI party in September, 2000 from soil around roots of unidentified grasses at Sasan Gir, district Junagarh.

Elsewhere : Uttar Pradesh.

Remarks : This species is being reported for the first time from the State.

111. *Iotonchus jairi* (Lordello, 1958) Clark, 1960

Measurements : *Female* (1): L= 1.34 mm; a= 25; b=3.4; c= 17; V=84²⁵

Description : *Female* : Lip region 30 μ m wide and 11 μ m high. Buccal cavity 42 x 26 μ m. Dorsal tooth minute, situated in anterior half of buccal cavity; its apex 28 μ m or 66% of the length of buccal cavity from base. Reproductive system monoprodelphic. Posterior uterine sac absent. Tail conoid, 76 μ m or about 2.3 anal body-width long. Caudal glands and spinneret absent. *Male* : Not found

Habitat & locality : Collected by ZSI party in December, 2001 from soil around roots of chilli at Sagbara, Taluka Sagbara, district Narmada.

Elsewhere : Uttaranchal.

Remarks : This species is reported for the first time from the State.

SUMMARY

Before we initiated the present study, the analysis of the nematology literature from India revealed that only 33 species had been recorded from Gujarat State. Most of recorded species by the nematologist were found phytophagous. It was therefore, felt necessary to conduct study on the fauna of plant and soil nematodes from the state. Hence, ZSI tour parties conducted surveys for collecting the plant and soil nematodes from the following 11 districts of Gujarat state in the years 2000-2001 : Junagarh, Jamnagar, Rajkot, Surendranagar, Bharuach, Valsad, Vadodara, Surat, Narmada, Navsari and Dangs. During the course of study, the authors have identified 83 species belonging to 41 genera of 18 families from the state. Out of these 83 species, 78 species have been recorded for the first time from Gujarat

(Table-II) while the remaining five species had already been recorded by earlier taxonomists. Keeping in view the wealth of information gathered by us as well as by the earlier scientists, all the information has been compiled in this paper. The paper reports 111 species (recorded by the authors as well as reported by others) belonging to 53 genera spread over 27 families of the orders Tylenchida, Aphelenchida, dorylaimida and Mononchida. Wherever necessary, keys for identification of the taxa have also been provided so that it may become easier for others to identify the nematodes from Gujarat State. The species recorded for the first time from Gujarat State are marked with asterisk. The species now known from Gujarat are listed below:

Tylenchidae : *Basiria brevistylus**, *Basiria bilineata*

Anguinidae : *Ditylenchus triformis*

Hoplolaimidae : *Hoplolaimus indicus*, *Hoplolaimus pararobustus*, *Scutellonema brachyurus*, *Helicotylenchus dihystra**, *Helicotylenchus anhelicus**, *Helicotylenchus erytherinae*, *Helicotylenchus exallus**, *Helicotylenchus indicus*, *Helicotylenchus multicinctus**, *Helicotylenchus orthosomaticus**, *Helicotylenchus retusus**, *Helicotylenchus rotundicauda**, *Helicotylenchus truncatus**

Rotylenchulidae : *Rotylenchulus reniformis*

Pratylenchidae : *Pratylenchus loosi**, *Pratylenchus thornei*, *Pratylenchus zaeae*, *Hirschmanniella gracilis**, *Hirschmanniella mucronata*, *Hirschmanniella oryzae*, *Radopholus similis*.

Meloidogynidae : *Meloidogyne arenaria*, *Meloidogyne hapla*, *Meloidogyne incognita*, *Meloidogyne javanica*, *Meloidogyne indica*.

Heteroderidae : *Heterodera cajani*, *Heterodera zaeae*.

Telotylenchidae : *Telotylenchus paaloofi**, *Tylenchorhynchus divittatus**, *Tylenchorhynchus latus*, *Tylenchorhynchus mashhoodi**, *Tylenchorhynchus microcephalus*, *Tylenchorhynchus nudus** *Bitylenchus brevilineatus*, *Bitylenchus vulgaris*, *Scutylenchus hexincisus*.

Psilenchidae : *Psilenchus hilarus*

Paurodontidae : *Paurodontus similis*

Aphelenchidae : *Aphelenchus avenae**

Aphelenchoididae : *Aphelenchoides besseyi*, *Aphelenchoides parascalcaudatus*.

Dorylaimidae : *Laimydorus baldus**, *Laimydorus kherai**, *Laimydorus finalis**, *Mesodorylaimus adalbarti**, *Mesodorylaimus brassicus**, *Mesodorylaimus caudatus*, *Mesodorylaimus margeritus**, *Mesodorylaimus mesonyctius**, *Mesodorylaimus szunyoghyi**, *Thornenema mauritianum**, *Sicaguttur sartum**

Aporcelaimidae : *Aporcelaimellus heynsi**, *Tubixaba parva**

Qudsianematidae : *Labronema confusum**, *Ecumenicus monohystera**, *Allodorylaimus kosambaensis*, *Discolaimus major**, *Discolaimium mukhtarpuriense**, *Discolaimoides bulbiferus**, *Latocephalus gracile**

Nordiidae : *Longidorella xenura**, *Kochinema farodai**, *Kochinema caudatum**, *Oriverutus labiatus**

Actinolaimidae : *Neoactinolaimus kosambus*, *Neoactinolaimus attenuatus*.

Longidoridae : *Longidorus elongatus** *Paralongidorus citri**, *Paralongidorus major**, *Paralongidorus beryllus**, *Paralongidorus microlaimus**

Xiphinematidae : *Xiphinema americanum**, *Xiphinema basiri**, *Xiphinema elongatum**, *Xiphinema insigne**, *Xiphinema orbum**

Belondiridae : *Belondira bulbosa**, *Belondira tenuidens**, *Belondira porta**, *Axonchium (Axonchium) bulbosum**, *Axonchium (Axonchium) nitidum**, *Dorylaimellus (Dorylaimellus) demani**, *Dorylaimellus (Axodorylaimellus) parvulus**, *Dorylaimellus (Belondorylaimellus) discocephalus**

Tylencholaimidae : *Tylencholaimus annulatus**, *Tylencholaimus gertii**, *Tylencholaimus nagauriensis**, *Tylencholaimus leptonchoides**, *Utahnema tenuidens**

Leptonchidae : *Leptonchus granulatus**, *Proleptonchus clarus**, *Tyleptus projectus**

Mydonomidae : *Dorylaimoides (Digidorylaimoides) micoletzyki**, *Dorylaimoides (Longidorylaimoides) leptura**, *Dorylaimoides (Tarjania) constrictoides**, *Dorylaimoides (Dorylaimoides) parateres**.

Nygolaimidae : *Aquatides aquaticus**, *Aquatides thornei**

Mononchidae : *Mononchus aquaticus**.

Mylonchulidae : *Mylonchulus contractus**, *Mylonchulus hawaiiensis**, *Mylonchulus lacustris**, *Mylonchulus minor**, *Mylonchulus subsimilis**, *Sporonchulus vagabundus**.

Iotonchidae : *Iotonchus jairi**.

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REFERENCES

- Ahmad, W. 1993. Studies on the genus *Mesodorylaimus* Andrassy, 1959 from India. *Nematologica*, **39** (4) : 417-430.
- Ahmad, W. 1996. *Plant Parasitic Nematodes of India. An Identification Manual*. Litho Offset Printers, Achal Tal, G.T. Road, Aligarh. pp. 345.
- Baqri, Q.H. 1991. Contribution to the fauna of Sikkim. Nematodes associated with citrus from Sikkim, India. *Rec. Zool. Surv. India. Occasional Paper No. 128* : 1-100.
- Baqri, Q.H. and Jairajpuri, M.S. 1995. *Bibliography of Nematology of India*. CBS Publishers & Distributors, Daryaganj, New Delhi, 279 pp.
- Chawla, M.L., Bhamburkar, B.L., Khan, E and Prasad, S.K. 1968. One new genus and seven new species of Nematodes from India. *Labdev. J. Sci. Tech.*, **6-B** (2) : 86-100.
- Chitwood, B.G. 1949. Root-knot nematodes Part-I. A revision of the genus *Meloidogyne* Goeldi, 1881. *Proc. Helminth. Soc. Wash.*, **16**, 90-104 (H.A. 18, No. 254d).
- Christie, J.R. 1942. A description of *Aphelenchoides besseyi* n. sp. the summer-dwarf nematode of strawberries with comments on the identity of *Aphelenchoides subtenuis* (Cobb, 1926) and *Aphelenchoides hodsoni* Goodey, 1935. *Proc. Helminth. Soc. Wash.*, **9** : 82-84.
- Desai, M.V. 1992. Nematode-limiting factors in groundnut production in Gujarat. *Indian J. Mycol. & Plant Pathol.*, **22** (1) : 27-34.
- Hunt, D.J. 1993. Aphelenchida, Longidoridae and Trichodoridae. Their systematics and Bionomics. CAB International, Wallingford, Oxon, OX10 8DE, U.K.
- Husain, Z. and Rasheed, A. 1969. A description of the male of *Psilenchus hilarus* Siddiqi, 1963 (Nematoda : Tylenchidae). *Indian J. Ent.* (1968), **30** : 312-313.
- Husaini, T.A., Ahmad, I. and Firdausi, N.S. 1997. Three new species in the superfamily Bunonematoidea (Rhabditida) from India. *Nematologia Mediterranea*, **25** (1) : 41-48.

- Jairajpuri, M.S. and Ahmad, W. 1992. *Dorylaimida. Free living, Predaceous and Plant-Parasitic Nematodes*. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. Pp. 457.
- Jairajpuri, M.S. and Baqri, Q.H. 1968. *Tylenchorhynchus hexincisus* n.sp. and *Telotylenchus historicus* n. sp. (Tylenchida) from India. *Nematologica*, 14 : 217-222.
- Jairajpuri, M.S. and Baqri, Q.H. 1991. *Nematode Pests of Rice*. Mohan Pramlani for Oxford & IBH Publishing Co. Pvt. Ltd., 66 Janpath, New Delhi. Pp. 1-66.
- Khan, Z, Ahmad, W., and Jairajpuri, M.S. 1994. Three new species of the family, Actinolaimidae (Nematoda : Dorylaimida) from India. *Fundamental & Applied Nematology*, 17 (3) : 267-273.
- Khan, Z., Ahmad, W. and Jairajpuri, M.S. 1995. Description of four new species of dorylaimid nematodes. *Afro-Asian J. Nematol.* 5 (2) : 133-140.
- Kishan, Singh, Shah, H.M., Krishna Murthy, G.V.G. and Patel, G.G. 1964. Plant parasitic nematodes found in the root zones of tobacco. *Curr. Sci.* 33 : 531-532.
- Koshy, P.K., Swarup, G. and Sethi, C.L. 1971. *Heterodera zea* n.sp. (Nematoda : Heteroderidae) a cyst forming nematode on *Zea mays*. *Nematologica* 16 : 511-516.
- Patel, B.A., Thakur, N.A. and Patel, D.J. 1987. Plant parasitic nematodes associated with bidi tobacco in Gujarat. *Indian J. Nematol.*, 17 : 150.
- Patel, D.J., Makadia, B.M. and Shah, H.M. 1982. Occurrence of root-knot on turmeric (*Curcuma longa* L.) and its chemical control. *Indian J. Nematol.*, 12 : 168-171.
- Patel, D.J., Patel, B.A., Chavda, J.C. and Patel, M.V. 1988. Record of *Meloidogyne javanica* on groundnut in Gujarat. *Int. Arachis. Newl.*, No. 3 : 16-17.
- Patel, D.J., Thakar, N.A., Patel, H.R. and Patel, C.C. 1987. Outbreak of stunt nematodes on wheat in Gujarat. *Curr. Sci.* 56 : 731.
- Patel, G.J., Desai, M.V. and Shah, M.M. 1962. Stunt nematodes and tobacco in Gujarat, India. *Plant Dis. Repr.*, 46 : 173-174.
- Patel, G.J., Patel, D.J., Jogani, D.K. and Patel, S.T. 1986. Wheat-a new host of *Meloidogyne javanica* in India. *Indian J. Nematol.*, 16 : 134.
- Patel, H.K., Patel, D.J. and Patel, C.C. 1988. *Scutellonema brachyurum* ? pest of banana crop in Gujarat. *Indian J. Nematol.*, 18 : 351.
- Saha, M. and Khan, E. 1982. *Duotylenchus bilineatus* gen n. sp. n. and *Tylenchorhynchus badliensis* sp. n. (Tylenchida : Nematoda) from Haryana, India. *Indian J. Nematol.*, 11 : 205-211.
- Shah, H.M. and Patel, D.J. 1979. Occurrence of root-knot disease in cumin. *Indian J. Nematol.*, 9: 179-180.
- Shah, H.M., Patel, D.J. and Jaisani, B.G. 1985. Reaction of two Japanese tobacco varieties ?Okinawa-6? and ?Okinawa-12? to *Meloidogyne javanica* under Gujarat conditions. *Indian J. Nematol.*, 15 : 108.
- Sharma, N.N., Edward, J.C., Misra, S.L. and Chandrashekhar, M. 1992. Studies on phytonematodes associated with important rice growing tracts of India. *Current Nematol.*, 3 (2) : 107-109.

- Sharma, S.B., Ali, S.S., Patel, H.V., Patel, B.A., and Patel, S.K. 1993. Distribution and importance of plant parasitic nematodes associated with pigeonpea in Gujarat State, India. *Afro-Asian J. Nematol.*, **3** (1) : 55-59.
- Sher, S.A. 1963. Revision of the Hoplolaiminae (Nematoda) IV. *Peltamigratus* and *Aorolaimus* n.gen. *Nematologica*, **9** : 267-295.
- Sher, S.A. 1968. Revision of the genus *Radopholus* Thorne, 1949 (Nematoda : Tylenchoidea). *Proc. Helminth. Soc. Wash.*, **35** : 219-237 (H.A. 38, No. 2838)
- Siddiqi, .R. 1963. Two new species of the genus *Helicotylenchus* Steiner, 1945 (Nematoda : Tylenchida) with a description of *Zygotylenchus browni* nov. gen. et nov. sp. *Z. Parasitenk*, **23** : 390-396.
- Siddiqi, M.R. 2000. *Tylenchida. Parasites of Plants and Insects*. CAB International, Wallingford, Oxon OX10 8 DE U.K., Pp. 833.
- Siddiqi, M.R. and Patel, D.J. 1990. *Tylenchorhynchus microcephalus* sp.n. and *Paurodontus similis* Siddiqi, 1961 (Nematoda : Tylenchida) from Gujarat. *Current Nematol.*, **1** (1) : 7-10.
- Tarjan, A.C. 1973. A synopsis of the genera and species in Tylenchorhynchinae (Tylenchoidea: Nematoda). *Proc. Helminth. Soc. Wash.*, **40** : 123-144.
- Upadhyay, K.D., Swarup, G. and Sethi, C.L. 1972. *Tylenchorhynchus vulgaris* sp.n. associated with maize in India with notes on the embryology and life history. *Indian J. Nematol.*, **2** : 129-138.
- Whitehead, A.G. 1968. Taxonomy of *Meloidogyne* (Nematoda : Heteroderidae) with description of four new species. *Trans. Zool. Soc. Lond.*, **31** : 263-401 (H.A. (B) 39 No. 745.
- Yadav, B.S. and Verma, A.C. 1983. Cyst nematodes. *Heterodera, Globodera, Sarisodera, Punctodera, Dolichodera*. Dept. of Nematology, Rajasthan College of Agriculture, Mohan Lal Sukhadia University, Udaipur, pp 98.

CNIDARIA :MEDUSAE

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INTRODUCTION

Medusae of the Indian coast have received considerable attention over a few decades and our present knowledge on this group is based on the works from Browne (1905, 1916), Annandale (1907, 1916) to recent workers such as Kramp (1958), Ganapati and Nagabhusanam (1958), Santhakumari and Nair (1969), Vannucci and Santhakumari (1970) and others. As a result 125 species under 82 genera have so far been reported from the Indian coast. This shows that the Indian waters except some regions like Kathiawar coast having record of only 5 species (except siphonophora), are rich in medusae.

The present study is based on the material, a part collected on board I.N.S. DARSHAK in 1973-74 and it was studied while the author stationed at Chennai and a part of material from the author's survey work along the Gujarat coast in 1977, 1978 and 1980-90. As a result 19 species under 19 genera and 14 families are being presented in this paper, of them 17 species are new to the area under study though they are known already from the south-west coast i.e. Kerala. One species, *Amphogona apsteini* (Vanhoffen), was not available in the study sample.

In short, the morphology and terminology, collection and preservation are available in Haldar & Choudhury, 1995. Here classification is followed after Kramp (1961). References to earlier authors have been made, wherever necessary.

MATERIAL AND METHODS

Plankton samples containing medusae were collected with a compact sampler consisting of a

rectangular metallic frame (55 cm x 15 cm) with a streamlined float provided with a stabilizing keel and fitted with a conical net of 190 cm long made of bolting silk having 60 meshes per linear centimetre. The sampler was allowed to float on the surface of water and was held in position by a system of poles and ropes. It sampled a vertical column of 15 cm from the surface and was operated for 10 minutes duration.

Further, with the help of Nansen type plankton net of 225 cm long and 50 cm mouth diameter of same cloth and same mesh size the plankton samples were collected hauling the net vertically from 20-100 metre to surface.

In both the sets metallic buckets were fitted tightly to the end of the nets collected the samples. The contents of the nets were emptied in separate jars and preserved in 4% buffered sea water formalin. It was observed that the volume of contents during night was far denser than during the day.

LIST OF SPECIES KNOWN FROM THE STUDY AREA

Phylum CNIDARIA

Class HYDROZOA

Order A. ANTHOMEDUSAE

Family I. TUBULARIIDAE

Genus (1) *Hybocodon* L.A. Agassiz, 1862

* 1. *Hybocodon forbesi* Mayer, 1894

Family II. CYTAEIDIDAE

Genus (2) *Cytaeis* Eschscholtz, 1829

* 2. *Cytaeis tetrastyla* Eschscholtz, 1829

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Family III. BOUGAINVILLIIDAE

- Genus (3) *Bougainvillia* Lesson, 1836
 * 3. *Bougainvillia fulva* Agassiz & Mayer, 1899

- Genus (4) *Koellikerina* Kramp, 1939
 * 4. *Koellikerina constricta* (Menon, 1932)

Family IV. PANDEIDAE

- Genus (5) *Amphinema* Hackel, 1879
 * 5. *Amphinema dinema* (Peron & Lesueur, 1809)

- Genus (6) *Leuckartiara* Hartlaub, 1913
 * 6. *Leuckartiara octona* (Fleming, 1823)

- Genus (7) *Merga* Hartlaub, 1913
 * 7. *Merga violacea* (Agassiz & Mayer, 1899)

Order B. LEPTOMEDUSAE

Family V. LAODICEIDAE

- Genus (8) *Laodicea* Lesson, 1843
 * 8. *Laodicea indica* Browne, 1905
 Genus (9) *Staurodiscus* Haeckel, 1879
 * 9. *Staurodiscus tetrastaurus* Haeckel, 1879

Family VI. EIRENIDIAE

- Genus (10) *Eirene* Eschscholtz, 1829
 * 10. *Eirene ceylonensis* Browne, 1905

Family VII. AEQUOREIDAE

- Genus (11) *Aequorea* Peron & Lesueur, 1809
 * 11. *Aequorea pensilis* (Eschscholtz, 1829)
 Genus (12) *Zygocanna* Haeckel, 1879
 * 12. *Zygocanna buitendijki* Stiasny, 1928

Family VIII. PROBOSCIDACTYLIDAE

- Genus (13) *Proboscidactyla* Brandt, 1835
 * 13. *Proboscidactyla ornata* (McCrary, 1857)

Order C. TRACHYMEDUSAE

Family IX. GERYONIIDAE

- Genus (14) *Liriope* Lesson, 1843
 * 14. *Liriope tetraphylla* (Chamisso & Eysenhardt, 1821)

Family X. RHOPALONEMATIDAE

- Genus (15) *Amphogona* Browne, 1905
 * 15. *Amphogona apsteini* (Vanhoffen, 1902)

Order D. NARCOMEDUSAE

Family XI. AEGINIDAE

- Genus (16) *Solmundella* Haeckel, 1879
 16. *Solmundella bitentaculata* (Quoy & Gaimard, 1833)

Order E. SEMAEOSTOMEAE

Family XII. ULMARIDAE

- Genus (17) *Aurelia* Peron & Lesueur, 1809
 * 17. *Aurelia solida* Browne, 1905

Order F. RHIZOSTOMEAE

Family XIII. CASSIOPEIDAE

- Genus (18) *Cassiopea* Peron & Lesueur, 1809
 18. *Cassiopea andromeda* (Forsk., 1775)

Family XIV. CEPHEIDAE

- Genus (19) *Netrostoma* L.S. Schultze, 1898
 * 19. *Netrostoma coeruleescens* Mass, 1903

* indicates new record from the area under study.

SYSTEMATIC ACCOUNT

Order A. ANTHOMEDUSAE

Family I. TUBULARIIDAE

Genus I. *Hybocodon* L.A. Agassiz, 1862

1862. *Hybocodon* L. Agassiz, *Mem. Amer. Acad. Arts. Sci.*, 4 (9) : 243.

Diagnosis : Pointed apical process to umbrella absent; umbrella margin at oblique angle; one simple or compound marginal tentacular bulb with 1-3 tentacles; remaining three perradial bulbs rudimentary.

1. *Hybocodon forbesi* Mayer, 1894

1894. *Hybocodon forbesi* Mayer, *Bull. Mus. comp. Zool. Harvard*, 25 (11) : 236, pl. 1, fig. 1.

1961. *Hybocodon forbesi* : Kramp, *J. mar. biol. Ass. U.K.*, 40

Diagnosis : Bell pyriform, 2 mm in height; nematocyst cells present in rows on exumbrella; tentacles 4, one highly developed having a small base and large terminal swelling with nematocysts and others reduced to bulbs; manubrium spindle shaped and hanging down almost the level of mouth opening; velum well developed at bell margin.

Remark : Bell is slightly higher than broad and the gelatinous substances is of uniform thickness. The highly developed tentacle is about as long as the bell diameter and situated at the base of the longest radial canal.

Distribution : In India : Vizagapatnam (Ganapati & Nagabhusanam, 1958); Madras (Menon, 1932); Trivandrum (Nair, 1951); Gujarat (present record).

Elsewhere : Pacific Ocean : Tanabe Bay, Japan. Atlantic Ocean : Bahamas (Type locality); Tortugas, Florida.

Family II. CYTAEIDAE

Genus 2. *Cytaeis* Eschscholtz, 1829

1829. *Cytaeis* Eschscholtz, *System der Acalephen*, Berlin : 104

Diagnosis : Marginal tentacles 4, simple radially placed; oral tentacles simple, unbranched, inserted just above mouth opening.

2. *Cytaeis tetrastyla* Eschscholtz, 1829

1829. *Cytaeis tetrastyla* Eschscholtz, *System der Acalephoen*, Berlin : 104, tab. 8, fig. 2

1961. *Cytaeis tetrastyla* : Kramp, *J. mar. biol. Ass. U.K.*, 40

Diagnosis : Bell 2 mm wide, 3 mm high with a depression on top of bell; marginal tentacles 4, all alike, twice as long as bell radius; basal bulbs small; manubrium flask-shaped with short peduncle; mouth opening circular and at level of velar opening; stomach large; oral tentacles 4-6; gonads developed as interradial swellings.

Remarks : This medusa has been described under different names such as *C. vulgaris*, *C. atlantica*, *C. herdmani*, *C. nigritina*, *C. macrogaster* and *C. japonica*. Mayer (1910) opined that Eschscholtz's specimen probably young and immature and it might

be young of *C. atlantica*? But Kramp (1953 : 263) treated aforesaid species as synonym of *Cytaeis tetrastyla* Eschscholtz.

Distribution : In India : Madras (Menon, 1931); Trivandrum (Nair, 1951); Calicut (George, 1953); Gujarat (present record).

Elsewhere : Widely distributed in the torpical parts of all the oceans.

Family III. BOUGAINVILLIIDAE

Genus 3. *Bougainvillia* Lesson, 1836

1836. *Bougainvillia* Lesson, *Ann. Sci. nat. (zool.)*, (2) 5 : 262.

Diagnosis : Marginal tentacles grouped in clusters placed on four radii, tentacles of each cluster being all of one kind and similar in structure; perradials four and dichotomously branched.

3. *Bougainvillia fulva* Agassiz & Mayer, 1899

1899. *Bougainvillia fulva* Agassiz & Mayer, *Bull. Mus. comp. Zool. Harvard*, 32 (9) : 162.

1995. *Bougainvillia fulva* : Halder & Chowdhury, *Estuarine Ecosystem Series*, pt. 2 : 15

Diagnosis : Bell cylindrical with flatly rounded top, 10-12 mm high; marginal bulbs placed on four radials and each bulb having 15-20 tentacles; manubrium without peduncle, wide, half as long as depth of bell cavity; oral tentacles 4, branching dichotomously; radial canals four, straight and wide near junction with stomach; gonads 8, adradial in position.

Remarks : Common medusa in the coastal waters of India. During high salinity period it is found in the estuarine waters also.

Distribution : In India : Hugli-Matla estuary, West Bengal (Halder & Choudhury, 1995); Vizagapatnam (Ganapati & Nagabhusanam, 1958); Orissa (Kramp, 1958); Madras (Menon, 1932); Andamans (Kramp, 1958); Trivandrum (Nair, 1951).

Elsewhere : Indian Ocean : East Africa; Seychelles; Chagos Archipelago; Malay Archipel. Pacific Ocean : Sunda Strait; Philippines; China; Palao Island; Fiji Islands (Type locality).

Genus (4) *Koellikerina* Kramp, 1939

1862. *Koellikerina* L. Agassiz, *Contribution to the Natural History of the United States of America*, 4 : 345.

1939. *Koellikerina* Kramp, *Vidensk. Medd. dansk naturh. Foren. Kbh.*, 103 : 511.

Diagnosis : Marginal tentacles in eight bundles, all alike in structure; oral tentacles 4, dichotomously branched; centripetal canal absent.

4. *Koellikerina constricta* (Menon, 1932)

1932. *Koellikerina constricta* Menon, *Bull. Madras Govt. Mus., N.S., Nat. Hist. Sect.*, 3 (2) : 11-12, pl.2, fig. 11.

1939. *Koellikerina constricta* : Kramp, *Vidensk. Medd. dansk naturh. Foren. Kbh.*, 103 : 512.

Diagnosis : Bell 4 mm high, pyriform, with a constriction about one-third of its height from top separating solid gelatinous apex of bell from hollow lower portion; manubrium with a short peduncle hanging up to half the depth of bell cavity; oral tentacles 4, branching dichotomously several times resulting into very short ultimate branches bearing nematocyst knobs; gonads V-shaped, clearly folded and perradial in position; marginal tentacles 8, four radial and four interradial in each group.

Remarks : Gonads on the perradial side of stomach is a very uncommon feature in this order. This is the second record of this medusa since Menon (1932) described it from Madras coast. However, *K. elegans* was reported from Trivandrum coast by Nair (1951).

Distribution : In India : Madras coast Type locality. (Menon, 1932); Gujarat (present record).

Elsewhere : Indo-pacific waters.

Family IV. PANDEIDAE

Genus 5. *Amphinema* Haeckel, 1879

1879. *Amphinema* Haeckel, *Systema der Medusen*, Jena : 49, 51.

Diagnosis : Tentacles 2, diametrically opposed; rudimentary tentacles numerous, present on the margin; stomach with broad base, and without a gastric peduncle; gonads on adradial sides of stomach.

5. *Amphinema dinema* (Peron & Lesueur, 1809)

1809. *Oceania dinema* Peron & Lesueur, *Annu. Mus. Hist. nat.*, 14 : 346.

1932. *Amphinema dinema* : Menon, *Bull. Madras Govt. Mus., N.S., Nat. Hist. Sect.*, 2 : 8, pl. 1, fig. 7.

Diagnosis : Bell 4 mm high, 4.5 mm wide, with parallel sides and a solid apical projection; tentacles 2, long with large elongated conical basal bulbs; rudimentary tentacle bulbs 14, placed on margin of bell; subumbrellar cavity spacious and manubrium having four lips, hanging from its centre; stomach oval, nearly half as long as depth of bell cavity; radial canals 4, simple, slender and meeting ring canal; gonads 8, transversely folded, adradial and attached on sides of stomach.

Distribution : In India : Vizagapatnam (Ganapati & Nagabhusanam, 1958); Madras (Menon, 1932); Trivandrum (Nair, 1951); Gujarat (present record).

Elsewhere : Indian Ocean : Indian coasts only. Pacific ocean : N.E. Australia. Atlantic Ocean : Adriatic Sea : Triest; Heligoland; North Sea; British Coast; Gold coast, W. Africa; Brazil; Cape Cod to Tortugas, Florida.

Genus 6. *Leuckartiara* Hartlaub, 1913

1913. *Lueuckartiara* Hartlaub, *Nord. Plankt.*, Lief. 19, xii : 282.

Diagnosis : Tentacles more than 8 and ectodermal ocelli; manubrium not extended beyond bell opening; peduncle absent; mouth with crenulated lips; stomach attached to radial canals with mesenteries; gonads interradial, horse-shoe-shaped; radial canals broad and ribbon-like.

6. *Leuckartiara octona* (Fleming, 1823)

1823. *Geryonia octona* Fleming, *Edin. New Philos. J.*, 8 : 299.

1913. *Leuckartiara octona* : Hartlaub, *Nord. Plankt.*, Lief. 19, xii : 285, figs. 238-253.

Diagnosis: Bell transparent, 7-10 mm high and 4-6 mm wide, with solid conical apical projection; manubrium broad, not extended to velum level; mouth opening with four much folded lips; radial

canals straight with smooth edges; tentacles 12, well developed, and having tapered basal bulbs and spur-like processes; bulbs rudimentary, alternating with tentacles; gonads horse-shoe-shaped with folds directed perradially.

Remarks : The abaxial, spur-like processes of tentacle bulbs are less pronounced, and rudimentary bulbs are club-shaped.

Distribution : *In India* : Vizagapatnam (Ganapati & Nagabhusanam, 1958); Madras (Menon, 1932); Trivandrum (Nair, 1951); Gujarat (present record).

Elsewhere : *Indian Ocean* : Indian coasts only. *Pacific Ocean*: Malay Archipelago; Philippines; N.E. Australia; China; Japan; Vancouver. *Atlantic Ocean* : Very common form reported from numerous localities.

Genus 7. *Merga* Hartlaub, 1913

1913. *Merga* Hartlaub, *Nord. Plankt.*, Lief. 19, xii : 249.

Diagnosis : Bell with thick jelly and rounded top; gonads 8, smooth, adradial; tentacles 8 or more and also rudimentary bulbs or tentacles between them; stomach and radial canals connected with mesenteries; lips simple.

7. *Merga violacea* (Agassiz & Mayer, 1899)

1899. *Pandea violacea* Agassiz & Mayer, *Bull. Mus. comp. Zool. Harvard.*, 32 (9) : 160.

1913. *Merga violacea* : Hartlaub, *Nord. Plankt.*, Lief. 19, xii : 249, fig. 204.

Diagnosis : Bell 5-7 mm high with thick walls and dome-shaped top; subumbrellar cavity about a half of bell height; manubrium flask-shaped, extending about a half of it; mouth opening with four simple lips; tentacles 28-32, 8-10 well developed, very long, having long, tapering hollow basal bulbs and the rest rudimentary, 2-between each pair of long tentacles; radial canals 8, ending in a broad, ring canal; gonads adradial, with smooth surface.

Remarks : Large numbers were observed in the plankton samples during January and February.

Distribution : *In India* : Vizagapatnam (Ganapati & Nagabhusanam, 1958); Madras

(Menon, 1931, 1932); Nicobars (Kramp, 1958); Trivandrum (Nair, 1951); Gujarat (present record).

Elsewhere : *Indian Ocean* : Indian coasts only. *Pacific Ocean* : Great Barrier Reef; Fiji Islands; Mexico. *Atlantic Ocean* : Tortugas (Florida); the Bahamas; Italy; Mediterranean Sea.

Order B. LEPTOMEDUSAE

Family V. LAODICEIDAE

Genus 8. *Laodicea* Lesson, 1843

1843. *Laodicea* Lesson, *Histoire Naturelles des Zoophytes, Aculephes* : 294.

Diagnosis : Radial canals 4; gonads simple and wavy; marginal cirri present.

8. *Laodicea indica* Browne, 1905

1905. *Laodicea indica* Browne, *Rep. Ceylon Pearl Oyster Fish.*, pt. 4, *Suppl. Rept.* 27 : 136, pl.1, fig. 5, pl.4, figs. 7-11.

1961. *Laodicea indica* : Kramp, *J. mar. biol. Ass. U.K.* : 40

Diagnosis : Bell 5-6 mm wide, flatter than a hemisphere, 2-3 times as wide as high; stomach large, mouth with 4 short lips; gonads well developed, extending from stomach towards bell margin; radial canals 4; tentacles 50-60, spirally coiled and without basal spurs; marginal cirri present; cordylus small, club-shaped, one between every two tentacles.

Remarks : Extension of gonad from stomach varies, in one it reaches nearly to bell margin and in others it extends up to anterior half of radial canal; in another marginal cirri lost.

Distribution : *In India* : Nicobars (Kramp, 1958); Trivandrum (Nair, 1951).

Elsewhere : *Indian Ocean* : Gulf of Aden, Arabia; Ceylon; Malay Archipelago; Torres Strait, N. of Australia. *Pacific Ocean* : Great Barrier Reef. Australia.

Genus 9. *Staurodiscus* Haeckel, 1879

1879. *Staurodiscus* Haeckel, *Das system der Medusen* Jena : 145.

Diagnosis : Radial canals 4, each giving rise to 2 lateral branches; gonads on main canal and

its branches; adaxial ocelli present but marginal cirri absent.

9. *Staurodiscus tetrastaurus* Haeckel, 1879

1879. *Staurodiscus tetrastaurus* Haeckel, *Das System der Medusen*, Jena : 145.

Diagnosis : Bell hemispherical, 3 mm high and 6 mm wide; subumbrellar cavity not deep; mouth with 4 distinct lips; radial canals 4, each with two blind lateral pouches; gonads on lateral branches and distal portion of radial canals; tentacles 8, long and equally developed; ocelli 32 in number.

Remarks : In two immature specimens bell is about as high as wide, jelly transparent. There are four tentacles, four rudimentary bulbs and eight marginal clubs.

Distribution : In India : Vizagapatnam (Ganapati & Nagabhusanam, 1958); Madras (Menon, 1932); Trivandrum (Nair, 1951); Gujarat (present record).

Elsewhere : Atlantic Ocean : Tortugas, Florida; Canary Islands (Type locality).

Family VI. EIRENIDAE

Genus 10. *Eirene* Eschscholtz, 1829

1829. *Eirene* Eschscholtz, *System der Acalephen*, Berlin : 94.

1961. *Irene ceylonensis* : Haldar & Chowdhury, *Estuarine Ecosystem Series*, pt. 2 : 18-19.

Diagnosis : Numerous lithocysts and numerous simple tentacles; stomach mounted on a gelatinous peduncle.

10. *Eirene ceylonensis* Browne, 1905

1905. *Irene ceylonensis* Browne, *Rep. Ceylon Pearl Oyster Fish., Gulf of Manaar* Pt. IV. suppl. No. 27 : 140, pl.3, figs. 9-11.

Diagnosis : Bell watch glass-shaped width varying between 8 and 14 mm; tentacles short, number between 40 and 66, arranged along bell margin; mouth with 4 lips; radial canals 4; gonads thin, narrow bands, extending from peduncle base to near the umbrella margin; lithocyst one between every two tentacles.

Remarks : All the specimens were partially damaged and the peduncle twisted up. The present record is only the extension of range of its distribution.

Distribution : In India : Vizagapatnam (Ganapati and Nagabhusanam 1958); Nicobars (Kramp, 1958); Trivandrum (Nair, 1951); Maharashtra (Lele and Gae, 1935); Gujarat (present record).

Elsewhere : Indian Ocean : Burma; Mergui Archipelago; Java Sea. Pacific Ocean : Philippines; China; Great Barrier Reef.

Family VII. AEQUOREIDAE

Genus 11. *Aequorea* Peron & Lesueur, 1809

1809. *Aequorea* Peron & Lesueur, *Annu. Mus. Hist. nat.*, 14 : 336.

Diagnosis : Radial canals more than 8, simple and unbranched; lips more than 4; subumbrella smooth, without rows of pailliae; tentacles, lithocysts and excretory pores numerous.

11. *Aequorea pensilis* (Eschscholtz, 1829)

1829. *Mesonema coelum pensile* Eschscholtz, *System der Acalephen*, Berlin : 96.

1910. *Aequorea pensilis* : Mayer, *Medusae of the World, Hydromedusae*, 2 : 333.

Diagnosis : Bell 35-50 mm wide, central disc thick, plano-convex lense-shaped, margin thin; tentacles 16-20, placed at bell margin; rudimentary bulbs numerous; radial canals numerous running straight from stomach to ring canal; gonads cylindrical sacs, not equally developed, extending along almost entire length of radial canals; mouth nearly as broad as stomach, and stomach more than a half as wide as umbrella; excretory papillae absent but secretory pores present, one opposite each tentacle bulb; sense organ along umbrella margin, arranged in groups.

Remarks : Collection contained two intact specimens and the rest immature forms.

Distribution : In India : Ganges estuary West Bengal (Kramp, 1958; Haldar & Choudhury, 1995), Orissa Coast (Kramp, 1958); Vizagapatnam (Kramp, 1958; Ganapati & Nagabhusanam, 1958);

Bay of Bengal (Kramp, 1958; Rao, 1959); Madras (Menon, 1931, 1932); Trivandrum (Nair, 1951); Calicut (George, 1953); Gujarat (present record).

Elsewhere : *Indian Ocean* : Cape of Good Hope; Port Natal; Chagos Archipelago; Red Sea; Tropical India Ocean : Iranian Gulf; Mergui Archipelago. *Pacific Ocean* : Indochina; Philippines; Great Barrier Reef; Amoy, China; Hong Kong; Japan. *Atlantic Ocean* : Tortugas, Florida; W. of Galapagos Island; Southern British coast; West of Ascension; Benguela & Agulhas Current.

Genus 12. *Zygocanna* Haeckel, 1879

1879. *Zygocanna* Haeckel, *Das System der Medusen*, Jena : 214.

Diagnosis : Radial canals numerous, branched; manubrium without peduncle.

12. *Zygocanna buitendijki* Stiasny, 1928

1928. *Zygocanna buitendijki* Stiasny, *Zool. Medd.*, 11 : 218.

1988. *Zygocanna buitendijki* : Bouillon, *Indo-Malay Zool.*, 5 (1) : 122.

Diagnosis : Bell hemispherical, 30-40 mm wide, about 10 mm high; jelly fairly thick and transparent; stomach about half as broad as wide of subumbrella; manubrium much folded and its margin throwing eight or more short lips; radial canals 12-16, each dividing into 2-4 branches very near the peripheral part of stomach; tentacles 16, eight long and eight short, and as many small bulbs; excretory papillae present; gonads on branches of radial canals.

Remarks : The medusa is fairly common in the east coast- Vizagapatnam and Madras coast but it is so far not reported from the west coast. A few specimens indicated that it was rare.

Distribution : *In India* : Vizagapatnam (Ganapati & Nagabhusanam 1958); Madras (Menon, 1932); Gujarat (present record).

Elsewhere : *Indian Ocean* : Java Sea (Type locality); Mergui Archipelago.

Family VIII. PROBOSCIDACTYLIDAE

Genus 13. *Proboscidactyla* Brandt, 1835

1835. *Proboscidactyla* Brandt, *Rec. Act. Acad. Imp. Sci. St. Peters.*, 28.

Diagnosis : Primary radial canals 4-6; usually without ring canal; gonads extending on to radial lobes of stomach.

13. *Proboscidactyla ornata* (McCrary, 1857)

1857. *Willsia ornata* McCrary, *Proc. Elliot. Soc. nat. Hist.*, 1 : 149, pl. 9, figs. 9-11.

1905. *Proboscidactyla ornata* : Browne, *Fauna and Geography of the Maldive and Laccadive Archipelago*, 2 (3) : 726.

Diagnosis : Bell higher than a hemisphere, jelly thick only at top and rigid; and bell cavity more or less deep; tentacles 16-20, longer than bell diameter; clusters of nematocyst on full length of tentacles and on exumbrella between tentacles; ring canal absent; stomach with four radial lobes; mouth with four recurved, crenulated lips.

Remarks : Kramp (1961) synonymised *P. conica* Menon, 1932 with *P. ornata* (McCrary).

Distribution : *In India* : Vizagapatnam (Ganapati & Nagabhusanam, 1958); Madras (Menon, 1932); Trivandrum (Nair, 1951); Nicobars (Kramp, 1958); Gujarat (present record).

Elsewhere : *Indian Ocean* : Amirante Islands; Maldives; Malay Archipelago. *Pacific Ocean* : Louisiade Islands; Amoy, China; Tanabe & Misaki, Japan. *Atlantic Ocean* : New England to Bahamas; Brazil; Guinea.

Order C. TRACHYMEDUSAE

Family IX. GERYONIIDAE

Genus 14 *Liriope* Lesson, 1843

1843. *Liriope* Lesson, *Histoire Naturelles des Zoophytes. Aclephes* : 332.

Diagnosis : Stomach with peduncle; radial canals and gonads 4 each; marginal tentacles of two kinds, hollow and solid.

14. *Liriope tetraphylla* (Chamisso & Eysenhardt, 1821)

1821. *Geryonia tetraphylla* Chamisso & Eysenhardt, *Nova Acta Phys. Med. Acad. Leopold Carol.*, 10 (2) : 357, pl. 27, fig. 2.

1856. *Liriope tetraphylla* : Gagenbaur, *Z. wiss. Zool.*, 8 : 257, pl. 8, fig. 17.

1995. *Liriope tetraphylla* : Haldar & Chowdhury, *Estuarine Ecosystem Series*, pt. 2 : 22.

Diagnosis : Bell 10-15 mm wide, 5-7 mm high, hemispherical with thick jelly; stomach sac-shaped; peduncle long, tapering; mouth with 4 simple lips; gonads nearly all alike; radial canals fairly broad; perradial tentacles 4, long and hollow, and interradial tentacles 4, small and solid.

Remarks : A few specimens were well preserved and the rest were either damaged or immature forms. This is very common form along the Indian coast.

Distribution : In India : Hughly-Matla estuary, West Bengal (Haldar & Choudhury, 1995); Vizagapatnam (Ganapati & Nagabhusanam, 1958); Nicobars : Nancowry, Octavia Bay & Off Muz (Kramp, 1958); Madras (Menon, 1932); Trivandrum (Nair, 1951); Maharashtra (Lele & Gae, 1935; Bal & Pradhan, 1952); Gujarat (present record).

Elsewhere : Warm parts of all the Oceans.

Family X. RHOPALONEMATIDAE

Genus 15. *Amphogona* Browne, 1905

1905. *Amphogona* Browne, *Fauna and Geography of the Maldive and Laccadive Archipelago*, 2; 724, 739.

Diagnosis : Gastric peduncle short, conical; exumbrella smooth; radial canals eight; gonads of unequal size, sac-shaped, pendant on radial canals; tentacles all alike, not densely crowded; statocysts marginal, free and club-shaped.

15. *Amphogona apsteini* (Vanhoffen, 1902)

1902. *Pantachogon apsteini* Vanhoffen, *Wiss. Ergebn. 'Valdivia'* 3 : 65, pl. 10, fig. 18, pl. 11, fig. 28.

1905. *Amphogona apsteini* : Browne, *Fauna and Geography of the Maldive and Laccadive Archipelago*, 2 : 740, pl. 54, fig. 5, pl. 56, fig. 1, pl. 57, figs. 10-15.

Remarks : As no specimen from the Gujarat coast was available for study the description given by Browne (1916) of a single specimen from Okhamandal p. 152 is depicted here.

Umbrella conical about 3 mm high and 4 mm wide, stomach on short peduncle, mouth with 4 lips; radial canals 8, each bearing traces or remains of gonads extending about three-quarters the distance down the canals; tentacles broken off, their stumps indicating 12-15 per octant; sense organs not observed.

The umbrella of this specimen is rather more highly arched, being higher in proportion to its width, than usually recorded and its tentacles are more numerous.

Distribution : In India : Okhamandal, N.W. India (Browne, 1916).

Elsewhere : Indian Ocean : Maldives; Chagos Archipelago; Sumatra (Type Locality); Cargados; Carajos and Farquhar Islands. Pacific Ocean : Mexico; Japan; Palao Island; N.E. Australia; N. of Galapagos Island. Atlantic Ocean : Gulf of Guinea.

Order D. NARCOMEDUSAE

Family XI. AEGINIDAE

Genus 16. *Solmundella* Haeckel, 1879

1879. *Solmundella* Haeckel, *Das System der Medusen*, Jena : 340, 349, 352.

Diagnosis : Tentacles 2, secondary tentacles absent; stomach pouches 8; peripheral canals absent.

16. *Solmundella bitentaculata*
(Quoy & Gaimard, 1833)

1833. *Charybdea bitentaculata* Quoy & Gaimard, *Voyage de l' Astrolabe pendant. M.J. Dumont d'Urville. Zoologie*, 4 : 295.

1879. *Solmundella bitentaculata* : Haeckel, *Das System der Medusen*, Jena : 341.

Diagnosis : Bell 5-9 mm wide, wider than high, apical jelly very thick; stomach circular and flat; stomach pouches rectangular; mouth circular; tentacles 2, very long and opposite in position,

arising from umbrella near apex; tentacular peronia 2, placed in deep grooves; gonads on lateral pouches and sometimes extending near to stomach.

Remarks : Two specimens were well preserved and the rest were damaged. Fully expanded mouth is nearly as wide as stomach.

Distribution : *In India* : Orissa (Kramp, 1958); Vizagapatnam (Ganapati and Nagabhusanam, 1958); Madras (Menon, 1931, 1932); Nicobars (Kramp, 1958); Trivandrum (Menon, 1945, Nair, 1951); Calicut (George, 1953); Bombay (Lele and Gae, 1935); Gujarat : Okhamondal (Browne, 1916).

Elsewhere : Widely distributed in all oceans, particularly in the southern hemisphere.

Order E. SEMAEOSTOMEAE

Family XII. ULMARIDAE

Genus 17. *Aurelia* Peron & Lesueur, 1809

1809. *Aurelia* Peron & Lesueur, *Annu. Mus. Hist. nat.*, 14 : 357.

Diagnosis : Mouth arms 4, unbranched; bell margin divided into 8 or 16 broad velar lobes; radial canals, in most cases, giving rise to anastomosing branches.

17. *Aurelia solida* Browne, 1905.

1905. *Aurelia solida* Browne, *Fauna and Geography of the Maldiva and Laccadive Archipelago*, 2 : 960, pl. 94, figs. 1, 2.

1961. *Aurelia solida* : Kramp, *J. mar. biol. Ass. U.K.*, 40.

Diagnosis : Bell flatter than hemisphere, 80-110 mm wide, jelly very thick and solid; exumbrella fairly granulated; marginal lobes 8, simple, rather unequal; tentacles numerous, 8-12 mm long, alternating with small, narrow lappets; marginal rhopalia 8, placed between clefts of marginal lobes; mouth opening surrounded by thick gelatinous mouth arms; mouth-arms thin, narrow ribbands, margins slightly folded in proximal portions; arm-margins provided with numerous tentacles, each 2-3 mm long; gonads horse-shoe-shaped, placed along 4 interradii; genital ostia small, circular pores.

Remarks : Variation of the aforesaid description is very common. The measurement of marginal lobes is highly variable. The number of marginal rhopalia varies from 5 to 11.

Distribution : *In India* : Madras (Menon, 1932; Gravely, 1941); Trivandrum (Nair, 1951); Gujarat (present record).

Elsewhere : *Indian Ocean* : Maldive Islands (Type locality). *Atlantic Ocean* : Azores; W. of N. Africa.

Order F. RHIZOSTOMEAE

Family XIII. CASSIOPEIDAE

Genus 18. *Cassiopea* Peron & Lesueur, 1809

1809. *Cassiopea* Peron & Lesueur, *Annu. Mus. Hist. nat.*, 14 : 356.

Diagnosis : Mouth-arms 8, pinnately or irregularly branched, bearing numerous ventral mouth-openings and vesicles; ring canal absent or faintly indicated; rhopalar and interrhopalar canals 16 each.

18. *Cassiopea andromeda* (Forsk., 1775)

1775. *Medusa andromeda* Forsk., *Descriptions animalium avium, vermium; quae in itinere orientale observavit, Petrus Forskal* : 107.

1829. *Cassiopea andromeda* : Eschscholtz, *System der Acalephen*, Berlin : 43.

Diagnosis : Bell 80-100 mm wide; exumbrella nearly flat, shield shaped; margin more or less entire, faint indication of 3-4 velar lappets; marginal sense organs highly variable, 12-15, placed at terminating point of radial canals; arm disc well developed; mouth arms 8, wide, flat, not extending beyond bell margin, short side-branches arising from each arm irregularly; club-shaped appendages of various sizes on each arm between mouths.

Remarks : Specimens were found washed ashore on the sandy beaches with their exumbrella down and mouth arms spreading above.

Distribution : *In India* : Sandheads, West Bengal (Haldar & Choudhury, 1995); Tamil Nadu : Madras (Menon, 1932); Krusadai and Rameswaram (Rao, 1931); Gujarat : Okhamondal (Browne, 1916).

Elsewhere : Widely distributed in the Indo-Pacific Ocean.

Family XIV. CEPHEIDAE

Genus 19. *Netrostoma* L.S. Schultze, 1898

1898. *Netrostoma* L.S. Schultze, *Denskschr. med. natur. Ges.*, Jena, 8 : 457.

Diagnosis : Interrhopalar radial canal 3 in each octant; exumbrella with large warts on central dome; appendages on mouth arms, and arm disc stiff.

19. *Netrostoma coerulescens* Maas, 1903

1903. *Netrostoma coerulescens* Maas, *Siboga Exped. Monogr.*, 11 (x) : 35, pl. 5, fig. 37, 46; pl. 11, fig. 97, pl. 12, fig. 109.

1995. *Netrostoma coerulescens* : Haldar & Chowdhury, *Estuarine Ecosystem Series*, pt. 2 : 25.

Diagnosis : Bell 200-220 mm wide; central dome of bell bearing about 10 wart-like projections, marginal lappets 6-8, round edged in each octant; mouth arms 8, short, massive, laterally compressed and curved outwards, each mouth arm bifurcating at its outer end giving rise to numerous very short lateral branches upon its lower side, these side branches themselves branching somewhat dichotomously, giving a complex system of mouth bearing ramuli upon lower side of mouth arm; between mouths appendages of two kinds: one small, thin, tubular with prominent nematocyst warts and the other somewhat larger, spindle-shaped.

Remarks : Variation observed in both the individuals. Different quadrants of the same medusa being unlike- there was 8 radial canals in the radii of the 8 marginal sense organs and 24 intermediate canals with numerous side branches forming a communicating net work with each other.

Distribution : In India : Krusadai Islands, Gulf of Mannar (Menon, 1936); Trivandrum (Nair, 1951); Calicut (George, 1953 as *Netrostoma* sp.); Malabar (Ranson, 1945); Gujarat (present record).

Elsewhere : Indian Ocean : Arabian Sea; Maldives; Malay Archipelago. Pacific Ocean : Indochina; Philippines; Australia; Japan.

DISCUSSION

Plankton samples containing medusae were collected from late December, 1973 to end of March, 1974 mainly from inshore zone depth ranges from 20-100 m mainly during night hours along the Gujarat coast on board I.N.S. 'DARSHAK' Some collections were also made in April, 1977, February, 1978 and January, 1990 by the author during his survey work along this coast. Collection is rich in species composition but not in abundance due to non-coincidence with their reproductive period.

Studying the plankton samples which represent only 5 species of medusae 2 determined up to species level and 3 determined up to generic level besides 2 species of siphonophores Browne (1916) commented "it soon became evident that the collection was more or less a failure. The scarcity may be due to the collection have been done at the wrong season of the year, or at stations too close to inshore."

The paucity of rich fauna was due to the collection made at the entrance to the Gulf of Kutch only rightly inferred by Browne (1916) and not due to the stations very close to inshore as evident from the present collection. In this coast rich plankton is expected in March and April together with September and October.

SUMMARY

The paper deals with 19 species under 19 genera and 14 families of medusae mainly from the inshore zone along the Gujarat coast and a few from trawl net and from fisherman's net. Of them 17 species constitute new locality records from the area under study. One species, *Amphogona apsteini* (Vanhoffen), was not available in the collection but included here from its previous record. Beside taxonomic account material and methods as well as world-wide distribution of all the species dealt here is given.

Table showing collection data of the species collected off Gujarat coast

Name of the species	Latitude (N)	Longitude (E)	Depth of Stn. (m)	Depth of haul (m)	Date & Time	Net used	Number of exs.
1. <i>Hybocodon forbesi</i> L. A. Agassiz	22°09'	68°48'	37	25-0	18.1.74 08.00	Nansen	1
2. <i>Cytaeis tetrastyla</i> Eschscholtz	21°34'	69°32'	31	0	25.2.74 08.05	Surface	1
3. <i>Bougainvillia fulva</i> Agassiz & Mayer	19°30'	71°44'	46	30-0	25.1.74 01.00	Nansen	3
	20°32'	69°58'	70	20-0	27.1.74 01.32	Nansen	1
4. <i>Koellikerina constricta</i> (Menon)	20°54'	69°34'	66	50-0	27.2.74 09.55	Nansen	1
5. <i>Amphinema dinema</i> (Peron & Lesueur)	21°11'	69°53'	28	0	27.2.74 06.08	Surface	1
6. <i>Leuckartiara octona</i> (Fleming)	19°30'	71°44'	46	30-0	25.1.74 01.00	Nansen	3
	20°24'	69°46'	65	50-0	26.1.74 22.30	Nansen	2
7. <i>Merga violacea</i> (Agassiz & Mayer)	22°18'	68°49'	30	0	18.1.74 06.45	Surface	7
	22°09'	68°40'	37	0	18.1.74 08.00	Surface	9
8. <i>Laodicea indica</i> Browne	21°58'	68°29'	64	0	18.1.74 10.35	Surface	1
	21°38'	68°07'	139	100-0	17.1.74 14.35	Nansen	2
	23°57'	68°01'	27	0	20.3.74 08.30	Surface	3
9. <i>Staurodiscus tetrastaurus</i> Haeckel	19°30'	71°58'	32	0	25.1.74 02.50	Surface	2
	22°44'	69°23'	84	70-0	27.2.74 11.28	Nansen	1
	Off Okha,	Gulf of Kutch		0	13.4.77 07.35	Surface	2

Name of the species	Latitude (N)	Longitude (E)	Depth of Stn. (m)	Depth of haul (m)	Date & Time	Net used	Number of exs.
10. <i>Eirena ceylonensis</i> Browne	19°58'	70°01'	82	70-0	25.12.73 16.30	Nansen	2
	19°58'	72°21'	35	0	23.1.74 11.05	Surface	4
	Off Okha,	Gulf of Kutch		0	13.4.77 07.35	Surface	5
11. <i>Aequorea pensilis</i> (Eschscholtz)	20°30'	71°36'	27	0	23.12.73 01.30	Surface	6
12. <i>Zycocanna buitendijki</i> Stiasny	19°47'	69°50'	93	50-0	25.12.73 13.20	Nansen	2
	19°58'	70°01'	82	70-0	25.12.73 16.30	Nansen	2
13. <i>Proboscidactyla ornata</i> (McCrary)	20°00'	72°35'	20	0	23.1.74 13.25	Surface	2
	Off Okha,	Gulf of Kutch		0	17.1.90 08.00	Surface	1
14. <i>Liriope tetraphylla</i> (Chamisso & Eysenhardt)	19°58'	72°02'	50	0	23.1.74 23.50	Surface	6
	21°45'	69°00'	54	50-0	17.1.74 23.45	Nansen	3
	20°07'	70°10'	70	60-0	25.12.73 18.45	Nansen	2
15. <i>Amphogona apsteini</i> (Vanhoffen)	—	—	—	—	—	—	—
16. <i>Solmundella bitentaculata</i> (Quoy & Gaimard)	20°22'	69°58'	70	20-0	27.1.74 01.32	Nansen	2
	20°40'	70°10'	47	30-0	27.1.74 03.45	Nansen	3
	20°54'	69°34'	66	50-0	27.2.74 09.55	Nansen	2
17. <i>Aurelia solida</i> Browne	21°37'	69°18'		MFV 'Rock Pearch'	1.4.77	Trawl	3
	Balapur Bay,	Gulf of Kutch			17.1.90	—	2
18. <i>Cassiopea andromeda</i> (Forsk.)	21°45'	72°02'			1.2.78	Trawl	2
	Byet Island				18.1.90	Fisherman's net	2
19. <i>Netrostoma coerulescens</i> Maas	21°40'	69°16'		MFV 'Rock Pearch'	2.4.99	Trawl	1
	Positra Bay, near Okha,	Gulf of Kutch			15.1.90	Fisherman's net	1

Table showing distribution of medusae in different Indian coasts

Sl. No.	Name of species	West Bengal	Orissa	Andhra Pradesh	Tamil Nadu	Andamans	Nicobars	Kerala	Lakshadweep	Maharashtra	Gujarat
*1.	<i>Hybocodon forbesi</i> Mayer			+	+			+			+
*2.	<i>Cytaeis tetrastyla</i> Eschscholtz				+			+			+
*3.	<i>Bougainvillia fulva</i> Agassiz & Mayer	+	+	+	+	+		+			+
*4.	<i>Koellikerina constricta</i> (Menon)				+						+
*5.	<i>Amphinema dinema</i> (Peron & Lesueur)			+	+			+			+
*6.	<i>Leuckartiara octona</i> (Fleming)			+	+			+			+
*7.	<i>Merga violacea</i> (Agassiz & Mayer)			+	+		+	+			+
*8.	<i>Laodicea indica</i> Browne						+	+			+
*9.	<i>Staurodiscus tetrastaurus</i> Haeckel			+	+			+			+
*10.	<i>Eirena ceylonensis</i> Browne			+			+	+		+	+
*11.	<i>Aequorea pensilis</i> (Eschscholtz)	+	+	+	+			+			+
*12.	<i>Zycocanna buitendijki</i> Stiasny			+	+						+
*13.	<i>Proboscidactyla ornata</i> (McCrary)			+	+		+	+			+
*14.	<i>Liriope tetraphylla</i> (Chamisso & Eysenhardt)	+		+	+		+	+		+	+
*15.	<i>Amphogona apsteini</i> (Vanhoffen)										+
16.	<i>Solmundella bitentaculata</i> (Quoy & Gaimard)		+	+	+			+		+	+
*17.	<i>Aurelia solida</i> Browne				+			+			+
18.	<i>Cassiopea andromeda</i> (Forsk.)	+			+						+
*19.	<i>Netrostoma coerulescens</i> Maas				+			+			+

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REFERENCES

- Annandale, N. 1907. Notes on the freshwater-fauna of India. No. XI. Preliminary note on the occurrence of a medusa (*Irene ceylonensis*, Browne) in a brackish pool in the Ganges delta, and on the hydroid stage of the species. *J. Asiat. Soc. Bengal*, N.S., **3** (2) : 79-81, pl.11.
- Annandale, N. 1916. Fauna of the Chilka Lake. The coelenterata of the Lake with an account of the Actiniaria of brackish waters in the Gangetic delta. *Mem. Indian Mus.*, **5** : 65-114, pls. 6-9.
- Bal, D.V. & Pradhan, L.A. 1952. Records of zooplankton in Bombay waters during 1944-47. *J. Univ. Bombay, N.S.*, **20B** : 75-80.
- Browne, E.T. 1905. Hydromedusae with a revision of the Williade and Petasidae. *Fauna and Geography of the Maldive and Laccadive Archipelago*, **2** (3) : 724-749, pls. 1-4.
- Browne, E.T. 1916. Notes on some jelly-fishes from Okhamandal in Kathiawar, collected by Mr. James Hornell in 1904-5. In : *Rep. Govt. Baroda mar. zool. Okhamandal*, Pt. II : 151-155.
- Ganapati, P.N. & Nagabhusanam, R. 1958. Seasonal distribution of the Hydromedusae off the Visakhapatnam coast. *Mem. Oceanogr. Andhra Univ.*, **3** (2) : 91-99.
- George, P.C. 1953. The marine plankton of the coastal waters of Calicut with observations on the hydrological conditions. *J. zool. Soc. India*, **5** (1) : 76-107, 4 text-figs.
- Gravely, F.H. 1941. Shells and other animal remains found on the Madras beach. I. Groups other than snails, etc. (Mollusca, Gastropoda) *Bull. Madras Govt. Mus. N.S. Nat. Hist. Sec.*, **5**(1) : 1-112.
- Haldar, B.P. 2000. Medusae : Cnidaria. In : *Estuarine Ecosystem Series*, Pt. 3 : *Godavary Estuary*, Zoological Survey of India, Calcutta.
- Haldar, B.P. & Choudhury, A. 1995. Medusae : Cnidaria. In : *Estuarine Ecosystem Series*, Pt. 2 : *Hugli Matla Estuary*, Zoological Survey of India : 9-30.
- Kramp, P.L. 1953. Hydromedusae. *Sci. Rept. Gr. Barrier Reef. Exped.*, **6** (4) : 259-322, text-figs. 1-9, pls. 1,2.
- Kramp, P.L. 1958. Hydromedusae in the Indian Museum. *Rec. Indian Mus.*, **53** : 339-376, text-figs. 1-5.
- Kramp, P.L. 1961. Synopsis of the Medusae of the world. *J. mar. Biol. Ass. U.K.*, **40** : 1-469.
- Lele, S.H. & Gae, P.B., 1935. Some common Hydromedusae of Bombay Harbour. *J. Univ. Bombay*, **3** (5) : 91-101, 3 pls., 1 text-fig.
- Mayer, A.G. 1910. Medusae of the world. Hydromedusae, **1 & 2** : 1-498, pls. 1-55, Scyphomedusae, **3** : 499-735, pls. 56-76, Washington.
- Menon, K.S. 1931. A preliminary account of Madras plankton. *Rec. Indian Mus.*, **33** : 489-516.

- Menon, M.A.S. 1945. Observations on the seasonal distribution of the plankton of the Trivandrum coast. *Proc. Indian Acad. Sci.*, **22 B** (2) : 31-62, text-figs.
- Menon, M.G.K. 1930. The scyphomedusae of Madras and the neighbouring coast. *Bull. Madras Govt. Mus. N.S. Nat. Hist. Sect.*, **3** (1) : 1-28, 3 pls.
- Menon, M.G.K. 1932. The Hydromedusae of Madras. *Bull. Madras Govt. Mus. N.S. nat. Hist. Sect.*, **3** (2) : 1-32, 3 pls.
- Menon, M.G.K. 1936. Scyphomedusae of the Krusadai Island. *Bull. Madras Govt. Mus.*, **1** (2) : 1-9, 1 pl.
- Nair, K.K. 1951. Medusae of the Trivandrum coast. Part I. Systematics. *Bull. Res. Inst. Univ. Travancore*, (C) **2** (1) : 47-75, 1 pl.
- Ranson, G. 1945. Les Scyphomeduses de la collection des Museum National d'histoire Naturelle Paris. Pt. II Catalogue raisonne. *Bull. Mus. nat. Hist. Paris*, (2) **17** : 312-320.
- Rao, H.S. 1931. Notes on scyphomedusae in the Indian Museum. *Rec. Indian Mus.*, **33** : 25-62, pls. 3, 4.
- Rao, H.S. 1959. Hemurid larvae (Trematoda) in the Medusa *Aequorea pensilis* (Haeckel) from the Bay of Bengal. *Ann. Mag. nat. Hist.*, (13) **1** : 702-704.
- Santhakumari, V. & Nair, B. 1969. A commensalic hydroid from woodboring mollusca. *J. nat. Hist.*, **3** (1) : 19-33.
- Vannucci, M. & Santhakumari, V. 1970. The ecology of hydromedusae from the Cochin area. *Marine Biol.*, **7** : 49-58.

PROTOZOA

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INTRODUCTION

Protozoa from Gujarat are least explored and studied till date. Perusal of available literature reveals that there is no published taxonomic account on any freeliving protozoa from the state although these are cosmopolitan in distribution and available in almost all water bodies, mosses and soils. Parasitic protozoa of the state are also almost unattended. However, in the course of detailed study on haematozoa of birds of "Eastern and Southern Asia" McClure, *et al.*, (1978) examined large number of blood slides prepared from blood smears of 75 species of birds collected from Gujarat. Out of these, 33 species were found to be infected with protozoan species belonging to the genera *Trypanosoma* Gruby, *Plasmodium* Marchiafava and Celli, *Haemoproteus* Kruse and *Leucocytozoon* Sambon (Table 1), the specific identity of which were not ascertained during that or any subsequent study.

The other parasitic protozoa reported from the state include *Hepatozoon funambuli* (Patton), *Plasmodium falciparum* (Welch), *P. malariae* Leveran and *P. vivax* (Grassi and Feletti). The first one was reported by Bhatia (1938) from Kathiawar which was then included under the Bombay Presidency. The remaining three protozoan species were reported by Knowles, Senior White and Das Gupta (1930) by producing a map which displayed the distribution of "malarial species" in the Indian subregion (*see* also Bhatia, 1938).

Only one species of termite host, *viz.*, *Heterotermes indicola* belonging to the family Rhinotermitidae has been studied so far for symbiotic protozoa of the state. Six species of hypermastigid flagellates, *viz.*, *Trichonympha*

gujarathensis Uttangi, *Holomastigotoides magnus* Uttangi, *H. melloi* Uttangi, *H. ovalis* Uttangi, *H. saccusiformis* Uttangi and *H. visnagarensis* Uttangi have been recovered from the gut of this host (Uttangi 1959, 1962). Amongst these, taxonomic status of *T. gujarathensis* appears to be doubtful. This will be discussed elsewhere during dealing with its taxonomic account.

It needs mention here that no survey has been undertaken so far in Gujarat by the scientists of the Zoological Survey of India for the collection of protozoa and no protozoa collection of the state is available in the National Zoological Collections of this survey for taxonomic study. In view of above, the following taxonomic account is solely based on those protozoan species which were reported earlier from the state by different workers as detailed above. Since no protozoa collection was made by the present author from Gujarat the "collection and preservation" methodology of this group is not incorporated in the present communication. However, Das *et al.*, (1995) may be consulted for above purpose.

SYSTEMATIC LIST

Parasitic protozoa

- Subkingdom **PROTOZOA**
- Phylum SARCOMASTIGOPHORA
- Subphylum MASTIGOPHORA
- Class ZOOMASTIGOPHOREA
- Order KINETOPLASTIDA
- Suborder TRYPANOSOMATINA
- Family TRYPANOSOMATIDAE

Genus *Trypanosoma* Gruby

1. *Trypanosoma* sp.

Phylum APICOMPLEXA
 Class SPOROZOEA
 Order EUCOCCIDA
 Suborder ADELINA
 Family HAEMOGREGARINIDAE

Genus *Hepatozoon* Miller

2. *Hepatozoon funambuli* (Patton)

Suborder HAEMOSPORINA
 Family PLASMODIIDAE

Genus *Plasmodium* Marchiafava and Celli

3. *Plasmodium falciparum* (Welch)

4. *Plasmodium malariae* Leveran

5. *Plasmodium vivax* (Grassi and Feletti)

6. *Plasmodium* sp.

Family HAEMOPROTEIDAE

Genus *Haemoproteus* Kruse

7. *Haemoproteus* sp.

Family LEUCOCYTOZOIDAE

Genus *Leucocytozoon* Sambon

8. *Leucocytozoon* sp.

Symbiotic protozoa

Phylum SARCOMASTIGOPHORA
 Subphylum MASTIGOPHORA
 Class ZOOMASTIGOPHOREA
 Order HYPERMASTIGIDA
 Family HOLOMASTIGOTIDAE

Genus *Holomastigotoides* Grassi & Foa

9. *Holomastigotoides magnus* Uttangi

10. *Holomastigotoides melloi* Uttangi

11. *Holomastigotoides ovalis* Uttangi

12. *Holomastigotoides saccusiformis* Uttangi

13. *Holomastigotoides visnagarensis* Uttangi

Family TRICHONYMPHIDAE

Genus *Trichonympha* Leidy

14. *Trichonympha gujarathensis* Uttangi

TAXONOMIC ACCOUNT

A. Parasitic protozoa

Phylum SARCOMASTIGOPHORA
 Class ZOOMASTIGOPHOREA
 Order KINETOPLSTIDA
 Family TRYPANOSOMATIDAE

Diagnosis : Body characteristically leaf like, with a single flagellum attached to the body by undulating membrane, kinetoplast relatively small and compact.

Genus *Trypanosoma* Gruby

1843. *Trypanosoma* Grudy, C.R. Acad. Sci., 17 : 1134.

Diagnosis : Body highly flattened, leaf like, pointed at flagellar end and bluntly rounded or pointed at opposite end; flagellum arising from a blepharoplast running towards opposite end and making the outer boundary of the undulating membrane; polymorphism common, parasitic in circulatory system of vertebrates.

1. *Trypanosoma* sp.

Host : *Pycnonotus leucogenus* (Gray); site of infection : blood

Distribution : India : Gujarat.

Remarks : While examining haematozoa in the bird of Eastern and Southern Asia McClure *et al.*, (1978) observed double infection of *Trypanosoma* sp. and *Plasmodium* sp. in the blood of one adult bird as mentioned above. They (*op. cit.*) neither ascertained specific identity of this *Trypanosoma* nor mentioned the exact locality of Gujarat from where the bird had been collected.

Phylum APICOMPLEXA
 Class SPOROZOEA
 Order EUCOCCIDA
 Suborder ADELINA
 Family HAEMOGREGARINIDAE

Diagnosis : Macrogamont and microgamont usually associated in syzygy during development;

microgamont producing 1-4 microgametes; zygote active, life cycle involving two hosts, one vertebrate and another invertebrate (leech).

Genus *Hepatozoon* Miller

1908. *Hepatozoon* Miller, *Bull. Hyg. Lab.* Washington, No. 46, pp. 1-48.

Diagnosis : Oocysts with numerous sporocysts, each with 4-16 or more sporozoites, infection of vertebrate host by ingestion of invertebrate hosts, schizogony occurring in cells of internal organs (liver, spleen, bone marrow, etc.) or leucocytes of vertebrates.

2. *Hepatozoon funambuli* (Patton)

1906. *Leucocytozoon funambuli* Patton, *Sci. Mem. Off. Med. & San. Dep. Govt. India* N.S. 24, pp. 1-13.

1926. *Hepatozoon funambuli* Wenyon, *Protozoology*, pp. 1085, 1358.

Diagnosis : Gametocyte elongate and oval, with one end larger and rounder than other, lying in large mononuclear leucocyte; narrow end of gametocyte showing a distinct bend upwards simulating a tail; free forms elongated and spindle shaped, nucleus large, irregularly quadrilateral, lying around the centre; number of large chromatic dots visible in the cytoplasm, more in one extremity than in other; free forms containing a rounded or oval nucleus.

Hosts : Squirrel, *Funambulus pennantii* and louse, *Haematopinus* sp; site of infection; leucocytes of squirrel and body of louse.

Distribution : India : Gujarat ("Kathiawar")

Suborder HAEMOSPORINA

Key to the families

1. Parasites having sexual phase in mosquito and asexual cycle (schizogony) in tissue and blood cells of vertebrate hosts, gametocytes produced and confined to mature erythrocytes; haemozoin pigment present in certain stages of parasite Family PLASMODIIDAE

Parasites having sexual phase in insects other than mosquitoes and schizogony in tissue cells of vertebrate hosts 2

2. Gametocytes develop in mature erythrocytes, haemozoin pigment present in certain stages of life cycle ... Family HAEMOPROTEIDAE

Gametocytes develop in immature erythrocytes and white blood cells; haemozoin pigment absent in all stages of life cycle Family LEUCOCYTOZOIDAE

Family PLASMODIIDAE

Genus *Plasmodium* Marchiafava and Celli

1885. *Plasmodium* Marchiafava and Celli, *Ref. Med.*, Naples, No. 214, p. 737.

Diagnosis : Trophozoites ring shaped, amoeboid in erythrocytes, schizonts (merogony) in erythrocytes and also in various other tissues depending on species; haemozoin pigment usually formed and visible with light microscope; vectors mosquitoes or phlebotomine flies; parasitic in mammals, birds and reptiles.

Key to the species

1. Full grown schizonts rounded, nearly filling erythrocytes, merozoites typically arranged in circle, schizogony in 72 hours ... *P. malariae*
Full grown schizonts irregular in form, filling half to two-third the erythrocyte and irregularly arranged, schizogony in about 48 hours 2
2. Gametocytes crescent shaped, infected erythrocytes normal or atrophied *P. falciparum*
Gametocytes rounded or oval, infected erythrocytes hypertrophied *P. vivax*

3. *Plasmodium falciparum* (Welch)

1897. *Haematozoon falciparum* Welch, *Syst. Pract. Med.*, 1, p. 17.

1966. *Plasmodium falciparum* (Welch) : Garnham, *Malarial parasites and other haemosporidia*. Blackwell Scientific Publications, Oxford, p. 357.

Diagnosis : "Ring" form relatively small, often two or more in each infecting red cell, with double dots of chromatin, some apparently on edge (acoele forms), usually with crescentic gametocytes, macrogametocyte 12-14 μm long; trophozoite compact, rarely seen in peripheral blood; mature schizont irregular in form, 8-32 merozoites irregularly arranged filling half to two-third the erythrocyte, with early clumping of coarse dark pigments; rarely occur in peripheral circulation; host erythrocyte not hypertrophied but accompanied by reddish clefts known as Maurer's cleft.

Host : Man, *Homo sapiens*; site of infection : blood, liver, kidney, spleen, bone marrow, brain, etc.

Distribution : India, Gujarat (Junagarh, Rajkot, Sabarkantha, Surat and Surendranagar districts), also in almost all parts of India (Knowles, Senior White and Das Gupta, 1930; Bhatia, 1938).

4. *Plasmodium malariae* (Grassi and Felletti)

1892. *Haemamoeba malariae* Grassi and Felletti, *Atti Acad. Zioenia Sci. nat. Catania*, Memoir, 5, p. 10.

1900. *Plasmodium malariae* Luhe, *Zbl. Bakt.*, 27, p. 460.

Diagnosis : "Ring" form about one-third diameter of erythrocyte, one in each infecting erythrocyte; trophozoite compact, often bandlike, schizonts rounded, 7 μm in diameter, nearly filling the erythrocyte, 6-12 merozoites typically arranged in circle, schizogony in 72 hours; gametocyte round or ovoid, 9 μm in diameter with brown black pigments; host erythrocyte not hypertrophied.

Host : Man, *Homo sapiens*; site of infection : blood, liver, kidney, etc.

Distribution : India : Gujarat (Junagarh and Sabarkantha districts), also almost all over India (Knowles, senior White and Das Gupta, 1930; Bhatia, 1938).

5. *Plasmodium vivax* (Grassi and Feletti)

1892. *Haemamoeba vivax* Grassi and Feletti, *Atti Acad. Zioenia Sci. nat. Catania*, Memoir, 5, p. 10.

1900. *Plasmodium vivax* Luhe, *Zbl. Bakt.*, 27, p. 460.

Diagnosis : Relatively large 'ring' forms, about

one-third diameter of erythrocyte, round or oval, usually one in each infecting erythrocyte; a round chromatin dot in thin part of ring; trophozoite amoeboid; schizont irregular, filling half to two-third the erythrocyte; schizogony usually at interval of 48 hours; 12-24 merozoites in irregular grape like cluster, with small pigment granules usually collected in a single mass; gametocyte large, round or ovoid, 10 μm in diameter; host erythrocyte hypertrophied, stippled with red dots known as Schiffner's dots; all erythrocytic stages occurring in peripheral blood.

Host : Man, *Homo sapiens*; site of infection : blood, liver, kidney, etc.

Distribution : India : Gujarat (Junagarh, Rajkot, Sabarkantha, Surat and Surendranagar district) also almost in all parts of India (Knowles, Senior White and Das Gupta, 1930; Bhatia, 1938).

6. *Plasmodium* sp.

Hosts : *Pycnonotus cafer* (Linnaeus), *Pycnonotus leucogenys* (Gray), *Hippolais caligata* (Lichtenstein); site of infection : erythrocytes.

Distribution : India : Gujarat.

Remarks : McClure *et al.*, (1978) reported this undetermined species of *Plasmodium* from the blood smears of above mentioned bird hosts collected from Gujarat without mentioning specific collection localities. Out of these, only one blood smear taken from the host *Hippolais caligata* showed double infection of *Plasmodium* sp. and *Haemoproteus* sp.

Family HAEMOPROTEIDAE

Genus *Haemoproteus* Kruse

1890. *Haemoproteus* Kruse, *Arch. Pathol. Anat.*, 120, p. 541.

Diagnosis : Trophozoite in erythrocytes; merogony (schizogony) in endothelial cells of blood vessels, especially in lungs and in erythrocytes; haemozoin pigments formed and visible with light microscope; vectors hippoboscids (culicoids or chrysops), parasitic in birds, reptiles and amphibia.

7. *Haemoproteus* sp.

Hosts : *Columba livia* Gmelin, *Streptopelia decaocto* (Frivaldszky), *Clamator jacobinus* (Boddaert), *Otus bakkamoena* Penant, *Merops orientalis* Latham, *Eremopterix grisea* (Scopoli), *Galerida deva* (Sykes), *Tephrodornis pondiceriana* (Gmelin), *Dendrocita vagabunda* (Latham), *Turdoides malcolmi* (Sykes), *Pycnonotus cafer* (Linnaeus), *Pycnonotus leucogenys* (Gray), *Erithacus svecicus* (Linnaeus), *Saxicola caprata* (Linnaeus), *Acrocephalus dumetorium* Blyth, *Acrocephalus stentoreus* (Hemprich and Ehrenberg), *Hippolais caligata* (Lichtenstein), *Orthotomus sutorius* (Pennant), *Sylvia communis* Latham, *Sylvia hortensis* (Gmelin), *Muscicapa striata* (Pallas), *Anthus novaeseelandiae* (Gmelin), *Lanius excubitor* Linnaeus, *Lanius schach* Linnaeus, *Sturnus pagodarum* (Gmelin), *Sturnus roseus* (Linnaeus), *Nectarinia asiatica* (Latham), *Lonchura malabarica* (Linnaeus), *Passer domesticus* (Linnaeus), *Petronia xanthocollis* Burton; site of infection : endothelial cells of blood vessels.

Distribution : India : Gujarat.

Remarks : McClure *et al.* (1978) recovered this undetermined species of *Haemoproteus* from 30 species of bird hosts as listed above out of 75 species of birds of Gujarat examined for the occurrence of haematozoa (Table 1). This reveals that this genus of blood protozoa is commonly available in avian species of this state.

Family LEUCOCYTOZOIDAE

Genus *Leucocytozoon* Sambon

1908. *Leucocytozoon* Sambon, *J. Trop. Med. Hyg.*, 11, pp. 245-248 & 325-328.

Diagnosis : Unpigmented gametocytes occurring in R.B.C. and rarely in W.B.C. of birds; host cells grossly hypertrophied, host cell nucleus distorted and displaced peripherally; schizogony in liver and other tissues; schizonts with cytomeres; sporogony in Simuliidae and Ceratopogonidae; oocysts small, unpigmented with fewer than 100 sporozoites.

8. *Leucocytozoon* sp.

Hosts : *Clamator jacobinus* (Boddaert), *Otus bakkamoena* Pennant, *Upupa epops* Linnaeus, *Tephrodornis pondiceriana* (Gmelin), *Coturnix coromandelica* (Gmelin), *Turdoides malcolmi* (Sykes), *Pycnonotus cafer* (Linnaeus), *Aegithina nigrolutea* (Marshall), *Acrocephalus stentoreus* (Hemprich and Ehrenberg); site of infection : erythrocytes and sometimes white blood cells.

Distribution : India : Gujarat.

Remarks : McClure *et al.* (1978) reported this undetermined species of *Leucocytozoon* from blood smears of 9 avian species as listed above, collected from Gujarat without mentioning specific collection localities.

B. Symbiotic protozoa

It has been mentioned earlier that no symbiotic protozoa has been collected from Gujarat by the present author. All the six species of symbiotic protozoa reported from Gujarat have been described by Uttangi (1959, 1962) from the gut of a single species of termite, viz., *Heterotermes indicola*, belonging to the family Rhinotermitidae. Out of these symbionts only one species, *Holomastigotoides magnus* Uttangi has been collected and studied by the present author (*see* Das, 1976) from West Bengal. The rest of the species have never been reported by any other worker till date. In view of above, the following key and species diagnosis are solely based on descriptions given by Uttangi (*op. cit.*).

Key to the families

1. Flagella arranged in spiral rows, number of such spiral rows 12-40, a mass of dense cytoplasm usually surrounding ovoid nucleus near anterior end
..... Family HOLOMASTIGOTIDAE
2. Spiral flagellar rows as above lacking, body divisible into three regions viz., rostrum, flagella bearing region beyond rostrum and non-flagellated posterior region
..... Family TRICHONYMPHIDAE

Family HOLOMASTIGOTIDAE

Genus *Holomastigotoides* Grassi and Foa

1911. *Holomastigotoides* Grassi and Foa, *Rend. R. Acad. Lincei*, ser. 5, sem. 1, 20 : 729.

Diagnosis : As for the family.

Key to the species

1. Prenuclear zone present 2
 Prenuclear zone absent 4
2. Posterior portion glabrous 3
 Posterior portion not glabrous, (prenuclear zone not well developed, "steriocilia" present)
 *H. visnagarensis*
3. Prenuclear zone forming a narrow strip over nucleus, body ovoidal, average dimensions 160 μm x 110 μm *H. magnus*
 Prenuclear zone forming a distinct cap like area over nucleus, body shape globular, dimensions 40-45 μm x 30-35 μm *H. melloi*
4. Body oval, anterior end narrowly round and posterior end broadly rounded, axostyle absent *H. ovalis*
 Body "typically baloon-shaped", anteriorly wide and broadly rounded and posteriorly tapering to a bluntly round end, axostyle well developed *H. saccusiformis*

9. *Holomastigotoides magnus* Uttangi

1962. *Holomastigotoides magnus* Uttangi, *J. Karnatak Univ. Sci.*, 7 : 188.

Diagnosis : Body large and ovoidal, both anterior or posterior ends broadly round, dimensions 165 μm x 110 μm ; flagella one type, covering major portion of the body leaving a posterior glabrous region measuring about one-fifth of the body length; axostyle fibrous and moderately developed, prenuclear zone clearly visible.

Host : *Heterotermes indicola* (Wasmann); site of infection : gut.

Distribution : India : Gujarat (Visnagar (North Gujarat)).

10. *Holomastigotoides melloi* Uttangi

1962. *Holomastigotoides melloi* Uttangi, *J. Karnatak Univ. Sci.*, 7 : 187.

Diagnosis : Body pyriform, anterior end protruding into a finger like projection, dimensions 40-45 μm x 30-35 μm , flagella one type covering the body leaving only a posterior glabrous region measuring about one-seventh of the total length of the body; axostyle conical, small but distinct, never extending beyond the middle of the body; prenuclear zone distinct forming a densely granulated cap like area over nucleus.

Host : *Heterotermes indicola* (Wasmann); site of infection : gut.

Distribution : India : Gujarat (Visnagar (North Gujarat))

11. *Holomastigotoides ovalis* Uttangi

1962. *Holomastigotoides ovalis* Uttangi, *J. Karnatak Univ. Sci.*, 7 : 185.

Diagnosis : Body oval, anterior end narrowly and posterior end broadly rounded, dimensions of mature forms 90 μm x 50 μm , flagella of two types longer flagella covering the whole body leaving some glabrous posterior region which bears "steriocilia"; axostyle and prenuclear zone lacking.

Host : *Heterotermes indicola* (Wasmann); site of infection : gut.

Distribution : India : Gujarat (Visnagar (North Gujarat))

12. *Holomastigotoides saccusiformis* Uttangi

1962. *Holomastigotoides saccusiformis* Uttangi, *J. Karnatak Univ. Sci.*, 7 : 194.

Diagnosis : Body typically "baloon shaped", wide and broadly rounded anteriorly and tapering to a bluntly rounded end posteriorly, dimensions 115 μm x 70 μm , flagella one type covering body dextrorotically leaving posterior fifth of body as

glabrous; apical pit present at anterior pole from where flagellar rows originate; axostyle fibrous, cord-like, conical, extending beyond the middle region of the body, prenuclear zone lacking.

Host : *Heterotermes indicola* (Wasmann); site of infection : gut.

Distribution : India : Gujarat (Visnagar (North Gujarat))

13. *Holomastigotoides visnagarensis* Uttangi

1962. *Holomastigotoides visnagarensis* Uttangi, *J. Karnatak Univ. Sci.*, 7 : 183.

Diagnosis : Body somewhat rounded or globose, dimensions 67-70 μm x 50-60 μm , apical pit present in some individuals, flagella two types - the longer ones covering the body dextrotropically whereas shorter ones restricted to posterior extremity; axostyle cord-like, conical, not distinct in all individuals and in some it extending beyond the middle of the body.

Host : *Heterotermes indicola* (Wasmann); site of infection : gut.

Distribution : India : Gujarat (Visnagar (North Gujarat))

Family TRICHONYMPHIDAE

Genus *Trichonympha* Leidy

1877. *Trichonympha* Leidy, *Proc. Acad. Nat. Sci. Phil.*, 29 : 147.

Diagnosis : Body relatively large and subdivided into three regions-rostrum, flagella bearing region behind rostrum, nonflagellated posterior region; flagella arising at posterior limit longest, extending beyond posterior portion of the body; parabasal apparatus composed of numerous cords in endoplasm of posterior region.

14. *Trichonympha gujarathensis* Uttangi

1959. *Trichonympha gujarathensis* Uttangi, *J. Karnatak Univ. Sci.*, 4, pp. 101-107.

Diagnosis : Body typically sac like, dimensions 70-80 μm x 30 μm ; nucleus 12 μm x 10 μm ; length of rostral tube 8-10 μm , height of cap 2-4 μm , width of glabrous region 20 μm ; nucleus surrounded by a conspicuous nuclear membrane and located at one side towards posterior end of the body; prenuclear zone finely granular while

post nuclear region coarser and filled with vacuoles; a number of ingested foreign bodies including sphaerita, wood matters present in posterior part of the body.

Host : *Heterotermes indicola* (Wasmann); site of infection : gut.

Distribution : India : Gujarat (Visnagar (North Gujarat)).

Remarks : A total of 25 species under the genus *Trichonympha* have so far been described from the gut of wood-eating termites of the world. Critical analysis of distribution pattern of these species in termite hosts made by Kirby (1932, 1937, 1949) and recently by Das (1990) reveals that excepting the genus *Reticulitermes* which is unique as regards its flagellate symbionts are concerned no other genus under the family Rhinotermitidae has been found to harbour *Trichonympha*. Therefore, occurrence of this genus of flagellate in the gut of Rhinotermitid termite, *Heterotermes indicola* is very doubtful. Further, the original text-figure of *T. gujarathensis* produced by Uttangi (1959) appears to be that of a species belonging to the genus *Pseudotriconympha* which is very common in the gut of the present host species. It also needs mention here that *H. indicola* has been thoroughly studied by different workers in different parts of India for its flagellate symbionts. But, in no other occasion *Trichonympha* has been reported from this host (see Das, 1983, 1990).

SUMMARY

Taxonomic account of all the species of protozoa reported so far from Gujarat along with a complete list of bird hosts examined for blood protozoa from the state is presented in this paper. A total of 14 species of protozoa (8 species parasitic and 6 species symbiotic) are so far recorded from the state.

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REFERENCES

- Bhatia, B.L. 1930. *The Fauna of British India including Ceylon and Burma, Protozoa : Sporozoa*, xx + 497 pp., London (Taylor and Francis, Ltd).
- Das, A.K. 1976. Studies on some hypermastigids (Protozoa) from the termites of West Bengal, India. *Acta Protozool.*, **15** : 101-124.
- Das, A.K. 1883. A critique to the study of termite flagellates from India in relation to there hosts. *Proc. Symp. Host Environ. zool. Surv. India* : 39-53.
- Das, A.K. 1990. Taxonomy and co-evolution of symbiotic protozoa. In : *Taxonomy in Environment and Biology* : 109-117. Ed. Director, Zoological Survey of India.
- Das, A.K., Mandal, A.K., Tiwari, D.N. and Sarkar, N.C. 1995. Fauna of Meghalaya : Protozoa. *Zool. Surv. India, State Fauna Series 4 : Fauna of Meghalaya, Part 10* : 1-107.
- Kirby, H. 1932. Flagellates of the genus *Trichonympha* in termites. *Univ. Calif. Publ. Zool.*, **37** : 349-476.
- Kirby, H. 1937. Host-parasite relations in the distribution of protozoa in termites. *Univ. Calif. Publ. Zool.*, **41** : 189-212.
- Kirby, H. 1949. Systematic differentiation and evolution flagellates in termites. *Rev. Soc. Mexic. hist. Nat.*, **10** : 57-79.
- Knowles, R., White, R.S. and Das Gupta, B.M. 1930. Studies in the parasitology of malaria. *Indian Med. Res. Mem.*, **18** : 1-436.
- McClure, H.E., Poonswad, P., Greiner, E.C. and Laired, M. 1978. *Haemoprotozoa in the birds of Eastern and Southern Asia*. International Reference Centre for Avian Haematozoa, Deptt. of Biology, Newfoundland, Canada : X + 296 pp.
- Uttangi, J.C. 1959. Occurrence of a hypermastigote, *Trichonympha gujaratensis* n. sp. in the Indian termite, *Heterotermes indicola* Wasmann from North Gujarat. *J. Karnatak Univ., Sci.*, **4** : 101-107.
- Uttangi, J.C. 1962. On some new species of *Holomastigotoides* from Indian termites. *J. Karnatak Univ. Sci.*, **7** : 182-199.

Table 1. Prevalence of blood protozoa in birds of Gujarat

(TE = total no. of birds examined; TI = total no. of birds infected; Hae = *Haemoproteus* sp.;
P1 = *Plasmodium* sp.; Leu = *Leucocytozoon* sp.; Tr. = *Trypanosoma* sp.)

Sl. No.	Family & species of bird host	TE	TI	Hae	P1	Leu	Tr
	Family ACCIPITRIDAE						
1.	<i>Accipiter vigratus</i> (Temnick)	10	0				
	Family PHASIANIDAE						
2.	<i>Coturnix coromandelica</i> (Gmelin)	1	1			1	
3.	<i>Francolinus pondicerianus</i> (Gmelin)	1	0				
	Family ROSTRATULIDAE						
4.	<i>Rostratula bengalensis</i> (Linnaeus)	3	0				
	Family CHARADRIIDAE						
5.	<i>Charadrius alexandrinus</i> Linnaeus	2	0				
6.	<i>Charadrius dubius</i> Scopoli	4	0				
7.	<i>Charadrius leschenaulti</i> Lesson	1	0				
8.	<i>Vanella indicus</i> (Boddaert)	6	0				
	Family SCOLOPACIDAE						
9.	<i>Capella gallinago</i> (Linnaeus)	5	0				
10.	<i>Capella stenura</i> (Bonaparte)	1	0				
11.	<i>Tringa glareola</i> Linnaeus	2	0				
12.	<i>Tringa nebularia</i> (Gennerus)	2	0				
13.	<i>Tringa ochropus</i> Linnaeus	5	0				
14.	<i>Tringa stagnatilis</i> (Bechstein)	3	0				
15.	<i>Tringa totanus</i> (Linnaeus)	4	0				
	Family COLUMBIDAE						
16.	<i>Xenus cinereus</i> (Guldenstaedt)	3	0				
17.	<i>Columba livia</i> Gmelin	6	6	6			
18.	<i>Streptopelia decaocto</i> (Frivaldsky)	9	1	1			
19.	<i>Streptopelia senegalensis</i> (Linnaeus)	5	0				
20.	<i>Streptopelia tranquebarica</i> (Hermann)	7	0				
	Family CUCULIDAE						
21.	<i>Clamator jacobinus</i> (Boddaert)	1	1	1		1	
	Family STRIGIDAE						
22.	<i>Otus bakkamoena</i> Pennant	1	1	1		1	

Table 1. Contd.

Sl. No.	Family & species of bird host	TE	TI	Hae	P1	Leu	Tr
	Family ALCEDINIDAE						
23.	<i>Alcedo atthis</i> (Linnaeus)	3	0				
24.	<i>Halcyon smyrnensis</i> (Linnaeus)	5	0				
	Family MEROPIDAE						
25.	<i>Merops orientalis</i> Latham	14	5	5			
	Family UPUPIDAE						
26.	<i>Upupa epops</i> Linnaeus	12	2			2	
	Family PICIDAE						
27.	<i>Dendrocopos mahrattensis</i> (Latham)	5	0				
28.	<i>Junk torquilla</i> Linnaeus	6	0				
	Family ALUDIDAE						
29.	<i>Eremopterix grisea</i> (Scopoli)	12	3	3			
30.	<i>Galerida cristata</i> (Linnaeus)	2	0				
31.	<i>Galerida deva</i> (Sykes)	9	2	2			
	Family CAMPEPHAGIDAE						
32.	<i>Tephrodornis pondiceriana</i> (Gmelin)	5	1	1		1	
	Family CORVIDAE						
33.	<i>Corvus splendens</i> Vieillot	1	0				
34.	<i>Dendrocita vagabunda</i> (Latham)	3	2	2			
	Family TIMALIIDAE						
35.	<i>Alcippe poiocephala</i> (Jerdon)	1	0				
36.	<i>Chrysoma sinense</i> (Gmelin)	2	0				
37.	<i>Turdoides malcolmi</i> (Sykes)	5	1	1		1	
	Family PARADOXORNITHIDAE						
38.	<i>Pycnonotus cafer</i> (Linnaeus)	14	2	1	1	1	
39.	<i>Pycnonotus leucogenys</i> (Gray)	9	1	1	1		1
	Family AEGITHINIDAE						
40.	<i>Aegithina nigrolutea</i> (Marshall)	4	2			2	
	Family TURDIDAE						
41.	<i>Erithacus svecius</i> (Linnaeus)	9	2	2			
42.	<i>Saxicola caprata</i> (Linnaeus)	3	1	1			
	Family SYLVIIDAE						
43.	<i>Acrocephalus agricola</i> Jerdon	5	0				

Table 1. Contd.

Sl. No.	Family & species of bird host	TE	TI	Hae	P1	Leu	Tr
44.	<i>Acrocephalus dumetorum</i> Blyth	6	3	3			
45.	<i>Acrocephalus stentoreus</i> (Hemprich & Ehrenberg)	8	3	3		1	
46.	<i>Hippolais caligata</i> (Lichtenstein)	7	4	4	1		
47.	<i>Orthotomus sutorius</i> (Pennant)	4	1	1			
48.	<i>Phylloscopus collybita</i> (Vieillot)	8	0				
49.	<i>Phylloscopus inornatus</i> (Blyth)	1	0				
50.	<i>Prinia buchanani</i>	2	0				
51.	<i>Prinia socialis</i> Sykes	5	0				
52.	<i>Prinia subflava</i> (Gmelin)	2	0				
53.	<i>Sylvia communis</i> Latham	1	1				
54.	<i>Sylvia currucea</i> (Linnaeus)	14	0				
55.	<i>Sylvia hortensis</i> (Gmelin)	9	4	4			
	Family MUSCICAPIDAE						
56.	<i>Hypothymis azurea</i> (Boddaert)	1	0				
57.	<i>Muscicapa parva</i> Bechstein	3	0				
58.	<i>Muscicapa striata</i> (Pallas)	6	5	5			
59.	<i>Terpsiphone paradisi</i> Linnaeus	2	0				
60.	<i>Anthus novaeseelandiae</i> (Gmelin)	8	1	1			
61.	<i>Motacila alba</i> Linnaeus	1	0				
62.	<i>Motacila cinerea</i> Tunstall	1	0				
63.	<i>Motacilla flava</i> Linnaeus	2	0				
64.	<i>Lanius cristatus</i> Linnaeus	1	0				
65.	<i>Lanius excubitor</i> Linnaeus	2	2	2			
66.	<i>Lanius schach</i> Linnaeus	3	1	1			
67.	<i>Lanius vittatus</i> Valenciennes	2	0				
	Family STURNIDAE						
68.	<i>Sturnus pagodarum</i> (Gmelin)	8	2	2			
69.	<i>Sturnus roseus</i> (Linnaeus)	15	10	10			
	Family NACTARINIDAE						
70.	<i>Nectarinia asiatica</i> (Latham)	10	2	2			