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**Zoological Survey of India  
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Dr. J. R. B. ALFRED  
*Director*  
Zoological Survey of India

# RECORDS OF THE ZOOLOGICAL SURVEY OF INDIA

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## STUDIES ON BLOWFLIES (DIPTERA : CALLIPHORIDAE) OF SIKKIM, INDIA

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### INTRODUCTION

Taxonomical studies on blowflies from Sikkim have not so much known. Senior-White *et al.* (1940) reported *Calliphora pattoni* Aubertin, *Calliphora vicina* Robineau - Desvoidy, *Calliphora vomitoria* (Linnaeus), *Stomorphina xanthogaster* (Wiedemann) and *Idiella euidielloides* (Senior - White) from Sikkim. After lapse of over half a century, Kurahashi and Thapa (1994) reported *Melinda scutellata* (Senior - White) from this state. Nandi (1997b, 1997c) recorded and made a short note on importance of this flies. Subsequently, Datta and Parui (in press) recorded three more species from here. The author collected this flies from different parts of Sikkim in 1977 and nineteen species are reported here.

### SYSTEMATIC ACCOUNTS

Subfamily : CALLIPHORINAE

Tribe : CALLIPHORINI

#### 1. *Calliphora pattoni* Aubertin

1931. *Calliphora pattoni* Aubertin, *Ann. Mag. nat. Hist.*, (10)8 : 615.

*Material* : 1 ♂, Mangan, 1,189 m, 23.x.1977; 1 ♂, Gangtok Hospital Campus, 1,677 m, 27.x.1977.

*Bionomics* : This species was collected from bushes and flowering plants and has importance in pollination.

*Distribution* : Sikkim (Mangan, Gangtok), West Bengal (Darjeeling, Kalighat, Kurseong, Lebong, Rajabhatkhawa), Meghalaya (Shillong); China; Myanmar; Nepal; Taiwan and Thailand.

#### 2. *Calliphora vicina* Robineau - Desvoidy

1830. *Calliphora vicina* Robineau Desvoidy, *Mém. prés. div. Sav. Akad. Sci. Ins. Fr.* (2)2 : 435.

*Material* 2 ♂♂, Mangan, 1,189 m, 23.x.1977; 1 ♂, Phensang, 1,484 m, 19.x.1977.

*Bionomics* : This species was collected from garbages, human faeces and decaying fruits and has medical, veterinary and forensic importance.

*Distribution* Sikkim (Phensang, Mangan, Gangtok), West Bengal (Alipurduar, Birpara, Kalimpong, Kurseong, Rajabhatkhawa), Uttar Pradesh (Nainital), Himachal Pradesh (Shimla); Australia; Canary Islands; China; Eurasia; Hainan Islands; Hawaiian Islands; Japan; Mauritius; Mongolia; Nepal; New Zealand; Pakistan; Saudi Arabia; South Africa and USA.

### 3. *Calliphora vomitoria* (Linnaeus)

1758. *Musca vomitoria* Linnaeus. *Syst. Nat.*, **10** : 595.

1997. *Calliphora vomitoria* : Nandi, *J. Beng. nat. Hist.-Soc.*, **16(2)** : 66.

*Material* 1♂, Gazing, 1,686 m, 6.xi.1977; 1♂, Dentam, 1,672 m, 2.xi.1977.

*Bionomics* This species was collected from garbages and excrement of different animals and has medical and veterinary importance.

*Distribution* : Sikkim (Dentam, Gazing, Gangtok), Himachal Pradesh (Shimla), West Bengal (Darjeeling), Meghalaya (Jaintia); Bhutal (Phuntsholing); Afghanistan; Australia; Canary Islands; China; Eurasia; Hainan Islands; Hawaiian Islands; Hong Kong; Japan; Korea; Manchuria; Mongolia; Morocco; Nepal; New Zealand; North America; Philippines; Sweden; Taiwan and Thailand.

## Tribe BENGALIINI

### 4. *Bengalia labiata* Robineau - Desvoidy

1830. *Bengalia labiata* Robineau - Desvoidy, *Mém. prés. div. Sav. Akad. Sci. Inst. Fr.*, **(2)2** : 426; James, 1977, *Cat. Dipt. orient. Region*, **3** : 529.

*Material* : 1♂, Dentam, 1,372 m, 2.xi.1977.

*Bionomics* This species was collected from termite mound and has been recorded as parasite in ant pupae.

*Distribution* Sikkim (Dentam) and West Bengal (doubtful).

It is recorded for the first time from Sikkim.

### 5. *Bengalia surcoufi* Senior-White

1923. *Bengalia surcoufi* Senior-White, *Spolia zeylan.*, **12** : 300.

*Material* : 2♂♂, Chungthang, 1,647 m, 25.x.1977.

*Bionomics* : This species was collected from bushes and near decaying leaves on termite mound.

*Distribution* Sikkim (Chungthang), West Bengal (Mungpoo, Nagrakata, Sukna Forest), Assam (Silchar), Karnataka (Bangalore, Kaimara), Kerala (Cochin), Tamil Nadu (Chennai, Coimbatore, Tranquebar), Uttar Pradesh (Mussoorie, Nainital), Pondichery (Aurovil), Meghalaya (Khasi Hills) and Nepal.

It is recorded for the first time from Sikkim.

**6. *Bengalia torosa* (Wiedemann)**

1819. *Musca torosa* Wiedemann, *Zool. Mag., Keil*, **1(3)** : 21.

1994. *Bengalia torosa* Kurahashi and Thapa, *Jap. J. sanit Zool.*, **45** : 219.

*Material* : 1 ♂, Phensang, 1,484 m, 19.x.1977.

*Bionomics* : This species was collected from termite mound and it is parasitic on ant pupae.

*Distribution* : Sikkim (Phensang), West Bengal (Calcutta, Alipurduar, Buxa, Rajabhatkhawa), Tamil Nadu (Tranquebar, Coimbatore), Karnataka (Kaimara), Uttar Pradesh (Mussoorie), Pondichery (Aurovil); Bangladesh; Indonesia; Japan; Malaysia; Nepal; Pakistan; Philippines; Sri Lanka; Taiwan and Thailand.

It is the first report of this fly from Sikkim.

Subfamily : LUCILIINAE

Tribe : LUCILINI

**7. *Hemipyrellia ligurriens* (Wiedemann)**

1830. *Musca ligurriens* Wiedemann, *Ausser. Europ. Zweifl. Insekt.*, **2** : 655.

1997. *Hemipyrellia ligurriens* : Nandi, *J. Beng. nat. Hist. Soc.*, **16(2)** : 66.

*Material* : 2 ♂♂, Sikkim, Swistik Camp, 1,650 m, 21.x.1977; 1 ♂, Phensang, 1,484 m, 19.x.1977.

*Bionomics* : This species was collected from fish market and carcasses of animals and the larvae are parasitic on other animals.

*Distribution* : Sikkim (Phensang, Swistik), West Bengal (Buxa, Madarihat, Shibpur, Kalyani, Ranaghat, Calcutta), Bihar (Purnea), Tamil Nadu (Chennai); Australia; Amboina; Bangladesh; Bhutan (Phuntsholing); China; Formosa; Indonesia; Japan; Korea; Malaysia; Micronesia; Nepal; New Guinea; New Ireland; New Zealand; Pakistan; Philippines; Somoa; Sri Lanka; Taiwan and Thailand.

This is the first record of this species from Sikkim.

**8. *Lucilia illustris* (Meigen)**

1826. *Musca illustris* Meigen, *Syst. Besch. Europ. Zweifl. Insekt.*, **5** : 54.

1997. *Lucilia illustris* : Nandi and Bhattacharya, *J. Beng. nat. Hist. Soc.*, **16(2)** : 22.

*Material* : 2 ♂♂, Jorethang, 305 m, 20.x.1977.

*Bionomics* : This species was collected from garbages and fruits in the market area and has medical and veterinary importance.

*Distribution* Sikkim (Jorethang), West Bengal (Calcutta, Darjeeling, Jalpaiguri, Siliguri); Australia; Bhutan (Ha); Europe; Japan; Korea; Manchuria; Myanmar; Siberia and South America.

It is recorded for the first time from Sikkim.

### 9. *Lucilia porphyria* (Walker)

1856. *Musca porphyria* Walker, *J. Proc. Linn. Soc. Lond. Zool.*, **1** : 24.

1997. *Lucilia porphyria* : Nandi and Bhattacharya, *J. Beng. nat. Hist. Soc.*, **16(2)** : 23.

*Material* : 1 ♂, Jorethang, 305 m, 20.x.1977.

*Bionomics* : This species was collected from decaying vegetables and dead bodies of different animals and has medical and veterinary importance.

*Distribution* : Sikkim (Jorethang), West Bengal (Shibpur Botanical Garden, Ranaghat, Rajabhatkhawa), Assam (Sadiya), Arunachal Pradesh (Pasighat), Himachal Pradesh (Shimla), Kashmir (Gulmarg); Australia; Bhutan (Phuntsholing); Borneo; China; Indonesia; Japan; Korea; Malaysia; Nepal; Papua New Guinea; Philippines; Sri Lanka and Thailand.

Subfamily : CHRYSOMYINAE

Tribe : CHRYSOMYINI

### 10. *Chrysomya megacephala* (Fabricius)

1794. *Musca megacephala* Fabricius, *Syst. Ent.*, **4** : 317.

1997. *Chrysomya megacephala* : Nandi and Bhattacharya, *J. Beng. nat. Hist. Soc.*, **16(2)** : 24.

*Material* : 4 ♂ ♂, Jorethang, 305 m, 20.x.1977.

*Bionomics* : This species was collected from dead bodies and excreta of many animals, fishes from fish market and meat shop and has importance in medical and veterinary science. It has also been collected from dried fish.

*Distribution* : Sikkim (Jorethang), West Bengal; Bhutan (Phuntsholing) and almost throughout India.

### 11. *Chrysomya rufifacies* (Macquart)

1843. *Lucilia rufifacies* Macquart. *Mém. Soc. Sci. Agric. Lille*, **2(3)** : 303.

1997. *Chrysomya rufifacies* : Nandi. *J. Beng. nat. Hist. Soc.*, **16(2)** : 68.

*Material* : 2 ♂ ♂, Jorethang, 305 m, 20.x.1977.

*Bionomics* : This species was collected from garbages and dead bodies of different animals and has medical and veterinary importance.

**Distribution** : Sikkim (Jorethang), West Bengal and almost throughout India.

It is a new record from Sikkim.

Subfamily : MELANOMYINAE

12. *Melinda scutellata* (Senior - White)

1923. *Paradochosia scutellata* Senior - White, *Spolia zeylan.*, **12** : 312.

1997. *Melinda scutellata* : Nandi, 1997, *J. Beng. nat. Hist. Soc.*, **16(2)** : 68.

**Material** : 1 ♂, Gangtok Hospital Campus 1,677 m, 27.x.1977; 1 ♂, Gazing, 1,586 m, 6.xi.1977.

**Bionomics** : This species was collected from flowering plants and has importance in pollination.

**Distribution** : Sikkim (Gangtok, Gazing), West Bengal (Birpara, Mungpoo); Malaysia; Myanmar and Nepal.

Subfamily : POLLENIINAE

Tribe : POLLENIINI

13. *Onesia (Melindopsis) khasiensis* (Senior - White)

1923. *Nitellia khasiensis* Senior - White, *Mém. Dep. Agric. India, Vet. Ser.*, **8** : 51.

1997. *Onesia (Melindopsis) khasiensis* : Nandi, *J. Beng. nat. Hist. Soc.*, **16(2)** : 68.

**Material** : 2 ♂♂, Kabi Chulung, 1,644 m, 20.x.1977.

**Bionomics** : This species was collected from bushes and flowering plants and has importance in pollination.

**Distribution** : Sikkim (Kabi Chulung), West Bengal (Darjeeling), Meghalaya (Shilong); Bangladesh and Malaysia.

This fly is recorded for the first time from Sikkim.

Subfamily : RHINIINAE

Tribe : RHINIINI

14. *Stomorhina discolor* (Fabricius)

1794. *Musca discolor* Fabricius, *Syst. Ent.*, **4** : 320.

1997. *Stomorhina discolor* : Nandi, *J. Beng. nat. Hist. Soc.*, **16(2)** : 69.

**Material** : 1 ♂, Mangan, 1,189 m, 23.x.1977.

**Bionomics** : This species was collected from flowering plants and has importance in pollination.

*Distribution* : Sikkim (Mangan), West Bengal (Darjeeling, Sukna Forest), Assam (Dibrugarh); Australia; Bangladesh; Borneo; China; Fiji; Hawaiian Islands; Indonesia; Malaysia; Micronesia; Nepal; New Caledonia; Pakistan; Papua New Guinea; Philippines; Society Islands; Sri Lanka; Taiwan and Thailand.

It is recorded for the first time from Sikkim.

#### 15. *Stomorhina xanthogaster* (Wiedemann)

1820. *Idia xanthogaster* Wiedemann. *New Dipt. Gen.*, 8 : 21.

1994. *Stomorhina xanthogaster* : Kurahashi and Thapa. *Jap. J. sanit. Zool.*, 45 : 250.

*Material* 1♂, Gangtok, 1,677 m, 27.x.1977.

*Bionomics* This species was collected from bushes and has importance in pollination.

*Distribution* : Sikkim (Gangtok), Assam (Mangaldai), Bihar (Katihar, Chota Nagpur, Pareshnath Hill), Uttar Pradesh (Nainital), Madhya Pradesh (Bilaspur); Australia; Indonesia; Sri Lanka; Malaysia; Nepal; New Caledonia; Papua New Guinea; Taiwan and Vanuatu.

#### 16. *Rhinia malochi* Senior - White, Aubertin and Smart

1940. *Stomorhina malochi* Senior - White, Aubertin and Smart, *Fauna. Brit. India. Dipt.*, 6 : 204.

1997. *Rhinia malochi* : Nandi, *J. Beng. nat. Hist. Soc.*, 16(2) : 70.

*Material* 1♂, Phensang, 1,484 m, 19.x.1997.

*Bionomics* This species was collected from bushes and has importance in pollination.

*Distribution* Sikkim (Phensang) and West Bengal (Calcutta, Kalimpong, Sukna).

It is first recorded from this state.

#### 17. *Isomyia malayensis* (Townsend)

1927. *Strongyloneuropsis malayensis* Townsend, *Philip. Sci. J.* 34 : 376.

1997. *Isomyia malayensis* : Nandi, *J. Beng. nat. Hist. Soc.*, 16(2) : 70.

*Material* 1♂, Chungthang, 1,647 m, 25.x.1977; 1♂, Gazing, 1,686 m, 6.xi.1977.

*Bionomics* This species was collected from bushes.

*Distribution* Sikkim (Chungthang, Gazing), West Bengal (Darjeeling, Lebong); Malaysia and Singapore.

This species is recorded for the first time from Sikkim.

18. *Idiella euidielloides* (Senior - White)

1923. *Idiella euidielloides* Senior White, *Mém. Dép. Agric. India*, 7 : 166.

*Material* : 1 ♂, Gangtok, 1,677 m, 27.x.1977.

*Bionomics* : This species was collected from flowering plants and might have importance in pollination.

*Distribution* : Sikkim (Gangtok), West Bengal (Darjeeling); Philippines and Sri Lanka.

19. *Idiella tripartita* (Bigot)

1874. *Idia tripartita* Bigot, *Anns. Soc. ent. Fr.*, (5)4 : 236.

1997. *Idiella tripartita* : Nandi, *J. Beng. nat. Hist. Soc.*, 16(2) : 71.

*Material* : 1 ♂, Phensang, 1,484 m, 19.x.1977.

*Bionomics* This species was collected from bushes and the larvae are parasitic on vertebrates and ant pupae.

*Distribution* : Sikkim (Phensang), West Bengal (Darjeeling); China; Nepal and Philippines.

**ACKNOWLEDGEMENTS**

The author expresses his sincere thanks to the Principal, Krishnagar Govt. College for laboratory facilities. He is also thankful to the University Grants Commission, New Delhi, for financial help for survey program.

**SUMMARY**

Systematic account of nineteen species of blowflies under eleven genera of which ten species are as new records, are reported from Sikkim, India. Distributional records from India and rest of the world along with short notes on bionomics of all the species are also included.

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## ON A COLLECTION OF BUTTERFLIES (LEPIDOPTERA : RHOPALOCERA) FROM SIDHI DISTRICT, MADHYA PRADESH, INDIA

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### INTRODUCTION

The present paper deals with the studies on butterflies of hitherto unexplored area of Sidhi district, which is situated in eastern part of Madhya Pradesh. The district is bordered in east by Mirzapur district of Uttar Pradesh. The area of Sidhi district is 10526 sq. km., of which about one-tenth area along the western slope of Kaimur Hill was surveyed.

The butterflies were collected by the senior author and other team members during the Environmental Impact Assessment studies of Ban Sagar Canal Construction on Faunal Components in July, 1999. The study revealed the presence of twenty seven species under twenty two genera and seven families of which two species viz. *Spindasis ictis ictis* (Hewitson) of family Lycaenidae and *Badamia exclamationis* (Fabricius) of family Hesperiiidae are recorded for the first time from Madhya Pradesh and all twenty seven species are reported for the first time from Sidhi district.

### ABBREVIATIONS USED

coll. - Name of collector  
ex. (s) - Number of examples

### SYSTEMATIC ACCOUNTS

Phylum : ARTHROPODA  
Class : INSECTA  
Order : LEPIDOPTERA  
Sub order : RHOPALOCERA  
Family 1 : PAPILIONIDAE  
Genus 1 : *Papilio* Linnaeus

#### 1. *Papilio demoleus demoleus* Linnaeus

1758. *Papilio demoleus* Linnaeus, *Syst. Nat.* ed. X., : 464.

1939. *Papilio demoleus demoleus* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 189.

*Common name* : The Lime Butterfly.

*Material examined* : 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 4 exs., Pachokhar, 26 km., Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party; 5 exs., Turre, 47 kms. Bansagar canal, Sidhi district, 24.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Bihar, Delhi, Orissa, Uttar Pradesh, almost throughout India.

*Elsewhere* Sri Lanka; Pakistan and North Myanmar.

*Host plants* : Cultivated *Citrus*; *Citrus aurantium*, *C. hystrix*, *C. maxima*, *C. medica*, *Faronia elephantum*; *Zanthoxylum rhetsa*; *Ziziphus mauritiana*; *Glycosmis pentaphylla*; *Ruta graveoleus*; *Aegle marmelos*; *Murraya koengii* and *Chloroxylon swietenia*.

## 2. *Papilio polytes romulus* Cramer

1775. *Papilio romulus* Cramer, *Pap. Exot.*, 1 : 67.

1939. *Papilio polytes romulus* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 178.

*Common name* : The Common Mormon.

*Material examined* 1 ex., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party.

*Distribution* India : Madhya Pradesh, Andaman and Nicobar, Assam, Bihar, Delhi, Goa, Kerala, Lakshadweep, Sikkim, Tamil Nadu and Uttar Pradesh.

*Elsewhere* Sri Lanka; Bangladesh and Myanmar.

*Host plants* Cultivated *Citrus*, *Citrus medica*; *Glycosmis pentaphylla*; *Zanthoxylum rhetsa*; *Aegle marmelos* and *Murraya koenigii*.

Family 2 : PIERIDAE

Genus 2 : *Cepora* Billberg

## 3. *Cepora nerissa phryne* (Fabricius)

1775. *Papilio phryne* Fabricius, *Syst. Ent.*, : 473.

1939. *Cepora nerissa phryne* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 362.

*Common name* : The Common Gull.

*Material examined* 1 ex., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party.

**Distribution** : India : Madhya Pradesh, Assam, Biḥar, Maharashtra, Sikkim, Tamil Nadu, Uttar Pradesh and North-West Himalayas.

**Elsewhere** : Nepal and Sri Lanka.

**Host plants** : *Capparis aphylla*, *C. sepiaria*, *C. horrida*, *C. heyneana*, *C. decidua* and *C. zeylanica*.

Genus 3 : *Anapheis* Hubner

4. *Anapheis aurota aurota* (Fabricius)

1793. *Papilio aurota* Fabricius, *Syst. Ent.*, 3 : 197.

1939. *Anapheis aurota aurota* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 380.

**Common name** : The Pioneer.

**Material examined** : 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party.

**Distribution** : India : Madhya Pradesh, Andaman and Nicobar, Delhi, Karnataka, Tamil Nadu, Uttar Pradesh and West Bengal.

**Elsewhere** : Pakistan and Sri Lanka.

**Host plants** : *Capparis aphylla*, *C. sepiaria*, *C. heyneana*; *Cadaba indica* and *Maerua arenaria*.

Genus 4 : *Catopsilia* Hubner

5. *Catopsilia pomona* (Fabricius)

1775. *Papilio pomona* Fabricius, *Syst. Ent.*, : 479.

1939. *Catopsilia pomona* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 493.

**Common name** : The Lemon Emigrant.

**Material examined** : 1 ex., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party; 4 exs., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party.

**Distribution** : India : Madhya Pradesh, Assam, Andaman and Nicobar, Bihar, Delhi, Gujarat, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal and North-West Himalayas.

**Elsewhere** : Sri Lanka; Myanmar and Pakistan.

**Host plants** : *Cassia fistula*, *C. siamea*, *C. tora*, *C. auriculata*, *C. grandis*, *C. javanica*, *C. nodosa*, *C. occidentalis*; *Butea frondosa*; *Bauhinia racemosa* and *Diospyros discolor*.

### 6. *Catopsilia pyranthe pyranthe* (Linnaeus)

1758. *Papilio pyranthe* Linnaeus, *Syst. Nat.*, ed. X. 1 : 469.

1939. *Catopsilia pyranthe pyranthe* : Talbot, *The Fauna of Brit. India*, Butterflies. 1 : 497.

*Common name* The Motted Emigrant.

*Material examined* 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra; 1 ex., Pachokhar, 26 kms. Bansagar canal, Sidhi district 23.7.1999, coll. K. Chandra & party; 1 ex., Mohania, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* India : Madhya Pradesh, Andamans, Assam, Gujarat, Tamil Nadu, Uttar Pradesh, West Bengal and N. W. Himalayas.

*Elsewhere* : Sri Lanka; Myanmar and Pakistan.

*Host plants* : *Cassia tora*, *C. auriculata*, *C. occidentalis*, *C. nodosa* and *Sesbania aegyptica*.

Genus 5 : *Eurema* Hubner

### 7. *Eurema laeta laeta* (Boisduval)

1836. *Terias laeta* Boisduval, *Spec. Gen. Lep.*, 1 : 674.

1939. *Eurema laeta laeta* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 517.

*Common name* The Small Grass Yellow.

*Material examined* : 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 2 exs., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party.

*Distribution* : India Madhya Pradesh, Bihar, Delhi, Himachal Pradesh, Karnataka, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal and Peninsular India to N. W. Himalayas.

*Elsewhere* Sri Lanka; Nepal; Pakistan and Myanmar.

*Host plants* : Leguminosae and Grasses.

### 8. *Eurema hecabe simulata* (Moore)

1881. *Terias simulata* Moore, *Lep. Ceylon*, 1 : 119.

1939. *Eurema hecabe simulata* : Talbot, *The Fauna of Brit. India*, Butterflies, 1 : 530.

*Common name* The Common Grass Yellow.

*Material examined* 2 exs., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party.

**Distribution** : India : Madhya Pradesh, Bihar, Delhi, Himachal Pradesh, Karnataka, Lakshadweep, Maharashtra, Uttar Pradesh, Tamil Nadu and West Bengal.

**Elsewhere** : Sri Lanka and Pakistan.

**Host plants** : *Cassia tora*, *C. fistula*, *C. mimosoides*; *Wagatea spicata*; *Pithecolobium dulce*; *Sesbania aculeata*; *Albizia procera*; *Caesalpinia* sp., *Acacia* sp.

Family 3 : DANAIDAE

Genus 6 : *Danaus* Kluk

### 9. *Danaus chrysippus chrysippus* (Linnaeus)

1758. *Papilio chrysippus* Linnaeus, *Syst. Nat.* ed. X, 1 : 471.

1947. *Danaus chrysippus chrysippus* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 20.

**Common name** : The Plain Tiger.

**Material examined** : 1 ex., Pachokhar, 26 kms. Bansagar canal; Sidhi district, 23.7.1999, coll. K. Chandra & party; 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 1 ex., Turra, 47 kms. Bansagar canal; Sidhi district, 24.7.1999, coll. K. Chandra & party.

**Distribution** : India : Madhya Pradesh, Andaman and Nicobar, Assam, Bihar, Delhi, Gujarat, Himachal Pradesh, Maharashtra, Manipur, Orissa, Sikkim, Tamil Nadu and Uttar Pradesh.

**Elsewhere** : Sri Lanka; Pakistan; Nepal; Myanmar; Indonesia and China.

**Host plants** : *Calotropis gigantea*, *C. procera*; *Asclepias curassavica*.

### 10. *Danaus genutia* (Cramer)

1779. *Papilio genutia* Cramer, *Pap. Exot.*, 3 : 23.

1947. *Danaus plexippus plexippus* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 25.

1987. *Danaus genutia* : Gupta and Shukla. *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 17.

**Common name** : The Common Tiger.

**Material examined** : 1 ex., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party.

**Distribution** : India : Madhya Pradesh, Andaman and Nicobar, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Karnataka, Manipur, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

**Elsewhere** : Afghanistan, Pakistan, Nepal, Myanmar, Sri Lanka, Thailand and China.

**Host plants** : *Cynanchum dalhousieae*; *Ceropegia intermedia*; *Stephanotis floribunda*; *Raphistemma pulchellum*.

Genus 7      *Euploea* Fabricius11. *Euploea core core* (Cramer)

1780. *Papilio core* Cramer, *Pap. Exot.*, 3 : 133.

1947. *Euploea core core* : Talbot, *The Fauna of Brit. India*, Butterflies, 2 : 67.

*Common name* The Common Crow.

*Material examined* 4 exs., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party; 2 exs., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 3 exs., Mohania, Rampur road, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* India Madhya Pradesh, Andaman and Nicobar, Bihar, Delhi, Karnataka, Lakshadweep, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

*Elsewhere* Myanmar, Pakistan and Nepal.

*Host plants* *Streblus asper*; *Ficus bengalensis*, *F. indica*, *F. glomerata*, *F. religiosa*; *Holarrhena antidysenterica*; *Nerium odorum*, *N. oleander*, *Ichnocarpus frutescens*; *Hemidesmus indicus*; *Cryptolepis elegans*; *Anodendron paniculatum*; *Cryptostegia grandiflora* and *Holigarna arnottiana*.

Family 4 : SATYRIDAE

Genus 8 : *Melanitis* Fabricius

12. *Melanitis leda ismene* (Cramer)

1775. *Papilio ismene* Cramer, *Pap. Exot.*, 1 : 40.

1947. *Melanitis leda ismene* : Talbot *The Fauna of Brit. India*, Butterflies, 2 : 366.

*Common name* The Common Evening Brown.

*Material examined* : 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 1 ex., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Andaman and Nicobar, Assam, Bihar, Delhi, Himachal Pradesh, Lakshadweep, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

*Elsewhere* Pakistan, Nepal, Sri Lanka, Myanmar and China.

*Host plants* *Oryza sativa* and Grasses.

Family 5 : NYMPHALIDAE

Genus 9 : *Phalanta* Horsfield

13. *Phalanta phalantha phalantha* (Drury)

1770. *Papilio phalantha* Drury, *Exot. Inst.*, 1 : 41.

1987. *Phalanta phalantha phalantha* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 30.

*Common name* : The Common Leopard.

*Material examined* : 2 exs., Pachokhar 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party; 6 exs., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 1 ex., Turra, 47 kms. Bansagar canal, Sidhi district, 24.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Arunachal Pradesh, Bihar, Delhi, Maharashtra, Nicobar, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal.

*Elsewhere* : Pakistan, Sri Lanka and Myanmar.

*Host plants* : *Flacourtia ramontchi*, *F. montana*; *Aberia gardner*; *Salix pentandra*, *S. tetrasperma*; *Smilax* sp. and *Salix* sp.

#### Genus 10 : *Junonia* Hubner

#### 14. *Junonia orithya swinhoei* Butler

1885. *Junonia swinhoei* Butler, *Ann. Mag. nat. Hist.*, (5)16 : 309.

1987. *Precis orithya swinhoei* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 33.

1994. *Junonia orithya* : Varshney, *Oriental Ins.*, 28 : 176.

*Common name* : The Blue Pansy.

*Material examined* : 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 1 ex., Turra, 47 kms. Bansagar canal, Sidhi district, 24.7.1999, coll. K. Chandra & party; 1 ex., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Bihar, Delhi, Himachal Pradesh, Orissa, South India and Uttar Pradesh.

*Elsewhere* : Pakistan, Sri Lanka and Myanmar.

*Host plants* : *Justicia procumbens*, *J. micrantha* and *Lepidagathis prostrata*.

#### 15. *Junonia lemonias vaisya* (Fruhstorfer)

1912. *Precis vaisya* Fruhstorfer, In Seitz; *The Macrolepidoptera of the World*, 9 : 520.

1987. *Precis lemonias vaisya* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 34.

1994. *Junonia lemonias* : Varshney, *Oriental Ins.*, 28 : 176.

*Common name* : The Lemon Pansy.

*Material examined* : 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Bihar, Orissa and South India.

*Elsewhere* : Sri Lanka.

*Host plants* : *Nelsonia campestris*; *Asteracantha longifolia*; *Sida rhombifolia* and *Strobilanthes* sp.

Genus 11 : *Hypolimnas* Hubner

16. *Hypolimnas misippus* (Linnaeus)

1764. *Papilio misippus* Linnaeus, *Mus. Ulr.*, : 264.

1987. *Hypolimnas misippus* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 28.

*Common name* : The Danaid Eggfly.

*Material examined* : 3 exs., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party; 2 exs., Pachokhar, 26 kms. Bansagar canal, Sidhi district, 23.7.1999, coll. K. Chandra & party; 3 exs., Turra, 47 kms. Bansagar canal, Sidhi district, 24.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Arunachal Pradesh, Andaman and Nicobar, Bihar, Delhi, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh and West Bengal.

*Elsewhere* : Pakistan, Sri Lanka and Myanmar.

*Host plants* : *Portulaca oleracea*, *P. grandiflora*; *Abutilon* sp. and *Hibiscus* sp.

Genus 12 : *Symphaedra* Hubner

17. *Symphaedra nais* (Forster)

1771. *Papilio nais* Forster, *Nov. Spec. Ins. Cent.*, 1 : 73.

1987. *Euthalia nais* : Gupta & Shukla, *Rec. zool. Surv. India*, Occ. Pap. No. 106 : 38.

1994. *Symphaedra nais* : Varshney, *Oriental Ins.*, 28 : 184.

*Common name* The Baronet.

*Material examined* 1 ex., Mohania, Rampur road, Sidhi district, 22.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Bihar, Goa, Gujarat, Sikkim, Uttar Pradesh and South India.

*Elsewhere* Sri Lanka.

*Host plants* *Diospyros melanoxylon* and *Shorea robusta*.

Family 6 : LYCAENIDAE

Genus 13 : *Rapala* Moore

18. *Rapala melampus* (Cramer)

1781. *Papilio melampus* Cramer, *Pap. Ex.*, 4 : 142.

1932. *Rapala melampus* : Evans, *The Identification of Indian Butterflies*, : 299.

*Common name* : The Indian Red Flash.

*Material examined* : 2 exs., Mohania, Rampur road, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Orissa, Tamil Nadu and Uttar Pradesh.

*Elsewhere* : Pakistan, Sri Lanka and Indonesia.

Genus 14 : *Spindasis* Wallengren

19. *Spindasis ictis ictis* (Hewitson)

1865. *Aphaenus ictis* Hewitson, *Ill. Diurn. Lep.*, : 61.

1997. *Spindasis ictis ictis* : Gupta, *State Fauna Series 3 : Fauna of West Bengal*, Zool. Surv. India : 458.

*Common name* : The Common Shot Silverline.

*Material examined* : 1 ex., Mohania, Rampur road, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Jammu and Kashmir, Karnataka, Orissa, Uttar Pradesh and West Bengal.

*Elsewhere* : Pakistan.

Genus 15 : *Virachola* Moore

20. *Virachola isocrates* (Fabricius)

1793. *Hesperia isocrates* Fabricius, *Ent. Syst.*, BF 3(1) : 266 no. 29.

1997. *Virachola isocrates* : Gupta, *State Fauna Series 3 : Fauna of West Bengal*, Zool. Surv. India : 478.

*Common name* : The Common Gauva Blue.

*Material examined* : 1 ex., Mohania, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Assam, Maharashtra, Meghalaya, Nagaland, Orissa and West Bengal.

*Elsewhere* Pakistan and Sri Lanka.

*Remarks* This is the first report of the species from Madhya Pradesh.

Genus 16      *Lampides* Hubner

21. *Lampides boeticus* (Linnaeus)

1767. *Papilio boeticus* Linnaeus. *Syst. Nat.* (ed. 12) : 78.

1997. *Lampides boeticus* Gupta. *State Fauna Series 3 Fauna of West Bengal*. Zool. Surv. India : 448.

*Common name* The Pea Blue.

*Material examined* 1 ex., Mohania, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* India Madhya Pradesh, Andaman and Nicobar, Arunachal Pradesh, North-East India, Uttar Pradesh, West Bengal and widely distributed in India.

*Elsewhere* Nepal, Pakistan and Sri Lanka.

Genus 17      *Catochrysops* Biosduval

22. *Catochrysops strabo strabo* (Fabricius)

1793. *Hesperia strabo* Fabricius, *Ent. Syst.*, 3 : 287.

1997. *Catochrysops strabo strabo* : Gupta, *State Fauna Series 3 : Fauna of West Bengal*, Zool. Surv. India : 447.

*Common name* The Forget-Me-Not.

*Material examined* 1 ex., Turra, 47 kms. Bansagar canal, Sidhi district, 24.7.1999, coll. K. Chandra & party.

*Distribution* : India Madhya Pradesh; Bihar, Maharashtra, South India and West Bengal.

*Elsewhere* Myanmar.

Genus 18      : *Castalius* Hubner

23. *Castalius rosimon rosimon* (Fabricius)

1775. *Papilio rosimon* Fabricius, *Syst. Ent.*, : 523.

1997. *Castalius rosimon rosimon* : Gupta, *State Fauna Series 3 : Fauna of West Bengal*, Zool. Surv. India : 434.

*Common name* : The Common Pierrot.

*Material examined* : 1 ex., Turra, 47 kms. Bansagar canal, Sidhi district, 24.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, West Bengal, widely distributed in India.

*Elsewhere* : Pakistan, Sri Lanka and Myanmar.

Family 7 : HESPERIIDAE  
Genus 19 : *Badamia* Moore

24. *Badamia exclamationis* (Fabricius)

1775. *Papilio exclamationis* Fabricius, *Syst. Ent.*, : 530.

1997. *Badamia exclamationis* : Ghosh & Chaudhury, *State Fauna Series 3 : Fauna of West Bengal, Zool. Surv. India* : 277.

*Common name* : The Brown Awl.

*Material examined* : 1 ex., Mohania, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Andamans, Assam, Meghalaya, Sikkim and West Bengal.

*Elsewhere* : Papuan; Australian, Hawaiian and Oriental regions.

*Host plants* : *Terminalia belerica*; *Combretum ovalifolium*; *Linociera purpurea*; and *Ficus* sp.

*Remarks* : The species is being recorded for the first time from Madhya Pradesh.

Genus 20 : *Matapa* Moore

25. *Matapa aria* (Moore)

1865. *Ismene aria* Moore, *Proc. zool. Soc. Lond.*, : 784.

1997. *Matapa aria* : Ghosh & Chaudhury, *State Fauna Series 3 : Fauna of West Bengal, Zool. Surv. India* : 302.

*Common name* : The Common Redeye.

*Material examined* : 1 ex., Mohania, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Assam, South India, Sikkim, Uttar Pradesh and West Bengal.

*Elsewhere* : Oriental region.

*Host plants* : Bamboos.

Genus 21 : *Borbo* Evans

26. *Barbo cinnara* (Wallace)

1866. *Hesperia cinnara* Wallace, *Proc. zool. Soc. Lond.*, : 361.

1997. *Borbo cinnara* : Ghosh & Chaudhury, *State Fauna Series 3 : Fauna of West Bengal, Zool. Surv. India* : 312.

*Common name* The Rice Swift.

*Material examined* : 1 ex., Mohania, Sidhi district, 25.7.1999, coll. K. Chandra & party.

*Distribution* : India : Madhya Pradesh, Andaman and Nicobar, Himachal Pradesh, Manipur, Sikkim, South India and West Bengal.

*Elsewhere* : Papuan and Australian regions, Palaearctic and Oriental regions.

*Host plants* : Grasses.

Genus 22 : *Pelopidas* Walker

27. *Pelopidas mathias* (Fabricius)

1798. *Hesperia mathias* Fabricius, *Ent. Syst. Suppl.*, : 433.

1997. *Pelopidas mathias* : Ghosh & Chaudhury, *State Fauna Series 3 : Fauna of West Bengal, Zool. Surv. India* : 313.

*Common name* : The Small Branded Swift.

*Material examined* : 1 ex., Mohania, Sidhi district, 25.7.1999, coll. K. Chandra & party; 2 exs., Turra, 47 kms. Bansagar canal, Sidhi district, 24.7.1999, coll. K. Chandra & party.

*Distribution* India : Madhya Pradesh, Assam, Central India, Central Nicobars, Jammu and Kashmir, Maharashtra, Punjab, Rajasthan, Sikkim, South India, Uttar Pradesh and West Bengal.

*Elsewhere* : Papuan and Australian regions, Palaearctic and Oriental regions.

*Host plants* : Grasses.

### SUMMARY\*

The paper incorporates the account of 27 species in 22 genera distributed over seven families for the first time from Sidhi district, of which two species viz. *Spindasis ictis ictis* (Hewitson) of family Lycaenidae and *Badamia exclamationis* (Fabricius) of family Hesperidae, are recorded for the first time from Madhya Pradesh.

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## **FISH COMMUNITIES AND THEIR DISTRIBUTION IN HIMALAYAN DRAINAGE SYSTEM**

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### **INTRODUCTION**

Fishes and drainage systems are two inseparable parameters of the nature. To reveal fish fauna of the Himalayan region, the knowledge of the specific drainage systems of the Himalayas inhabited by them is a must.

Heckel (1838) first discovered Schizothoracine fishes from a collection made by Von Huegel from Kashmir who described 10 different species. Menon (1949) enlisted 23 species of fish from Kumaon Himalayas with notes on 6 species. Menon (1954) discussed evolution and distribution of torrential fishes of the Himalayas and 92 species were tabulated according to their occurrence in various drainage system and zoogeographical significance of their distribution were discussed. Silas (1960) gave a detailed account of 28 species of fish from Kashmir valley and key to the identification of these species. Menon (1962) published a distributional list of all known species of fishes (218 species) that have either been recorded in literature from definite drainage system in the Himalayas or actually examined by him in his own extensive surveys or in the reserve collection of the Zoological Survey of India. Das (1965) while revising the list of fishes from Kashmir Province, recognised the presence of 15 species of schizothoracids of the genera *Oreinus*, *Ptychobarbus*, *Diptychus*, *Schizothorax* and *Schizopygopsis*. Saxena (1968) reported 68 species of fish from Jammu and Kashmir. Tilak (1971) gave a systematic list, detailed account and key for identification of 38 species of fish from River Tawi and its tributaries (Jammu and Kashmir state) with notes on ecology. Talwar (1976) reported 21 species of fish from Ladakh Expedition, 1976. The collection, though small, was of interest as it contained an undescribed species of Palaearctic Cyprinoid genus *Gymnocypris* Gunther 1866, a specialised Schizothoracinae genus reported for the first time from the faunal limits of India. Sen and Jayaram (1982) reviewed Mahaseer fishes of India with etymology, taxonomy, biology, bionomics and fishery aspects. Sen (1985) gave a detailed account of 187 species of fish from Assam and neighbouring north-eastern states of India with figures of 109 species. Sen (1975) described 152 species of fish from Meghalaya with key for their identification and showed distribution of different genera and species in Khasi, Jaintia and Garo hills. Karmakar and Das (2000) described a detailed account of 141 species of fish from Manipur with a key for identification and distributional record.

According to Burrard and Hyden (1933) the Himalayan rivers can be divided into four groups. The rivers of the eastern region between the Brahmaputra and the Tista are grouped as the rivers of Assam Himalayas, the next group between the Tista and Kali - the Nepal Himalayas, another

group between Kali and Sutlej the Kumaon Himalayas and the last west of Sutlej - the Punjab Himalayas.

For the purpose of this contribution, the Himalayan regions and their corresponding drainage systems are arranged as follows

- (A) Eastern Himalayas - (1) The Chindwin drainage  
 (B) North-Eastern Himalayas - (2) The Brahmaputra drainage  
 (C) Central Himalayas - (3) The Kosi drainage  
 (4) The Bagmati and the Gandak drainage  
 (5) The Rapti, the Karnali and the Kali drainage.  
 (6) The Ramganga, the Ganga and Jamuna drainage  
 (D) North-Western Himalayas - (7) The Indus drainage

### MATERIALS AND METHODS

The present work includes distributional record of large number of fish collections made from extensive field surveys by Zoological Survey of India parties (by the author and other members); earlier identified collection available in the National Zoological Collection.

In the present study an attempt has been made to reveal the fish fauna of the entire Himalayas and their associated drainage systems. The distributional pattern in the Himalayan regions and corresponding drainage systems are given in tabular form. Method adopted by Menon (1962) in his distributional list of fishes of the Himalayas is being followed here with some modifications.

### OBSERVATIONS

Table showing fish communities and their distribution in the Himalayan drainage system. Here (A), (B), (C), and (D) indicate distinct Himalayan regions and 1-7 indicate Himalayan drainage systems mentioned earlier.

Name of species	(A) Eastern	(B) North-Eastern	(C) Central				(D) North-Western
	Himalayas	Himalayas	Himalayas				Himalayas
	1	2	3	4	5	6	7
Class : Teleostomi							
Order Osteoglossiformes							
Family : Notopteridae							
1. <i>Notopterus chitala</i> (Ham.-Buch.)	-	+	-	+	+	+	+
2. <i>N. notopterus</i> (Pallas)	-	+	-	+	+	+	+
Order Anguiliformes							
Family Moringuidae							
3. <i>Moringua hodgarti</i> Chaudhuri	-	+	-	-	-	-	-

	1	2	3	4	5	6	7
4. <i>M. raitabarua</i> (Ham.-Buch.)	-	+	-	-	-	-	
Order : Cypriniformes							
Family : Cyprinidae							
Sub-family : Cultrinae							
5. <i>Chela cachus</i> (Ham.-Buch.)	-	+	-	+	-	-	+
6. <i>C. laubuca</i> (Ham.-Buch.)	-	+	+	+	+	-	+
7. <i>Oxygaster argentea</i> (Day)	-	-	+	-	-	-	-
8. <i>Salmostoma bacaila</i> (Ham.-Buch.)	-	+	-	+	+	-	+
9. <i>S. phulo phulo</i> (Ham.-Buch.)	-	-	-	-	-	-	+
10. <i>S. sardinella</i> (Val.)	+	+	-	-	-	-	-
11. <i>Securicola gora</i> (Ham.-Buch.)	-	-	+	-	+	-	+
Sub-family : Rasborinae							
12. <i>Amblypharyngodon mola</i> (Ham.-Buch.)	-	+	-	+	+	+	+
13. <i>Aspidoparia jaya</i> (Ham.-Buch.)	-	+	+	+	+	-	-
14. <i>A. morar</i> (Ham.-Buch.)	-	+	+	+	+	+	+
15. <i>Barilius barila</i> (Ham.-Buch.)	+	+	+	-	+	-	-
16. <i>B. barna</i> (Ham.-Buch.)	-	+	+	+	+	-	-
17. <i>B. bendelisis</i> (Ham.-Buch.)	-	+	+	+	+	+	+
18. <i>B. bonarensis</i> Chaudhuri	-	-	-	-	-	+	-
19. <i>B. dogarsinghi</i> Hora	+	-	-	-	-	-	-
20. <i>Barilius modestus</i> Day	-	-	-	-	-	-	+
21. <i>B. ornatus</i> Sauvage	+	-	-	-	-	-	-
22. <i>B. shacra</i> (Ham.-Buch.)	-	+	+	+	-	-	-
23. <i>B. tilco</i> (Ham.-Buch.)	-	+	-	+	+	-	-
24. <i>B. vagra</i> (Ham.-Buch.)	-	+	+	+	+	+	+
25. <i>Brachydanio acuticephala</i> Hora	+	+	-	-	-	-	-
26. <i>B. rerio</i> (Ham.-Buch.)	-	+	-	+	+	+	+
27. <i>Danio aequipinnatus</i> (McClell.)	+	+	+	-	-	-	-
28. <i>D. dangila</i> (Ham.-Buch.)	+	+	+	+	-	-	-
29. <i>D. devario</i> (Ham.-Buch.)	-	+	+	+	+	-	+
30. <i>D. naganensis</i> Chaudhuri	+	-	-	-	-	-	-
31. <i>D. regina</i> Fowler	+	+	-	-	-	-	-
32. <i>Esomus danricus</i> (Ham.-Buch.)	-	+	-	+	+	+	+
33. <i>Raiamas bola</i> (Ham.-Buch.)	-	+	-	+	+	+	-
34. <i>R. guttatus</i> (Day)	+	-	-	-	-	-	-

	1	2	3	4	5	6	7
35. <i>Rasbora daniconius</i> (Ham.-Buch.)	-	+	+	+	+	+	+
36. <i>R. rasbora</i> (Ham.-Buch.)	+	+	-	-	-	-	-
Subfamily : Cyprininae							
37. <i>Catla catla</i> (Ham.-Buch.)	-	+	-	+	+	+	+
38. <i>Chagunius chagunio</i> (Ham.-Buch.)	-	+	+	+	+	-	-
39. <i>Cirrhinus mrigala</i> (Ham.-Buch.)	-	+	-	+	-	+	+
40. <i>C. reba</i> (Ham.-Buch.)	-	+	+	+	+	+	+
41. <i>Cyprinion modestum</i> (Day)	+	-	-	-	-	-	-
42. <i>C. semiplotum</i> (McClell.)	+	+	-	-	-	-	-
43. <i>Labeo angra</i> (Ham.-Buch.)	+	+	+	-	-	-	-
44. <i>L. bata</i> (Ham.-Buch.)	-	+	+	-	-	-	-
45. <i>L. boga</i> (Ham.-Buch.)	-	+	+	-	-	-	-
46. <i>L. calbasu</i> (Ham.-Buch.)	+	+	-	+	+	-	+
47. <i>L. dero</i> (Ham.-Buch.)	-	+	+	+	+	+	+
48. <i>L. devdevi</i> Hora	+	-	-	-	-	-	-
49. <i>L. dyocheilus</i> (McClell.)	-	+	+	+	+	+	+
50. <i>L. gonius</i> (Ham.-Buch.)	-	+	-	+	+	-	+
51. <i>L. microphthalmus</i> (Ham.-Buch.)	-	-	-	-	-	-	+
52. <i>Labeo nandina</i> (Ham.-Buch.)	-	+	-	-	-	-	-
53. <i>L. pangusia</i> (Ham.-Buch.)	+	+	-	-	-	-	-
54. <i>L. ricnorhynchus</i> (McClell.)	-	-	-	-	-	-	+
55. <i>L. rohita</i> (Ham.-Buch.)	-	+	+	+	+	+	+
56. <i>L. sindensis</i> Day	-	-	+	+	-	-	+
57. <i>Neolissocheilus hexagonolepis</i> (McClell.)	+	+	+	-	-	-	-
58. <i>N. hexastichus</i> (McClell.)	-	+	+	+	+	+	+
59. <i>N. spinulosus</i> (McClell.)	-	+	-	-	-	-	-
60. <i>Oreichthys cosuatus</i> (Ham.-Buch.)	-	+	-	+	-	-	-
61. <i>Osteobrama belangeri</i> (Val.)	+	-	-	-	-	-	-
62. <i>O. cotio cotio</i> (Ham.-Buch.)	-	+	-	+	+	-	+
63. <i>O. cocio cunma</i> (Day)	+	-	-	-	-	-	-
64. <i>Puntius burmanicus</i> (Day)	+	-	-	-	-	-	-
65. <i>P. chilinoides</i> (McClell.)	-	-	-	-	-	+	-
66. <i>P. chola</i> (Ham.-Buch.)	-	+	+	+	+	-	+
67. <i>P. clavatus</i> (McClell.)	+	+	+	-	-	-	-
68. <i>P. conchoniis</i> (Ham.-Buch.)	+	+	-	+	+	+	+

	1	2	3	4	5	6	7
69. <i>P. gelius</i> (Ham.-Buch.)	-	+	+	+	+	-	-
70. <i>P. guganio</i> (Ham.-Buch.)	-	-	-	+	-	-	+
71. <i>P. jayarami</i> Viswanath	+	-	-	-	-	-	-
72. <i>P. phutunio</i> (Ham.-Buch.)	-	+	-	-	-	-	-
73. <i>P. punjabensis</i> (Day)	-	-	-	-	-	-	+
74. <i>P. sarana sarana</i> (Ham.-Buch.)	-	+	+	+	+	+	+
75. <i>P. s. orphoides</i> (Val.)	+	-	-	-	-	-	-
76. <i>P. shalynius</i> Yazdani & Talukdar	-	+	-	-	-	-	-
77. <i>P. shanensis</i> Hora & Mukherjee	+	-	-	-	-	-	-
78. <i>P. sophore</i> (Ham.-Buch.)	-	+	-	+	+	-	+
79. <i>P. terio</i> (Ham.-Buch.)	-	-	-	-	-	-	+
80. <i>P. ticto</i> (Ham.-Buch.)	+	+	+	+	+	+	+
81. <i>P. waageni</i> (Day)	-	-	-	-	-	-	+
82. <i>Tor chelynoides</i> (McClell.)	-	+	+	-	-	+	+
83. <i>T. mosai</i> (Ham.-Buch.)	+	+	+	-	-	+	-
84. <i>Tor progeneius</i> (McClell.)	-	+	-	-	-	-	-
85. <i>T. putitora</i> (Ham.-Buch.)	-	+	+	+	+	+	+
86. <i>T. tor</i> (Gray)	+	+	-	+	-	+	+
Sub-family : Garrinae							
87. <i>Crossocheilus burmanicus</i> Hora	+	-	-	-	-	-	-
88. <i>C. latius diplocheilus</i> (Heckel)	-	-	-	-	-	-	+
89. <i>C. latius latius</i> (Ham.-Buch.)	+	+	+	+	+	+	-
90. <i>Garra annandalei</i> Hora	-	+	+	-	-	-	-
91. <i>G. gotyla</i> (Gray)	+	+	+	+	+	+	+
92. <i>G. gravelyi</i> (Annandale)	+	-	-	-	-	-	-
93. <i>G. kempfi</i> Hora	+	-	-	-	-	-	-
94. <i>G. lamta</i> (Ham.-Buch.)	-	+	+	+	+	-	-
95. <i>G. lissorhynchus</i> (McClell.)	-	+	-	-	-	-	-
96. <i>G. manipurensis</i> Viswanath & Sarojnalini	+	-	-	-	-	-	-
97. <i>G. naganensis</i> Hora	+	+	-	-	-	-	-
98. <i>G. nasuta</i> (McClell.)	+	-	-	-	-	-	-
99. <i>G. rupecula</i> (McClell.)	+	+	-	-	-	-	-
Sub-family : Schizothoracinae							
100. <i>Diptychus maculatus</i> Steind.	-	-	+	-	-	-	+
101. <i>Gymnocypris biswasi</i> Talwar	-	-	-	-	-	-	+

	1	2	3	4	5	6	7
102. <i>Ptychobarbus conirostris</i> Steind.	-	-	-	-	-	-	+
103. <i>Schizophysopsis stoliczkae</i> Steind.	-	-	-	-	-	-	+
104. <i>Schizothorax kumaonensis</i> Menon	-	-	-	-	-	+	-
105. <i>S. richardsonii</i> (Gray)	-	+	+	+	+	+	+
106. <i>Schizothoraichthys (Schizothoraichthys) curvifrons</i> (Heckel)	-	-	-	-	-	-	+
107. <i>S. (S.) esocinus</i> (Heckel)	-	-	-	-	-	-	+
108. <i>S. (S.) hugelii</i> (Heckel)	-	-	-	-	-	-	+
109. <i>S. (S.) micropogon</i> (Heckel)	-	-	-	-	-	-	+
110. <i>S. (S.) longipinnis</i> (Heckel)	-	-	-	-	-	-	+
111. <i>S. (S.) nasus</i> (Heckel)	-	-	-	-	-	-	+
112. <i>S. (S.) niger</i> (Heckel)	-	-	-	-	-	-	+
113. <i>S. (S.) planifrons</i> (Heckel)	-	-	-	-	-	-	+
114. <i>S. (Racoma) labiatus</i> McClell.	-	-	-	-	-	-	+
115. <i>S. (R.) progastus</i> McClell.	-	+	-	-	-	+	+
Family Psilorhynchidae							
116. <i>Psilorhynchus balitora</i> (Ham.-Buch.)	-	+	-	-	+	+	-
117. <i>P. homaloptera</i> (Hora & Mukherjee)	-	+	-	-	-	-	-
118. <i>P. pseudecheneis</i> Menon & Dutta	-	-	+	-	-	-	-
119. <i>P. sucatio</i> (Ham.-Buch.)	-	+	-	+	-	-	-
Family : Homalopteridae							
120. <i>Aborichthys elongatus</i> Hora	-	+	-	-	-	-	-
121. <i>A. garoensis</i> Hora	-	+	-	-	-	-	-
122. <i>A. kempfi</i> Chaudhuri	-	+	-	-	-	-	-
123. <i>A. tikaderi</i> Barman	-	+	-	-	-	-	-
124. <i>Balitora brucei</i> Gray	-	+	+	+	-	-	-
125. <i>Noemacheilus arunachalensis</i> (Menon)	-	+	-	-	-	-	-
126. <i>N. beavani</i> Gunther	-	+	-	-	+	+	-
127. <i>N. botia</i> (Ham.-Buch.)	-	+	+	+	+	+	+
128. <i>N. carletoni</i> Fowler	-	-	-	-	-	-	+
129. <i>N. chindwinicus</i> Tilak & Hussain	+	-	-	-	-	-	-
130. <i>N. corica</i> (Ham.-Buch.)	-	+	-	-	+	-	+
131. <i>N. devdevi</i> Hora	-	+	-	-	-	-	-
132. <i>N. doonensis</i> (Tilak & Hussain)	-	-	-	-	-	+	-
133. <i>N. elongatus</i> (Sen & Nalbant)	-	+	-	-	-	-	-

	1	2	3	4	5	6	7
134. <i>N. gangeticus</i> (Menon)	-	-	-	-	-	+	-
135. <i>N. horai</i> Menon	-	-	-	-	-	-	+
136. <i>N. himachalensis</i> (Menon)	-	-	-	-	-	-	+
137. <i>N. kangjupkhulensis</i> Hora	-	+	-	-	-	-	+
138. <i>N. kangrae</i> Menon	-	-	-	-	-	-	+
139. <i>N. labeosus</i> (Kottelat)	-	+	-	-	-	-	-
140. <i>N. manipurensis</i> Chaudhuri	+	+	-	-	-	-	-
141. <i>N. montanus</i> (McClell.)	-	-	-	-	-	-	+
142. <i>N. multifasciatus</i> Day	-	+	-	-	-	-	-
143. <i>N. naganensis</i> (Menon)	-	+	-	-	-	-	-
144. <i>N. pavonaceus</i> (McClell.)	-	+	-	-	-	-	-
145. <i>N. prashadi</i> Hora	+	-	-	-	-	-	-
146. <i>N. punjabensis</i> Hora	-	-	-	-	-	-	+
147. <i>N. rupecola</i> (McClell.)	-	-	-	-	-	+	+
148. <i>N. reticulofasciatus</i> (Singh, Sen & Banarescu)	-	+	-	-	-	-	-
149. <i>N. savona</i> (Ham.-Buch.)	-	+	+	+	+	-	-
150. <i>N. scaturigina</i> (McClell.)	-	+	+	+	-	-	-
151. <i>N. sijuensis</i> (Menon)	-	+	-	-	-	-	-
152. <i>N. sikmaiensis</i> Hora	+	-	-	-	-	-	-
153. <i>N. singhi</i> (Menon)	-	+	-	-	-	-	-
154. <i>N. vinciguerrai</i> Hora	+	-	-	-	-	-	-
155. <i>N. zonalternans</i> (Blyth)	+	-	-	-	-	-	-
Family : Cobitidae							
156. <i>Acanthopthalmus longipinnis</i> Menon	+	-	-	-	-	-	-
157. <i>A. pangia</i> (Ham.-Buch.)	+	+	-	-	-	-	-
158. <i>Botia almorhae</i> Day	-	-	-	-	+	+	-
159. <i>B. berdmorei</i> Blyth	+	-	-	-	-	-	-
160. <i>B. birdi</i> Chaudhuri	-	-	-	-	-	-	+
161. <i>B. dario</i> (Ham.-Buch.)	-	+	-	-	-	-	-
162. <i>B. dayi</i> Hora	-	+	-	+	+	+	+
163. <i>B. histrionica</i> Blyth	+	-	-	-	-	-	-
164. <i>B. lohachata</i> Chaudhuri	-	-	+	+	-	-	+
165. <i>B. rostrata</i> Gunther	-	+	-	-	-	-	-
166. <i>Lepidocephalus annandalei</i> (Chaudhuri)	-	+	-	-	-	-	-

	1	2	3	4	5	6	7
167. <i>L. berdmorei</i> (Blyth)	+	-	-	-	-	-	-
168. <i>L. caudofurcatus</i> Tilak & Hussain	-	+	-	-	-	+	-
169. <i>L. goalparensis</i> (Pillai & Yazdani)	-	+	-	-	-	-	-
170. <i>L. guntea</i> (Ham.-Buch.)	-	+	+	+	+	+	+
171. <i>L. irrorata</i> (Ham.-Buch.)	+	-	-	-	-	-	-
172. <i>Somileptes gongota</i> (Ham.-Buch.)	-	+	-	+	+	-	-
Order : Siluriformes							
Family Bagridae							
173. <i>Aorichthys aor</i> (Ham.-Buch.)	-	+	+	+	+	+	+
174. <i>A. seenghala</i> (Sykes)	-	+	+	+	+	+	-
175. <i>Batasio batasio</i> (Ham.-Buch.)	-	+	-	-	-	-	-
176. <i>B. tengara</i> (Ham.-Buch.)	+	+	-	-	-	-	-
177. <i>Mystus armatus</i> (Day)	-	+	-	-	-	-	-
178. <i>M. bleekeri</i> (Day)	+	+	+	+	-	-	+
179. <i>M. cavasius</i> (Ham.-Buch.)	-	+	-	+	-	+	+
180. <i>M. menoda</i> (Ham.-Buch.)	-	+	-	-	-	-	-
181. <i>M. microphthalmus</i> (Day)	+	-	-	-	-	-	-
182. <i>M. montanus</i> (Jerdon)	-	+	-	-	-	-	-
183. <i>M. tengara</i> (Ham.-Buch.)	-	+	+	-	-	+	-
184. <i>M. vittatus</i> (Bloch)	-	+	+	+	+	+	+
185. <i>Rama chandramara</i> (Ham.-Buch.)	-	+	-	-	-	+	-
186. <i>Rita rita</i> (Ham.-Buch.)	-	+	-	+	+	+	+
Family Siluridae							
187. <i>Kryptopterus inducus</i> Datta, Barman, Jayaram	-	+	-	-	-	-	-
188. <i>Ompok bimaculatus</i> (Bloch)	+	+	+	+	+	+	+
189. <i>O. pabda</i> (Ham.-Buch.)	+	+	-	-	-	-	-
190. <i>O. pabo</i> (Ham.-Buch.)	+	+	-	-	-	-	-
191. <i>Wallago attu</i> (Schneider)	+	+	+	+	+	+	+
Family : Schilbeidae							
192. <i>Ailia coila</i> (Ham.-Buch.)	-	+	+	+	+	+	-
193. <i>A. punctata</i> (Day)	-	-	-	-	-	+	-
194. <i>Clupisoma garua</i> (Ham.-Buch.)	-	+	+	+	+	+	+
195. <i>C. montana</i> Hora	-	+	+	+	-	+	-
196. <i>C. prateri</i> Hora	+	+	-	-	-	-	-

	1	2	3	4	5	6	7
197. <i>Eutropiichthys murius</i> (Ham.-Buch.)	-	+	+	-	-	-	-
198. <i>E. vacha</i> (Ham.-Buch.)	-	+	+	+	+	+	+
199. <i>Pseudeutropius atherinoides</i> (Bloch)	-	+	+	+	-	-	-
200. <i>Silonia silondia</i> (Ham.-Buch.)	-	+	-	+	+	+	-
Family : Pangassiidae							
201. <i>Pangassius pangassius</i> (Ham.-Buch.)	-	+	+	+	+	+	-
Family : Amblycipitidae							
202. <i>Amblyceps mangois</i> (Ham.-Buch.)	-	+	-	+	+	+	+
Family : Sisoridae							
203. <i>Begarius begarius</i> (Ham.-Buch.)	-	+	-	+	+	+	-
204. <i>B. yarrelli</i> Sykes	-	+	-	+	+	+	+
205. <i>Conta conta</i> (Ham.-Buch.)	-	+	-	-	-	-	-
206. <i>Erethistes pussilus</i> Muller & Troschel	-	+	-	+	+	-	-
207. <i>Erethistoides montana</i> Hora	-	+	-	-	-	-	-
208. <i>Euchilogianis hodgartii</i> (Hora)	-	+	-	-	+	-	-
209. <i>E. macroterma</i> Regan	-	+	-	-	-	-	-
210. <i>Exostoma labiatum</i> (McClell.)	-	+	-	-	-	-	-
211. <i>Gagata cenia</i> (Ham.-Buch.)	+	+	-	+	+	+	+
212. <i>G. gagata</i> (Ham.-Buch.)	+	+	-	-	-	-	-
213. <i>G. sexualis</i> Tilak	-	-	-	-	-	+	-
214. <i>Glyptosternum maculatum</i> (Regan)	-	+	-	-	-	-	-
215. <i>G. reticulatum</i> McClell.	-	-	-	-	-	-	+
216. <i>Glyptothorax alaknandi</i> Tilak	-	-	-	-	-	+	-
217. <i>G. annandalei</i> Hora	-	-	+	+	-	-	-
218. <i>G. cavia</i> (Ham.-Buch.)	-	+	+	+	+	-	-
219. <i>G. conirostris</i> (Steind.)	-	+	-	-	+	-	+
220. <i>G. dakpathari</i> Tilak & Hussain	-	-	-	-	-	+	-
221. <i>G. garhwali</i> Tilak	-	-	+	-	-	-	-
222. <i>G. gracile</i> (Gunther)	-	+	-	+	-	-	-
223. <i>G. indicus</i> Talwar	-	+	+	-	+	-	-
224. <i>G. kashmirensis</i> Hora	-	-	-	-	-	-	+
225. <i>G. platypogonoides</i> (Bleeker)	+	+	-	-	-	-	-
226. <i>G. saisii</i> (Jenkins)	-	-	+	+	+	-	-
227. <i>G. sinense</i> (Regan)	-	+	-	-	-	-	-
228. <i>G. stoliczkae</i> (Steind.)	-	-	-	-	-	+	+

	1	2	3	4	5	6	7
229. <i>G. striatus</i> (McClell.)	-	+	-	-	-	-	-
230. <i>G. telchitta</i> (Ham.-Buch.)	-	+	+	+	+	-	-
231. <i>G. trilineatus</i> Blyth	+	-	-	-	-	-	-
232. <i>Hara hara</i> (Ham.-Buch.)	+	+	-	-	+	-	-
233. <i>H. horai</i> Misra	-	+	-	-	-	-	-
234. <i>H. jerdoni</i> Day	-	+	+	-	-	-	-
235. <i>Laguvia kapuri</i> Tilak & Hussain	-	-	-	-	-	+	-
236. <i>L. ribeiroi</i> Hora	-	+	-	+	-	-	-
237. <i>L. shawi</i> Hora	-	+	-	-	-	-	-
238. <i>Nangra nangra</i> (Ham.-Buch.)	-	-	+	+	-	+	+
239. <i>N. viridescens</i> (Ham.-Buch.)	-	+	+	+	-	+	-
240. <i>Pseudecheneis sulcatus</i> (McClell.)	-	+	+	-	-	+	-
241. <i>Sisor rhabdophorus</i> (Ham.-Buch.)	-	+	-	-	-	+	+
Family : Clariidae							
242. <i>Clarias batrachus</i> (Linnaeus)	+	+	+	+	+	+	+
Family : Heteropneustidae							
243. <i>Heteropneustes fossilis</i> (Bloch)	-	+	+	+	+	+	+
Family : Chacidae							
244. <i>Chaca chaca</i> (Ham.-Buch.)	-	+	-	-	-	-	-
Family : Olyridae							
245. <i>Olyra horai</i> Prashad & Mukherjee	+	+	-	-	-	-	-
246. <i>O. longicaudata</i> McClell.	+	+	-	-	-	-	-
Order Cyprinodontiformes							
Family Belontiidae							
247. <i>Xenentodon cancila</i> (Ham.-Buch.)	-	+	+	+	-	+	+
Family : Aplocheilidae							
248. <i>Aplocheilus panchax</i> (Ham.-Buch.)	-	+	+	+	+	+	+
Order : Synbranchiformes							
Family Synbranchidae							
249. <i>Monopterus albus</i> (Ham.-Buch.)	-	+	+	+	-	-	+
250. <i>M. albus</i> (Zuiew)	-	+	-	-	-	-	-
Order Perciformes							
Family Ambassidae							
251. <i>Chanda nama</i> (Ham.-Buch.)	-	+	-	+	+	-	+
252. <i>Pseudambassis baculis</i> (Ham.-Buch.)	-	-	-	+	-	+	+

	1	2	3	4	5	6	7
253. <i>P. ranga</i> (Ham.-Buch.)	-	+	-	+	+	+	+
Family : Nandidae							
254. <i>Badis badis</i> (Ham.-Buch.)	-	+	-	+	+	-	-
255. <i>Nandus nandus</i> (Ham.-Buch.)	-	+	+	+	+	+	+
Family : Mugilidae							
256. <i>Sicamugil cascasia</i> (Ham.-Buch.)	-	+	-	-	-	+	+
Family : Gobiidae							
257. <i>Awaous stamineus</i> (Val.)	-	+	-	-	-	-	-
258. <i>Glossogobius giuris</i> (Ham.-Buch.)	-	+	+	+	+	+	+
Family : Anabantidae							
259. <i>Anabas testudineus</i> (Bloch)	-	+	-	+	+	+	+
Family : Belontiidae							
260. <i>Colisa fasciatus</i> (Bloch & Schneider)	-	+	+	+	+	+	+
261. <i>C. labiosa</i> (Day)	+	-	-	-	-	-	-
262. <i>C. lalia</i> (Ham.-Buch.)	-	+	-	+	+	+	+
263. <i>C. sota</i> (Ham.-Buch.)	-	+	-	-	-	+	-
Order : Channiformes							
Family : Channidae							
264. <i>Channa amphibius</i> (McClell.)	-	+	-	-	-	-	-
265. <i>C. barca</i> (Ham.-Buch.)	-	+	-	-	-	-	-
266. <i>C. marulius</i> (Ham.-Buch.)	-	+	-	-	-	+	+
267. <i>C. orientalis</i> Bloch & Schn.	-	+	+	+	+	+	+
268. <i>C. punctatus</i> (Bloch)	-	+	+	+	+	+	+
269. <i>C. stewartii</i> (Playfair)	-	+	+	+	-	-	-
270. <i>C. striatus</i> (Bloch)	-	+	-	+	-	-	+
Order : Mastacembeliformes							
Family : Mastacembelidae							
271. <i>Macrognathus aral</i> (Bloch & Schn.)	-	+	+	-	-	-	+
272. <i>M. caudicellatus</i> (Boulenger)	+	-	-	-	-	-	-
273. <i>M. puncaulus</i> (Ham.-Buch.)	-	+	-	+	+	-	+
274. <i>Mastacembelus armatus</i> (Lacepede)	-	+	-	+	+	+	+
Family : Chaudhuriidae							
275. <i>Chaudhuria indica</i> (Yazdani)	-	+	-	-	-	-	-
276. <i>C. khajurjai</i> (Talwar, Yazdani & Kundu)	-	+	-	-	-	-	-

### SUMMARY

The present contribution includes distributional list of 276 species of fish available in the Himalayan drainage systems. Menon (1962) published a distributional list of 218 species. This is an addition of 58 species in the course of 26 years of faunistic survey in the different Himalayan drainage systems. Out of 276 species, only 5 species are common in all four regions and 30 species are common excluding Eastern Himalayas; whereas 69 species are recorded from Eastern Himalayas, 190 species from North-Eastern Himalayas. 149 species in Central Himalayas, 111 species in North-Western Himalayas respectively. 29 species are exclusively found in North-Western Himalayas.

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## **A CHECKLIST OF THE ENDEMIC AND THREATENED FISHES OF WESTERN GHATS**

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### **INTRODUCTION**

The Western Ghats, an important biogeographic zone of India and one of the global hotspots, offer beautiful niches to the piscine fauna of the region. The Ghats having about 1400 km. long almost continuous chain of hills, obstruct southwest monsoon and forms major water shade for Peninsular India. It gives rise to three east flowing major rivers like Godavari, Krishna and Cauvery as well as many short west flowing rivers viz. Vaitarana, Savitri, Vashishthi, Shastri and number of their tributaries. Higher degree of precepitation, moderate climate and huge forest cover in the Western Ghats supports plenty of aquatic life including fish fauna. More than 60 million years old tropical ecosystem of Western Ghats, having senile topography and many naturally portected streams, ponds and rivulets enrich high degree of endemism among ichthyofauna. Yet, out of 135 species of fishes known from northern part of Western Ghats, about 38% are under threat and few are on the verge of extinction.

The present work is based on study carried out by examining the huge fish collection present at WRS/ZSI, Pune collected from 1960-1995 (Yadav 1997).

### **MATERIAL AND METHODS**

The colection was made by using cast net, bag net, water net etc. in rivers; by blocking a small portion of hillstream or by drying out smaller ponds.

The fish specimens were instantly fixed in the 4.5% Formaldehyde solution. Larger specimens were injected with conc. Formaldehyde, while medium sized specimens were given a silt on belly. After 4-5 hour's fixation, the fish specimens were washed with water and preserved in Rectified spirit with detailed label of locality, Dt., Coll. etc.

The specimens were indentified by examining the shape of snout, presence/absence and number of barbules by studying meristic characters (which do not vary with age) e. g. number of dorsal fin rays number of scales in lateral line, scales from dorsal fin to 1.1 and 1.1 to ventral fin, circumpeduncular scales etc. Relative proportion of Head length to standard length, Body depth to body length were also studied. The work of day (1875-78) and the latest books, Menon (1964, 1987), Jayaram (1981, 1991) and Talwar & Jhingran (1991) were consulted. Doubtful fish specimens were compared with the standard Reference collection.

Endemic fishes are considered as those occurring only in the Western Ghats and nowhere else. Obviously these are primary freshwater and hillstream fishes.

Threatened is a taxon which is facing high risk of extinction in the wild, in immediate future, if the casual factors continue operating. Threatened category falls under three sub groups : Critically Endangered, Endangered and Vulnerable.

By assuming identical methods of collection with the aid of good quality equipments, a data on the fish collection for the last 35 years (i. e. 1960 to 1995) have been analysed by evaluating number of fishes collected per survey, occurrence, abundance of fishes was found out (Yadav, 1997).

### ENDEMIC & THREATENED FISHES OF NORTHERN PART OF W. GHATS

Order : CYPRINIFORMES

Family : CYPRINIDAE

Sub family : RASBORINAE

\*1. *Barilius evezardi* Day

\*2. *Barilius gatensis* (Val.)

\*3. *Danio fraseri* Hora & Mukerji

\*4. *Rasbora labiosa* Mukerji

Sub family : CYPRININAE

5. *Cirrhinus cirrhosa* (Bloch)

\*6. *Gonoproktopterus curmuca* (Ham.-Buch.)

8. *Labeo calbasu* (Ham.-Buch.)

9. *Labeo dussumieri* (Val.)

10. *Labeo fimbriatus* (Bloch)

11. *Labeo kontius* (Jerdon)

\*12. *Labeo potail* (Sykes)

\*13. *Neolissochilus hexagonolepis* (McClelland)

\*14. *Osteobrama bhimensis* Singh & Yazdani

\*15. *Puntius caveriensis* (Hora)

\*16. *Puntius carnaticus* (Jerdon)

\*17. *Puntius crescentus* Yazdani & Singh

\*18. *Puntius deccanensis* Yazdani & Rao

\*19. *Puntius fasciatus fasciatus* (Jerdon)

\*20. *Puntius f. pradhani* Tilak

\*21. *Puntius fraseri* (Hora & Misra)

\*22. *Puntius jerdoni* (Day)

23. *Puntius narayani* (Hora)



Order PERCIFORMES  
Family NANDIDAE

\*50. *Pristolepis marginata* (Jerdon)

Order SYNBRANCHYFORMES  
Family SYNBRANCHIDAE

\*51 *Monopterus indicus* (Silas & Dawson)

\* Endemic

## RESULTS & DISCUSSION

The present study submits 51 species of fishes which are threatened of which 40 spp. are endemic to this region. (Table I), out of these, 3 cyprinids are restricted to the west flowing rivers. The present list incorporates 12 species recommend by Menon (1988) and Anonymous (1991) and 8 by Yazdani (1991).

The west flowing rivers of the Western Ghats having restricted range of distribution for fishes exhibit an interesting piscine fauna. These are *Puntius crescentus* Yazdani & Singh (Kalinadi river Karwar, Karnataka), *P. fasciatus* pradhani Tilak (Molem, Goa) and *P. setnai* Chhapgar & Sane (Sanguem, Goa).

Although speciation and extinction are natural phenomena, extinction due to human invasion, chemical sources etc, is harmful. Further, Menon (1994) elaborated the definition of extinction, i.e. if species not definitely located in the wild, during the last 50 years, then only it can be called as 'Extinct'

Despite several efforts of ichthyologists from W. R. S. Pune we could not collect *Rasbora labiosa* Mukerji and *Puntius fraseri* Hora & Misra (1939), from their type locality i.e. Darna river a tributary of Godavari river, Nasik Dist. Maharashtra. Hence it is suggested that these two species may be considered as extinct.

Anthropological activities and heavy industrial pollution throwing uncontrollable effluent water in rivers, inichthyofauna of Western Ghats is under threat.

For conserving precious ichthyofauna of Western Ghats, urgent steps like putting ban on mass killing of fishes, strict observance of close period during breeding season, enforcement of new fishery law, protecting fish life, provision of fish ladder, fish-refugia, eradication of water pollution, formation of fish sanctuaries etc. must be taken seriously.

**TABLE I : % Composition of threatened & endemic fishes of Western Ghats**

Sr. No.	Order	Endemic	Threatened
1.	Cypriniformes (n = 85)	23.5%	40%
2.	Siluriformes (n = 28)	17.8%	32%

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## **CONSERVATION STRATEGIES OF ICHTHYOFAUNA IN NORTHERN PART OF WESTERN GHATS**

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### **INTRODUCTION**

The Western Ghats is one of the global hotspots and is of prime importance from biodiversity conservation point of view. It constitutes almost a continuous chain of hills of 200 to 2600 meters altitude, starting from Dangs District of Gujarat in North to Kanyakumari (Tamil Nadu) in south. It gives rise to 3 major peninsular rivers viz. Godavari, Krishna and Cauvery, in addition to numerous west flowing rivrs alongwith their tributaries. The hillstreams, ponds, puddles, rivers and rivulets of northern part of Western Ghats harbour a rich piscine fauna, comprising 135 species under 54 genera of 21 families.

As an impact of modern development and anthropogenic pressure, the ichthyofauna is under threat. Among 135 fish species recorded from northern part of the Western Ghats, 51 are known to be threatened and 40 endemic to this region (Yadav, 1997, unpublished record). Taxonomically important fish species are endangered and few are on the way of extinction. Our valuable fish fauna of Western Ghats must be conserved (Yazdani, 1991).

For conserving the precious ichthyofauna, a holistic approach must be made including In-situ conservation (conserving species within the habitat) and Ex. situ conservation (conserving species outside the habitat). First step of conservation lies in maintaining water clean and free from pollution, water pollution includes many toxic chemicals coming out of sewage, industrial effluent water, garbage, insecticides, pesticides, fertilizers etc. We should try to avoid accumulation of chemicals and metal toxicity in water due to release of Lead, Mg, Cl, Hg, etc., as these chemicals are lethal to fishes, acting directly on gill filaments. Some of them are neurotoxic like Pb. Abnoxious aquatic weeds should also be removed. Water should be kept clean through dilution as well as self purifying system. As per standards laid down by Central Pollution Control Board (CPCB), a class-D water, suitable for fish propagation and wildlife should be maintained. Class-D water is slightly Alkaline (Ph. 6.8 to 8.5) having Dissolved oxygen (DO) 4mg/L, (Anonymous, 1982). Afforestation along the edges of waterbody should be encouraged and further efforts should be made to stop grazing, so that soil quality will be maintained. Salination of waterbody and siltation at the bottom should avoided, as it destruct breeding ground, migration route and it also affects benthic fauna and its natural regeneration (Thomas & Aziz, 1996). In developed countries 'Clean water Act' has been implemented since 1973 (Buddy, 1944), but in India, this aspect has been neglected. It is sad situation in our counrty that, 70% waterbodies are dried up and remaining are polluted. Water pollution is a serious problem which must be faught at all levels.

It is noteworthy that the Tata Electric Company, Lonawala has cultured the Deccan Mahseer, *Tor khudree* (Sykes) alongwith other species which also include air transportation of eggs to various states of country to boost conservation programme (Kulkarni & Ogale, 1979). Similarly in the fish hatchery at Bhubneshwar, artificial breeding experiments on the Rohu, *Labeo rohita* (Ham.-Buch.) have been reported with higher growth rate. Monoculture and polyculture experiments can be conducted, avoiding hybridization with due caution to exotic species e. g. *Oreochromes mossambica* (Peters).

The Dexter National Fish Hatchery Centre, New Mexico, is the first of its kind in the world, which successfully reintroduced and protected fish species of south America by forming 'Fish Refugia', 'Fish Park' etc. (Buddy, 1994).

In the Ex-situe conservation, cryopreservation of sperms of fishes prepared and at suitable period, fertilization can be achieved. Such type of work has been conducted at National Bureau of Fish Genetic Resources, Lucknow. The Scientists are working on endangered, endemic yellow catfishes - Kooral and Kuyil of Kerala (Anonymous, 1998). Recently Japanee's scientists succeeded in reproducing the variety of Zebra danio, *Brachydanio rerio* (Ham.-Buch.) with the aid of cryopreservation techniques and by using liquid Nitrogen (Akoi *et. al.*, 1997).

Ecologically important portion of rivers and certain waterbodies, in the Western Ghats, should be selected for conducting pisciculture experiments to save significant fish species. To achieve this, Non Government Organizations, University and College students' capabilities and interest can be utilized as a study curriculum (Gadgil, 1996a).

Conservation strategies for freshwater fishes of the Western Ghats can include the following significant steps.

1. Survey and species recovery plan.
2. Habitat restoration.
3. Scientific provision.
4. Legal protection.

### **1. Survey & species recovery plan**

For identifying the threatened fish species, a baseline survey of selected waterbodies in Western Ghats should be conducted. After preparing a careful inventory, endangered species can be identified. These species can be given protection. Further, they may be introduced in waterbodies, to enhance fish population. River ranching programmes should be implemented. Unfortunately, there is no Red Data Book on the fishes of India. Instead of teaching the Biology of Shark, Salmon, *Cyprinus* etc., detailed behaviour and Biology of our local fishes should be undertaken. It would help to conserve the ichthyofauna.

### **2. Habitat Restoration**

As a result of irrigation projects and human interference, many important habitats of fishes are lost. Rivers dry up or spoil due to pollution. Mula-Mutha and Pawana rivers in Pune dist.,

Ulhas river in Thane dist., Banganga river in Raigad dist., Panchganga river in Kolhapur dist., Krishna river in Satara dist. of Maharashtra state. Pamba and Periyar in Kerala state are few examples. Type localities of *Rasbora labiosa* Mukerji and *Puntius fraseri* Hora & Misra (Darna river, a tributary of Godavari river Nasik dist., Maharashtra state) and *Silonai childreni* (Sykes) (Mula Mutha river, Pune) have almost vanished and fish specimens can not be obtained. Similarly, the Mahseer, (Masundi), *Tor mussullah* (Sykes) & *Osteobrama* spp. could not be collected from its type locality i. e. Ghod river, Sirur & Pune dist., due to degradation of natural habitats (Jayaram, 1997).

Endangered fish species must be conserved by formation of sacred groves like one in Indryani river near Dehu, Pune dist., for *Schismatorhynchus (Nukta) nukta* (Sykes) and at holy region of Trimbakeshwar, near the origin of Godavari river, Nasik dist., Maharashtra.

Sacred groves have important influence on masses to save valuable fish species, Maintenance of sacred groves can be allotted to Non Government Organizations. Like the fish sanctuaries, their number should be increased in every district of Western Ghats.

### 3. Scientific Provision

The construction of dams have affected the fish migration, as many of the fishes undergo short term local migrations for feeding and breeding purpose. e.g. *Tor khudree* (Sykes) which requires rocky bottom, goes upstream for breeding, while *Bagarius bagarius* (Ham.-Buch.) goes down - stream and eels, catfishes undergo local migrations. Hence provision of a fish ladder (an easy zig-zag way/steps for fishes to cross over the dam) should be made (Tilak & Sharma, 1982), Nautiyal (1994). The idea of fish ladder has emerged in Western countries in 1973, to enable migration of Salmon. On the similar lines we should try to from some way for fishes to cross over the dam. Prior to construction of dam, a provision for fish ladder should be made. As per suggestions of Jhingran (1982), a fish sanctuary or fish farm with buffer zone must be formed nearby every dam, as a means of compensation to propagate ichthyofauna therein.

A close period should be strictly observed in the breeding season of fishes, (June to September). Eggs, fry, fingerlings and brooding adults must be protected. Aquaculture business should be encouraged with some recreation charges so as to percolate the knowledge about local fishes. Similarly training on fishery management and conservation programmes must be conducted for public awareness. In U. S. A. in 1960, citizens raised voice against killing of fishes (Johnson & Rinne, 1982). Thus in addition to Government's efforts, tribals and local residents should be involved in the fish conservation programme in India.

### 4. Legal Protection

Excessive killing of fishes should be abided by law. On the line of U. S. fish-wild life service, a new fishery law should be formed in our country in which protection to endangered fish species as well as to the identified localities of great significance should be given and degraded ones should restored. Recently Australian Government accorded protection to seahorses and other sea-fishes under wild life act from 1st January 1998 (Anonymous, 1997).

Every major fish market in the Western Ghats belt should have a licence and check over the sale of threatened fish species. For this purpose, Eco-restoration Fund should be raised from owners of fish farm under Aquaculture Act, which has been practised in Tamil Nadu (Anonymous, 1995). Further, Fishery Inspector should be appointed in every major fish market of the districts of Western Ghats. Eco-friendly attitude with sustainable use of natural resources should be formulated in the legal frame-work.

Fisherman should be instructed with guidelines to save particular fish with the use of nets of suitable mesh size & their practical knowledge can be utilized in conservation work. Attempts should be made to prepare an updated document on the ichthyofauna of the Western Ghats, similar to the idea of People's Biodiversity Register by Gadgil (1996b) including suggestions of Species Survival Commission and Convention on Trade in Endangered Species (CITES).

Thus by vigilant survey, collection, identification of fishes, protection and restoration of waterbodies, with the aid of scientific provision, legal protection and through public awareness precious ichthyofauna of the Western Ghats must be conserved.

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# **EFFECTS OF INFECTION OF THE FRESHWATER AMPHIPOD *GRAMMARUS PULEX* LINNAEUS 1758 WITH THE TAPEWORM *CYATHOCEPHALUS TRUNCATUS* (PALLAS, 1781) (CESTODA : SPATHEBOTHRIDEA)**

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## **INTRODUCTION**

*Gammarus pulex* serves as an intermediate host of the salmonid fish tapeworm. *Cyathocephalus truncatus* and harbours the larva (proceroid) in the haemocoel from the onchosphere stage till it becomes the infective stage (Wisniewski, 1932; Okaka 1989). Although several authors (Wisniewski, 1932; Vik, 1958; Awachie, 1966) have reported on the occurrence of the unusually large proceroid in the body cavity of the amphipod, no study has been conducted on the effects of the infection on the amphipod.

The present investigation was carried out on laboratory infected gammarids, over a 20-months period, to study the effects of the length and weight of the parasite on the host and the condition factor (k) of infected gammarids compared with uninfected ones. Histochemical and histopathological studies, using tissue sectioning and staining technique, were also conducted on infected and non-infected gammarids to study possible structural damages on tissues and organs in the body cavity (location of the parasite) of the infected amphipods.

## **MATERIALS AND METHODS**

Infected fish (rainbow trout, *Salmo gairdneri*) from which eggs of the tapeworm were obtained for infecting the gammarids (*Gammarus pulex*) were caught at the Southern Beck tributary of the River Hull in Driffield, Yorkshire, England. 2500 young specimens of *G. pulex* freshly released from the brood sac of the female gammarids were exposed to infection as already described by Okaka (1984, 1989) and maintained in the laboratory. 100 gammarids were then examined every month for 20 months from the infected stock to monitor their lengths and weights and general development.

The lengths of the amphipods were noted before they were teased open to release the proceroid larva on a dried and weighed Whatman filter paper. The length of the proceroid was then taken after which the set up (specimens on filter paper) was put in the oven for drying. After 24 hours of drying, the dry weights of the proceroid and its gammarid host were determined using a sensitive balance. The same method was used to determine the length and dry weight of the

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uninfected gammarids. Data obtained from the length and weight measurements were used to calculate the condition factor (k) using the formula  $k = w \times 100 / l^3$  where  $w$  = weight in grams and  $l$  = total length in centimeters (Bagenal and Tesch, 1978; Odum and Oradiwe, 1995).

For histopathological studies some infected and non-infected gammarids were fixed in Bouin's fluid and processed for routine paraffin wax (m. p. 60°C) sectioning employing hematoxylin/eosin and Masson's staining techniques (Humason, 1962). Longitudinal and transverse sections (10µm thick) of the specimens were critically studied. Whole mount preparations of infected amphipods made using the technique of Chubb (1962) were also studied. For histochemical studies, the specimens were fixed in 10% neutral buffered formalin at 4°C for 12 hours and then processed for paraffin wax sectioning using a low melting point wax (m.p. 41°C) as stated by Pearse (1972). The 10µm thick sections obtained were prepared for histochemical studies as follows : Periodic Acid Schiff's (PAS) staining technique was used for glycogen detection and Alcian blue staining technique for acid mucopolysaccharide determination : "Tween 66" incubation medium was used for Protein detection; oil-red-O staining technique was used for lipids localisation while Naphthol-AS-B1 phosphate method was used for alkaline and acid phosphatases enzyme activities at substrate pHs 8.3 and 5.2 respectively; 0-acetyl-5-bromoindoxyl was the substrate used for non-specific esterase localization. The above methods have been previously described by Arme (1966), Pearse (1972), Hassall and Jennings (1975) and Okaka (1984).

## RESULTS

### Longevity of Infection

Gammarids that harbour more than one of the tapeworm larvae in the body cavity tend to die within one year of infection and only those with single tapeworm larva infection tend to tolerate the infection for some longer months and by the 20th month, most gammarids had died (Table 1). In some extra experimental tanks maintained in the laboratory most gammarids were found to live with the infection only for about 2 years and all infected amphipods died at a maximum of 2 years and 4 months of infection.

### Length/weight variations and Condition factor

The relationship between the lengths and dry weights of the proceroid and those of the gammarid host showed a direct one in which the lengths and weights burden of the parasite were seen to increase as host also grows in length and weight (Table 2). The maximum length of the proceroid was 18mm while that of the infected amphipod was 14mm (Table 1). Such large proceroids were seen to fold over once or twice within the body cavity of the host (Fig. 1). The mean dry weights obtained for the proceroid and the infected gammarid host were 0.00070 g and 0.01209 mg respectively (i. e. a ratio of 1 : 17.30). The dry weights of the non-infected *G. pulex* were also seen to be generally higher (maximum dry weight of 0.059 g) than those of infected *G. pulex* of the same length (Table 2). Uninfected gammarids were found to have a significantly higher mean condition factor (k) of 2.10 than the infected gammarids with mean "k" value of 1.59. Among infected gammarids, the "k" value was also observed to decrease with increase in length and weight of the tapeworm proceroid (Table 2).

## Histological studies

Histological transverse sections of the infected and non-infected amphipods (Fig. 2a, 2b and 3) show clearly that the location of the worm in the ventral space results in the a displacement of the intestine and hepatic caeca to dorso-lateral positions. Folding of the worm results in the displacement of the organs to a greater extent (Fig. 2b). There were, however, no structural damages of the displaced organs when compared to those of the uninfected amphipod. A high power study of the histological section of the procercoid within the haemocoel of *G. pulex* show the presence of a thin surface coat or sheath over the teguments of the tapeworm and encloses the tapeworm procercoid within the host's body cavity.

The surface coat in tissue sections stained for histochemical studies, demonstrated strongly positive reaction to tests for glycogen and acid mucopolysaccharides but weakly positive reaction for lipids while test for enzyme activity for acid and alkaline phosphatases and non-specific esterases were negative. However, within the tegument and parenchyma of the procercoid, all these histochemical tests and enzyme localisation were positive as shown in Table 3. In both the infected and non-infected *G. pulex*, positive reactions were demonstrated for glycogen acid mucopolysaccharides and lipids in the hepatopancrease, intestine, gonads and fat bodies in the hemocoel. The organs also gave positive tests to enzyme activities for acid and alkaline phosphatases and non specific esterases (Table 3).

Observations on histological sections of infected amphipods show gonads that are structurally normal like those of uninfected gammarids. Infected male amphipods maintained in the laboratory were observed to copulate normally like the non-infected ones while the infected females were also observed to copulate normally and carry their brood like the non-infected females.

## DISCUSSION

The study on the lengths and weights variations further confirm earlier reports of Wisniewski (1932) and Okaka (1989) that gammarids are mostly infected when young and the parasite and gammarid grow together until the larva attains the infective stage. This may be significant in that the amphipod host probably gets used to tolerating the infection early enough as to be able to carry on with normal life activities just like the non-infected individuals for not more than 2 $\frac{1}{3}$  years after which the host dies. The large size of the mature procercoid, the weight burden which the larva exerts on the gammarid host and the fact that infected amphipods have a lower condition factor than uninfected amphipods are all evidence of heavy physiological dependence of the parasite on the host for growth and development. The sheer weight burden of the parasite on the host is likely to reduce the host's locomotory and feeding activities thereby making it easy prey for fish and this is probably how fish, the definitive host of the parasite, acquire the infection in large numbers. Moore (1984) made a similar observation on gammarids heavily infected with *Polymorphus minutus* and stated that it was the reduction of the locomotory activities of the gammarids due to the infection that make them stay by the water surface and thus become easy prey for the ducks (the definitive host).

From the histopathological studies it is clear that the absence of tissue damages of the infected gammarids is probably due to the possession by the parasite of a surface coat which apparently

allows permeability of nutrient substances (the sheath being positive to test for glycogen mucopolysaccharides and lipids) but not a zone for enzyme or metabolic activities (the sheath being negative to alkaline and acid phosphatases and nonspecific esterases). This surface coat usually referred to as glycocalyx, has been reported from other tapeworm larvae (Arme, 1966; Lumsden, 1975) and its ultrastructure in *C. truncatus* proceroid was described by Okaka (1990).

Scott and Bullock (1974) reported lack of gonads and possible sterility in amphipods infected by the tapeworm *Bothrimonus sturionis* but *C. truncatus* infected amphipods (*G. pulex*) were seen in the present study to have well developed gonads and engage in reproductive activities. The shielding effect of the surface coat of the parasite may still be responsible for the lack of structural destruction of the amphipods gonads.

### SUMMARY

Laboratory infected *Gammarus pulex* harbouring multiple infections of *Cyathocephalus truncatus* larvae tend to die within the first year of infection while those with single larva infection can live with the infection only for a maximum of about 2 years. A full grown proceroid after 11 months of infection is unusually larger in size than its amphipod host and it is folded within the body cavity displacing organs like the hepatopancrease and intestine of the host from their normal positions but with no obvious histopathological damages to the host tissues. The mean condition factor (k) of non-infected gammarids (K = 2.10) was found to be significantly higher (P < 0.05) than that of infected amphipods (k = 1.59).

*Index key words* Tapeworm, *Cyathocephalus truncatus*; Proceroid; Amphipod; *Gammarus pulex*; histopathology; condition factor.

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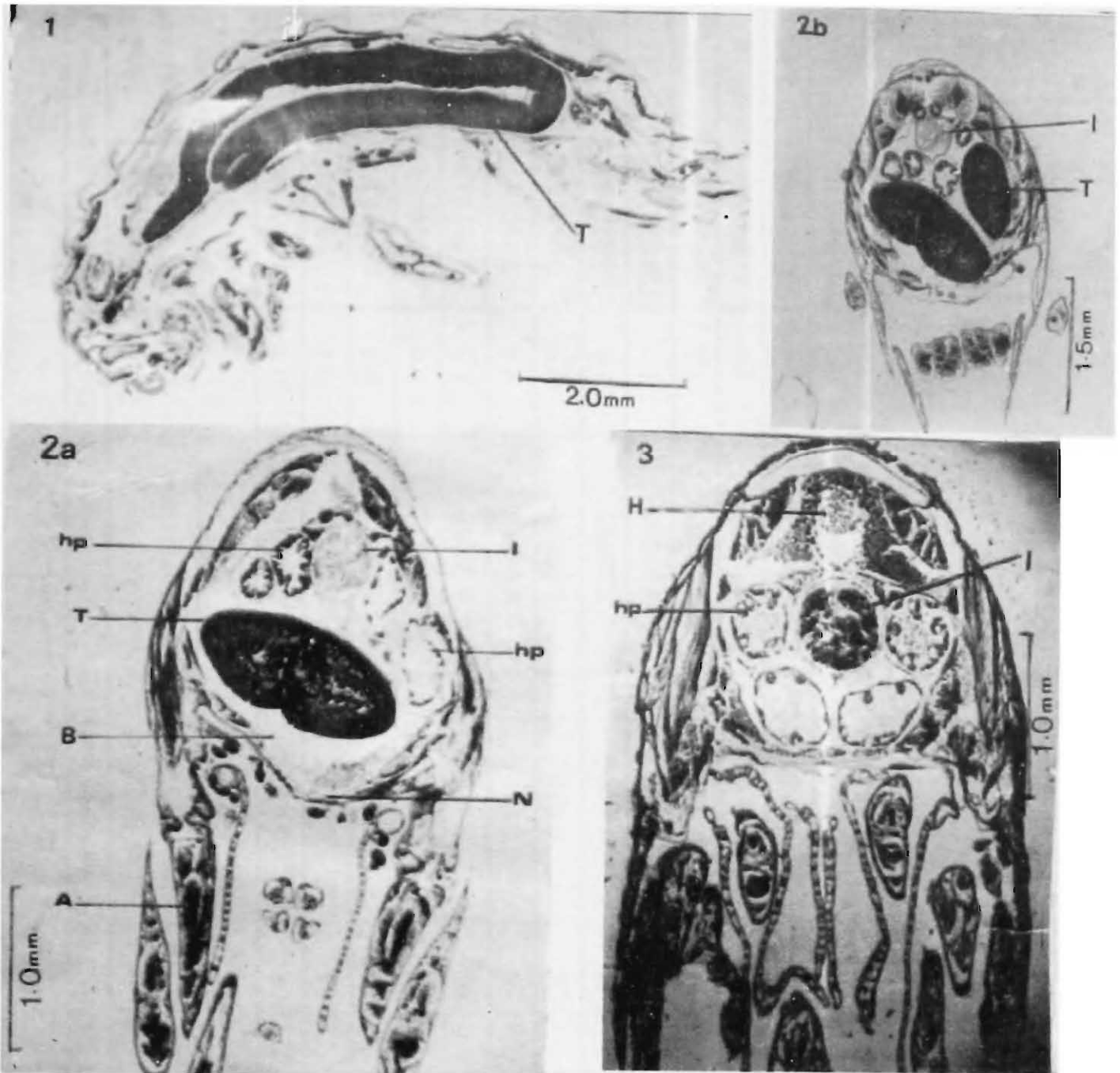
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**Table 1 :** Infections of *G. pulex* with *C. truncatus* proceroid following exposure of the amphipods to infective onchosphere of the tapeworms. 2500 *G. pulex* were exposed and 100 specimens examined monthly for 20 months.

Period	No. of <i>G. pulex</i> dead	No. of <i>G. pulex</i> alive	No. of <i>G. pulex</i> examined	No. infected	No. of proceroids retrieved	No. of <i>G. pulex</i> remaining Expt. tank	State of the proceroid
After 1 month	24	2476	100	16	48	2376	Immature
After 2 months	30	2346	100	30	38	2246	Immature
After 3 months	20	2226	100	28	32	2126	Mature
After 4 months	18	2108	100	26	26	2008	Mature
After 5 months	15	1993	100	24	24	1893	Mature
After 6 months	17	1876	100	25	25	1776	Mature
After 7 months	12	1764	100	25	26	1664	Mature
After 8 months	10	1654	100	26	26	1554	Mature
After 9 months	14	1540	100	29	30	1440	Mature
After 10 months	15	1425	100	32	32	1325	Mature
After 11 months	17	1308	100	35	35	1208	Mature & Egg laying
After 12 months	28	1180	100	43	45	1080	do
After 13 months	29	1051	100	38	38	951	do
After 14 months	26	925	100	34	34	825	do
After 15 months	28	797	100	35	35	697	do
After 16 months	32	665	100	20	20	565	do
After 17 months	30	535	100	17	17	435	do
After 18 months	34	411	100	23	23	301	do
After 19 months	68	223	100	37	37	133	do
After 20 months	120	13	13	12	12	-	do
<b>Total</b>	<b>587</b>		<b>1913</b>	<b>575</b>	<b>603</b>		



**Fig. 1** : Longitudinal section of infected *Gammarus pulex* showing the folded tapeworm.  
**Fig. 2a** : Transverse section of infected *Gammarus pulex* showing the tapeworm cut at mid-body.  
**Fig. 2b** : Transverse section of infected *Gammarus pulex* showing two sections of the folded tapeworm.  
**Fig. 3** : Transverse section of an uninfected *Gammarus pulex* showing the normal positions of internal organs.

**Labels :**

- |          |                        |         |   |
|----------|------------------------|---------|---|
| A .....  | Limb Appendages        | I ..... | Intestine   |
| B .....  | Hemocoel (body cavity) | N ..... | Nerve cord  |
| H .....  | Heart                  | T ..... | Tapeworm ( <i>Cyathocephalus truncatus</i> ) proceroid. |
| hp ..... | Hepateopancrease       |         |   |



**Table 2 :** The lengths, dry weights and condition factors of non-infected and infected *Gammarus pulex* and the length and dry weights of *Cyathocephalus truncatus* proceroid harboured by the amphipod (10 infected and 10 uninfected gammarids were used for each length).

S/NO	INFECTED <i>Gammarus pulex</i>					NON-INFECTED <i>Gammarus pulex</i>		
	Length (cm)	Mean Dry Weight (g)	Mean Condition Factors (k)	Mean length of <i>C. truncatus</i> larvae harboured (cm)	Mean Dry weight of <i>C. truncatus</i> larvae harboured (g)	Length (cm)	Mean Dry weight (g)	Mean condition factors (k)
1.	0.3	0.000564	2.08	0.4±0.2	0.00026	0.3	0.000566	2.09
2.	0.4	0.001320	2.06	0.6±0.3	0.00029	0.4	0.001322	2.06
3.	0.5	0.002586	2.06	0.6±0.2	0.00032	0.5	0.002650	2.12
4.	0.6	0.004322	2.00	0.8±0.2	0.00055	0.6	0.004498	2.08
5.	0.7	0.006703	1.95	0.8±0.2	0.00058	0.7	0.007232	2.10
6.	0.8	0.007686	1.50	0.9±0.2	0.00066	0.8	0.010760	2.10
7.	0.9	0.009210	1.26	0.9±0.2	0.00074	0.9	0.015452	2.11
8.	1.0	0.012792	1.27	1.0±0.3	0.00085	1.0	0.021005	2.10
9.	1.1	0.016763	1.25	1.1±0.2	0.00096	1.1	0.028216	2.11
10.	1.2	0.021765	1.25	1.2±0.2	0.00105	1.2	0.036973	2.13
11.	1.3	0.027456	1.24	1.4±0.2	0.00109	1.3	0.058994	2.14
12.	1.4	0.034000	1.23	1.6±0.2	0.00113	1.4	0.058994	2.14
Mean		0.012097	1.59	0.9±0.2	0.00070		0.019556	2.10

**Table 3 :** Distribution of some enzymes and reactions to certain histochemical stains in the alimentary tract and some organs in the body cavity of *Gammarus pulex* and in the larva of *Cyathocephalus truncatus*.

S/No	Tests	Infected <i>Gammarus pulex</i>				Non-infected <i>Gammarus pulex</i>				Larva of <i>C. truncatus</i>			
		Intestine	Hepatic caeca	Fat bodies in body cavity	Gonads	Intestine	Hepatic caeca	Fat bodies in body cavity	Gonads	Sheath	Tegu-ment	Parenchyma	Genital
1.	Alkaline phosphatase	**	**	*	**	**	***	**	**	-	***	**	**
2.	Acid phosphatase	**	**	*	**	***	***	**	**	-	***	**	**
3.	Non-specific esterase	*?	**	*	**	*	**	***	***	-	***	*	*
4.	Lipid (oil-Red-O)	*?	**	**	**	**	***	***	**	*	**	**	**
5.	Glycogen (PAS)	**	**	*	**	***	**	**	**	***	**	**	**
6.	Acid mucopolysaccharide (Alcian blue)	**	**	*?	**	***	**	**	**	***	***	*	*
7.	Protein (Tween 66)	*	**	*?	**	**	**	**	**	*	**	**	**

Key : \*\*\* Strongly positive  
 \*\* Positive  
 \* Weakly positive  
 - Negative  
 \*? Reaction uncertain

## **DIVERSITY OF GERROMORPHA (HETEROPTERA : HEMIPTERA : INSECTA) IN THE WESTERN GHATS STATES, INDIA.**

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### **INTRODUCTION**

The infraorder Gerromorpha comprises of semi-aquatic bugs characterised by long conspicuous antennae, longer than head and inserted in front of eyes, distributed in all kinds of climatic zones of the world, except the coldest and driest parts of the world (Andersen, 1982). These bugs are the most successful group living on the surface of water, occupying almost every kind of aquatic habitat. This infraorder contains 'water striders' or 'pond skaters' (Family Gerridae); 'small water striders' or 'water measurers' (Family Veliidae); 'marsh treaders' or 'water measurers' (Family Hydrometridae); 'water treaders' or 'pond weed bugs' (Family Mesoveliidae); 'velvet water bugs' (Family Hebridae) and bugs pertaining to the families Macroveliidae, Paraphrynoveliidae and Hermatobatidae. The last three families do not occur in India.

Aquatic and semi-aquatic bugs play an important role in fresh water ecosystems, as polyphagous and carnivorous insects in different trophic levels. These water bugs serve as zoogeographical indicators for diverse habitats due to their poor dispersal capability. Besides, the role of these bugs as predator in biological control of mosquito is well known (Jenkins, 1964). Knowledge on the ecological aspects of the bugs is essential to study (a) fish biology, due to reversals in prey-predator relationship and (b) food web as prey to higher vertebrates like newts, salamanders, water snakes and birds. Further, studies indicate that the quality of aquatic environment is partially dependent on aquatic bug population dynamics. (Thirumalai & Raghunathan, 1988).

The present day knowledge of Indian Gerromorpha is because of the contribution of Distant (1903; 1906; 1910 a, b), Annandale (1919), Paiva (1919 a, b), Hafiz & Mathai (1938), Hafiz & Ribeiro (1939), Hafiz & Pradhan (1947), Pradhan (1950 a, b), Selvanayagam (1981), Thirumalai (1986; 1989; 1992; 1994 a, b, 1996, 1999 a, b, c), Polhemus & Starmuhlner (1990), Thirumalai Dam (1996), Thirumalai & Radhakrishnan (1999), Ghosh *et al* (1989), Bal & Basu (1994, 1997), Zettel (1998) and Chen & Zettel (1999).

The political states of Karnataka, Kerala, Maharashtra and Tamilnadu falling within 8° & 22° N and 73° & 81° E have a geographical feature in common, the Western Ghats traversing them at one part or the other (Goa not included). Since taxonomy holds the key to biodiversity studies, this work has been undertaken to document diversity of semi-aquatic bugs of the four states. The similarity and biotal dispersity of these insects are taxonomically analysed by applying Sorensen and Koch's Indices.

## SYSTEMATIC LIST OF GERROMORPHA OF KARNATAKA

Infraorder GERROMORPHA  
 Family GERRIDAE  
 Subfamily CYLINDROSTETHINAE  
 Genus *Cylindrostethus* Mayr, 1865

1. *Cylindrostethus productus* Spinola, 1940

Subfamily EOTRECHINAE  
 Genus *Amemboa* Esaki, 1925  
 Subgenus *Amemboa* Esaki, 1925

2. *Amemboa (Amemboa) dentata* Polhemus & Andersen, 1984

3. *Amemboa (Amemboa) kumari* (Distant), 1910

Subgenus *Amemboides* Polhemus & Andersen, 1984

4. *Amemboa (Amemboides) perlata* Polhemus & Andersen, 1984

Genus *Onychotrechus* Kirkaldy, 1903

5. *Onychotrechus rhexenor* Kirkaldy, 1903

6. *Onychotrechus rupestris* Andersen, 1980

7. *Onychotrechus spinifer* Andersen, 1980

Genus *Tarsotrechus* Andersen, 1980

8. *Tarsotrechus polhemi* Andersen, 1980

Subfamily GERRINAE  
 Genus : *Aquarius* Schellenberg, 1800

9. *Aquarius adelaidis* (Dohrn), 1860

Genus *Neogerris* Mastumura, 1913

10. *Neogerris parvula* (Stal), 1859

Genus *Limnogonus* Stal, 1868  
 Subgenus *Limnogonus* Stal, 1868

11. *Limnogonus (Limnogonus) fossarum fossarum* (Fabricius), 1775

12. *Limnogonus (Limnogonus) nitidus* (Mayr), 1865

Subgenus *Limnogonoides* Poisson, 1965

13. *Limnogonus (Limnogonoides) pectoralis* (Mayr), 1865

Genus : *Limnometra* Mayr, 1865

14. *Limnometra anadyomene* (Kirkaldy), 1901

15. *Limnometra fluviorum* (Fabricius), 1798

Genus : *Tenagogonus* Stal, 1853

16. *Tenagogonus ceylonensis* Hungerford & Matsuda, 1962

Subfamily : HALOBATINAE

Genus : *Metrocoris* Mayr, 1865

17. *Metrocoris communis* (Distant), 1910

18. *Metrocoris indicus* Chen & Nieser, 1993

19. *Metrocoris malabaricus* Thirumalai, 1986

20. *Metrocoris variegans* Thirumalai, 1986

Genus : *Ventidius* Distant, 1910

Subgenus : *Ventidius* Distant, 1910

21. *Ventidius (Ventidius) aquarius* Distant, 1910

Subfamily : PTILOMERINAE

Genus : *Pleciobates* Esaki, 1930

22. *Pleciobatus tuberculatus* Esaki, 1930

Genus : *Ptilomera* Amyot & Serville, 1843

Subgenus : *Ptilomera* Amyot & Serville, 1843

23. *Ptilomera (Ptilomera) agroides* Schmidt, 1926

Subfamily : TREPOBATINAE

Genus : *Gnomobates* Polhemus & Polhemus, 1995

24. *Gnomobates kuiterti* (Hungerford & Matsuda), 1958

Genus : *Naboandelus* Distant, 1910

25. *Naboandelus signatus* Distant, 1910

Family : VELIIDAE

Subfamily : MICROVELIINAE

Genus : *Baptista* Distant, 1903

26. *Baptista angulata* Andersen, 1989

- Genus            *Microvelia* Westwood, 1834  
 Subgenus        *Microvelia* Westwood, 1834  
 27. *Microvelia (Microvelia) douglasi douglasi* Scott, 1874
- Genus            *Pseudovelina* Hoberlandt, 1950  
 Subgenus        *Pseudovelina* Hoberlandt, 1950  
 28. *Pseudovelina (Pseudovelina) sexualis* (Paiva), 1917
- Subfamily        RHAGOVELIINAE  
 Genus        : *Rhagovelina* Mayr, 1865  
 Subgenus        *Rhagovelina* Mayr, 1865  
 29. *Rhagovelina (Rhagovelina) tibialis* Lundblad, 1936
- Genus        : *Tetraripis* Lundblad, 1936  
 30. *Tetraripis asymmetricus* Polhemus & Karunaratne, 1979
- Family        : HEBRIDAE  
 Subfamily      : HEBRINAE  
 Genus        : *Neotimasius* Andersen, 1981  
 31. *Neotimasius orientalis* Andersen, 1981
- Genus            *Timasius* Distant, 1909  
 32. *Timasius splendens* Distant, 1909
- Family            MESOVELIIDAE  
 Subfamily        MESOVELIINAE  
 Genus            : *Mesovelina* Mulsant & Rey, 1852  
 33. *Mesovelina vittigera* Horvath, 1895
- Family            HYDROMETRIDAE  
 Subfamily        HYDROMETRINAE  
 Genus            *Hydrometra* Latreille, 1796  
 34. *Hydrometra butleri* Hungerford and Evans, 1934  
 35. *Hydrometra greeni* Kirkaldy, 1898

## SYSTEMATIC LIST OF GERROMORPHA OF KERALA

Infraorder : GERROMORPHA  
 Family : GERRIDAE  
 Subfamily : CYLINDROSTETHINAE  
 Genus : *Cylindrostethus* Mayr, 1865

1. *Cylindrostethus productus* Spinola, 1940

Subfamily : EOTRECHINAE  
 Genus : *Amemboa* Esaki, 1925  
 Subgenus : *Amemboa* Esaki, 1925

2. *Amemboa (Amemboa) kumari* (Distant), 1910

Genus : *Onychotrechus* Kirkaldy, 1903

3. *Onychotrechus major* Andersen, 1980

4. *Onychotrechus rhexenor* Kirkaldy, 1903

5. *Onychotrechus spinifer* Andersen, 1980

Genus : *Tarsotrechus* Andersen, 1980

6. *Tarsotrechus polhemi* Andersen, 1980

Subfamily : GERRINAE  
 Genus : *Aquarius* Schellenberg, 1800

7. *Aquarius adelaidis* (Dohrn), 1860

Genus : *Neogerris* Matsumara, 1913

8. *Neogerris parvula* (Stal), 1859

Genus : *Limnogonus* Stal, 1868  
 Subgenus : *Limnogonus* Stal, 1868

9. *Limnogonus (Limnogonus) fossarum fossarum* (Fabricius), 1775

10. *Limnogonus (Limnogonus) nitidus* (Mayr), 1865

Genus : *Limnometra* Mayr, 1865

11. *Limnometra anadyomene* (Kirkaldy), 1901

12. *Limnometra fluviorum* (Fabricius), 1798

Subfamily HALOBATINAE  
Genus *Metrocoris* Mayr, 1865

13. *Metrocoris indicus* Chen & Nieser, 1993  
14. *Metrocoris malabaricus* Thirumalai, 1986  
15. *Metrocoris variegans* Thirumalai, 1986  
16. *Metrocoris velamentus* Chen & Nieser, 1993

Genus *Ventidius* Distant, 1910  
Subgenus *Ventidius* Distant, 1910

17. *Ventidius (Ventidius) aquarius* Distant, 1910

Subfamily : PTILOMERINAE  
Genus *Pleciobates* Esaki, 1930

18. *Pleciobates indicus* Thirumalai, 1986  
19. *Pleciobates nostras* Thirumalai, 1986

Genus *Ptilomera* Amyot & Serville, 1843  
Subgenus *Ptilomera* Amyot & Serville, 1843

20. *Ptilomera (Ptilomera) agroides* Schmidt, 1926

Genus *Rheumatogonus* Kirkaldy, 1909

21. *Rheumatogonus custodiendus* (Distant), 1910

Subfamily RHAGADOTARSINAE  
Genus *Rhagadotarsus* Breddin, 1905  
Subgenus *Rhagadotarsus* Breddin, 1905

22. *Rhagadotarsus (Rhagadotarsus) kraepelini* Breddin, 1905

Subfamily TREPOBATINAE  
Genus *Cryptobates* Esaki, 1929

23. *Cryptobates raja* (Distant), 1910

Family HEBRIDAE  
Subfamily HYRCANINAE  
Genus *Hyrceanus* Distant, 1910

24. *Hyrceanus reichli* Zettel, 1998

Family : HYDROMETRIDAE  
 Subfamily : HYDROMETRINAE  
 Genus : *Hydrometra* Latreille, 1796

25. *Hydrometra butleri* Hungerford & Evans, 1934

26. *Hydrometra greeni* Kirkaldy, 1898

Family : MESOVELIIDAE  
 Subfamily : MESOVELIINAE  
 Genus : *Mesovelgia* Mulsant & Rey, 1852

27. *Mesovelgia vittigera* Horvath, 1895

Family : VELIIDAE  
 Subfamily : MICROVELIINAE  
 Genus : *Microvelia* Westwood, 1834  
 Subgenus : *Microvelia* Westwood, 1834

28. *Microvelia (Microvelia) douglasi douglasi* Scott, 1874

Subfamily : RHAGOVELIINAE  
 Genus : *Rhagovelgia* Mayr, 1865  
 Subgenus : *Rhagovelgia* Mayr, 1865

29. *Rhagovelgia (Rhagovelgia) ceylanica* Lundblad, 1936

30. *Rhagovelgia (Rhagovelgia) tibialis* Lundblad, 1936

#### SYSTEMETIC LIST OF GERROMORPHA OF MAHARASHTRA

Infraorder : GERROMORPHA  
 Family : GERRIDAE  
 Subfamily : CYLINDROSTETHINAE  
 Genus : *Cylindrostethus* Mayr, 1865

1. *Cylindrostethus productus* Spinola, 1940

Subfamily : EOTRECHINAE  
 Genus : *Onychotrechus* Kirkaldy, 1903

2. *Onychotrechus major* Andersen, 1980

3. *Onychotrechus rhexenor* Kirkaldy, 1903

4. *Onychotrechus spinifer* Andersen, 1980

Subfamily GERRINAE

Genus *Aquarius* Schellenberg, 1800

5. *Aquarius adelaidis* (Dohrn), 1860

Genus : *Limnogonus* Stal, 1868

Subgenus : *Limnogonus* Stal, 1868

6. *Limnogonus (Limnogonus) fossarum fossarum* (Fabricius), 1775

Genus *Limnometra* Mayr, 1865

7. *Limnogonus fluviorum* (Fabricius), 1798

Subfamily : HALOBATINAE

Genus *Halobates* Buchanan-White, 1883

8. *Halobates elephanta* Andersen & Foster, 1992

9. *Halobates formidabilis* (Distant), 1910

10. *Halobates galatea* Herring, 1961

Genus : *Metrocoris* Mayr, 1865

11. *Metrocoris communis* (Distant), 1910

Subfamily PTILOMERINAE

Genus *Ptilomera* Amyot & Serville, 1843

Subgenus *Ptilomera* Amyot & Serville, 1843

12. *Ptilomera (Ptilomera) agroides* Schmidt, 1926

Family : VELIIDAE

Subfamily MICROVELIINAE

Genus *Microvelia* Westwood, 1834

13. *Microvelia (Microvelia) diluta* Distant, 1909

14. *Microvelia (Microvelia) douglasi douglasi* Scott, 1874

Subfamily RHAGOVELIINAE

Genus : *Rhagovelina* Mayr, 1865

Subgenus *Rhagovelina* Mayr, 1865

15. *Rhagovelina (Rhagovelina) ceylanica* Lundblad, 1936

Family : HEBRIDAE  
 Subfamily : HEBRINAE  
 Genus : *Hebrus* Curtis, 1833

16. *Hebrus bombayensis* Paiva, 1919

Family : MESOVELIIDAE  
 Subfamily : MESOVELIINAE  
 Genus : *Mesovelia* Mulsant & Rey, 1852

17. *Mesovelia vittigera* Horvath, 1895

Family : HYDROMETRIDAE  
 Subfamily : HYDROMETRINAE  
 Genus : *Hydrometra* Latreille, 1796

18. *Hydrometra greeni* Kirkaldy, 1898

#### SYSTEMATIC LIST OF GERROMORPHA OF TAMIL NADU

Infraorder : GERROMORPHA  
 Family : GERRIDAE  
 Subfamily : CYLINDROSTETHINAE  
 Genus : *Cylindrostethus* Mayr, 1865  
 Subgenus : *Cylindrostethus* Mayr, 1865

1. *Cylindrostethus productus* Spinola, 1840

Subfamily : EOTRECHINAE  
 Genus : *Amemboa* Esaki, 1925  
 Subgenus : *Amemboa* Esaki, 1925

2. *Amemboa (Amemboa) kumari* (Distant), 1910

Genus : *Onychotrechus* Kirkaldy, 1903

3. *Onychotrechus rhexenor* Kirkaldy, 1903

Subfamily : GERRINAE  
 Genus : *Aquarius* Schellenberg, 1800

4. *Aquarius adelaidis* (Dohrn), 1860

Genus : *Limnogonus* Stal, 1868

Subgenus : *Limnogonus* Stal, 1868

5. *Limnogonus (Limnogonus) fossarum fossarum* (Fabricius), 1775

6. *L. (L). nitidus* (Mayr), 1865

Genus : *Limnometra* Mayr, 1865

7. *Limnometra anadyomene* (Kirkaldy), 1901

8. *L. fluviorum* (Fabricius), 1798

Genus : *Neogerris* Matsumura, 1913

9. *Neogerris parvula* (Stal), 1859

Subfamily : HALOBATINAE

Genus : *Asclepios* Distant, 1915

10. *Asclepios annandalei* Distant, 1915

Genus : *Halobates* Buchanan-White, 1883

11. *Halobates flaviventris* Eschscholtz, 1822

Genus : *Metrocoris* Mayr, 1865

12. *Metrocoris communis* (Distant), 1910

13. *M. communoides* Chen & Nieser, 1993

14. *M. indicus* Chen & Nieser, 1993

15. *M. malabaricius* Thirumalai, 1986

16. *M. velamentus* Chen & Nieser, 1993

Genus : *Ventidius* Distant, 1910

Subgenus : *Ventidius* Distant, 1910

17. *Ventidius (Ventidius) aquarius* Distant, 1910

Subfamily : PTILOMERINAE

Genus : *Pleciobates* Esaki, 1930

18. *Pleciobates tuberculatus* Esaki, 1930

Genus : *Ptilomera* Amyot & Serville, 1843

Subgenus : *Ptilomera* Amyot & Serville, 1843

19. *Ptilomera (Ptilomera) agroides* Schmidt, 1926

- Subfamily : RHAGADOTARSINAE  
 Genus : *Rhagadotarsus* Breddin, 1905  
 Subgenus : *Rhagadotarsus* Breddin, 1905

20. *Rhagadotarsus (Rhagadotarsus) kraepelini* Breddin, 1905

- Subfamily : TREPOBATINAE  
 Genus : *Naboandelus* Distant, 1910

21. *Naboandelus signatus* Distant, 1910

- Family : HEBRIDAE  
 Subfamily : HEBRINAE  
 Genus : *Neotimasius* Andersen, 1981

22. *Neotimasius orientalis* Andersen, 1981

- Genus : *Timasius* Distant, 1909

23. *Timasius spinifer* Andersen, 1981

24. *T. splendens* Distant, 1909

- Family : HYDROMETRIDAE  
 Subfamily : HYDROMETRINAE  
 Genus : *Hydrometra* Latreille, 1796

25. *Hydrometra bifurcata* ? Hungerford & Evans, 1934

26. *H. butleri* Hungerford & Evans, 1934

27. *H. greeni* Kirkaldy, 1898

- Family : MESOVELIIDAE  
 Subfamily : MESOVELIINAE  
 Genus : *Mesovelia* Mulsant & Rey, 1852

28. *Mesovelia horvathi* Lundblad, 1934

29. *M. indica* Horvath, 1915

30. *M. vittigera* Horvath, 1895

- Family : VELIIDAE  
 Subfamily : HALOVELIIDAE  
 Genus : *Strongylovelia* Esaki, 1924

31. *Strongylovelia* sp.

Genus *Xenobates* Esaki, 1927

32. *Xenobates* sp.

Subfamily MICROVELIINAE

Genus *Microvelia* Westwood, 1834

Subgenus *Microvelia* Westwood, 1834

33. *Microvelia (Microvelia) annandalei* Distant, 1909

34. *M. (M). diluta* Distant, 1909

35. *M. (M). douglasi douglasi* Scott, 1874

36. *M. (M). javadiensis* Thirumalai, 1989

37. *M. (M). santala* Hafiz & Ribeiro, 1939

Subfamily PERITTOPINAE

Genus *Perittopus* Fieber, 1861

38. *Perittopus campbelli* Lundblad, 1933

39. *P. horvathi* Lundblad, 1933

Subfamily : RHAGOVELIINAE

Genus *Rhagovelia* Mayr, 1865

Subgenus *Neorhagovelia* Matsuda, 1956

40. *R. (Neorhagovelia) nilgiriensis* Thirumalai, 1994

Subgenus : *Rhagovelia* Mayr, 1865

41. *Rhagovelia (Rhagovelia) ceylanica* Lundblad, 1936

42. *R. (R). tibialis* Lundblad, 1936

Genus : *Tetraripis* Lundblad, 1936

43. *Tetraripis asymmetricus* Polhemus & Karunaratne, 1979

### TAXONOMIC ANALYSIS

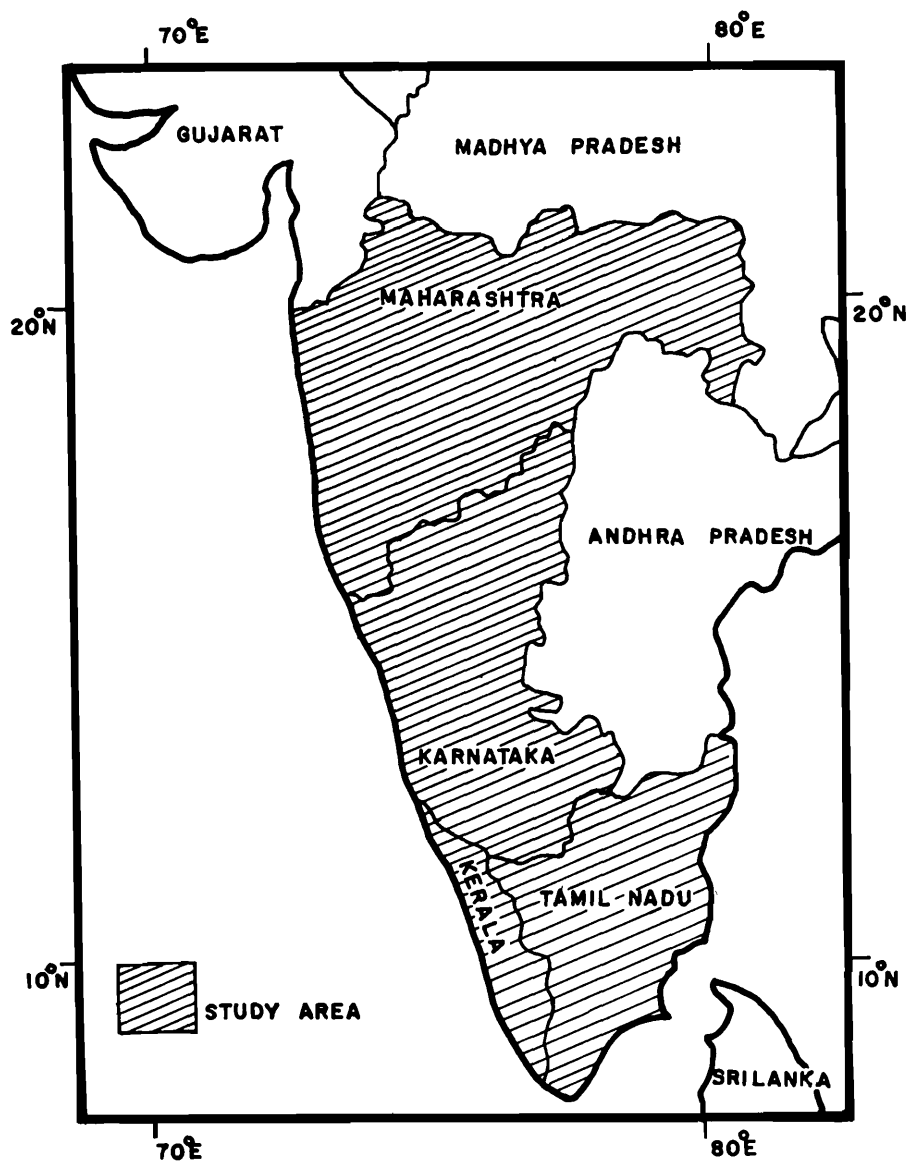
Out of the total 64 species so far recorded from the study area, 35 species accommodated in 24 genera under 5 families; 30 species, 19 genera, 5 families; 18 species, 13 genera, 4 families and 43 species, 25 genera, 5 families occur in Karnataka, Kerala, Maharashtra and Tamil Nadu respectively. Common to all four states are 8 species (*Cryptobates raja*, *Hyrceanus reichli*, *Pleciobates indicus*, *P. nostras* and *Rheumatogonus custodiendus*) in Kerala, 4 species (*Halobates elephanta*, *H. formidabilis*, *H. galatea* and *Hebrus bombayensis*) in Maharashtra and 14 species (*Asclepios annandalei*, *Halobates flaviventris*, *Hydrometra bifurcata* ?, *Mesovelia horvathi*, *M. indica*, *Microvelia annandalei*, *M. javadiensis*, *M. santala* ?, *Perittopus campbelli*, *P. horvathi*,

*Rhagovelia nilgiriensis*, *Strongylovelia* sp., *Timasius spinifer* and *Xenobates* sp.) in Tamil Nadu enjoy exclusive distribution. Among the 14 genera of the study area, 4 in Kerala, 1 in Maharashtra and 5 in Tamil Nadu have exclusive existence.

To study the similarity and dispersity of the semi-aquatic bugs of the four states. Sorensen Index of similarity (1948) and Index on Biotal Dispersity (IBD) of Koch (1957) have been applied on the formulae :

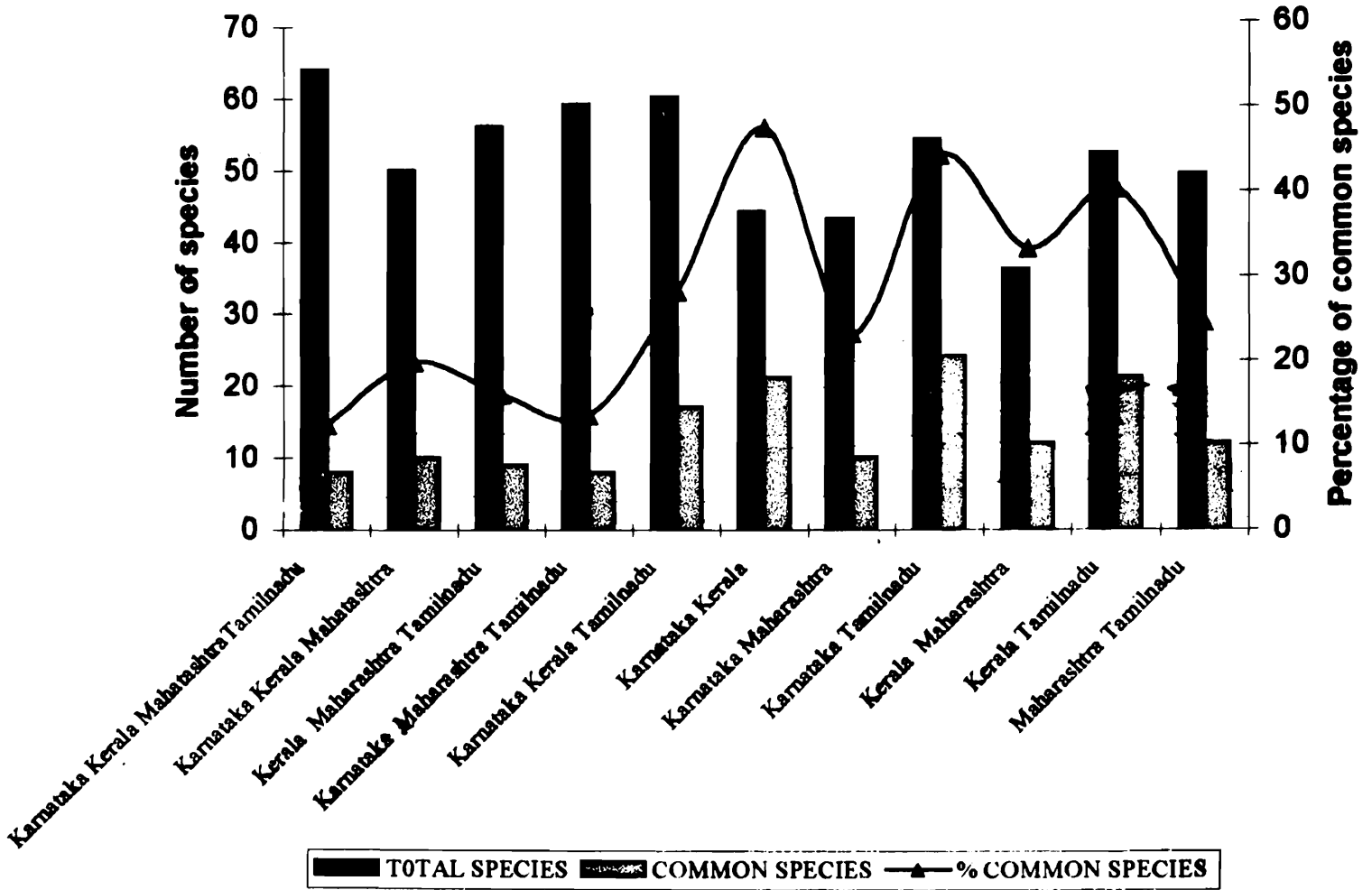
Sorensen Index (S) =  $2 C/a+b \times 100$  where 'C' is the number of species common to both the associations; 'a' the number of species in one association and 'b' the number of species in the other association.

Index of Biotal Dispersity (IBD) =  $T-S \times 100/S (n-1)$  where 'T' is the arithmetical sum of species living in each of 'n' compared association and 'S' is the total list of species in 'n' compared association. If the Sorensen Index is 100, it indicates absolute similarity and if the IBD is '0', 'T' will be equivalent to 'S', indicating a completely different set.

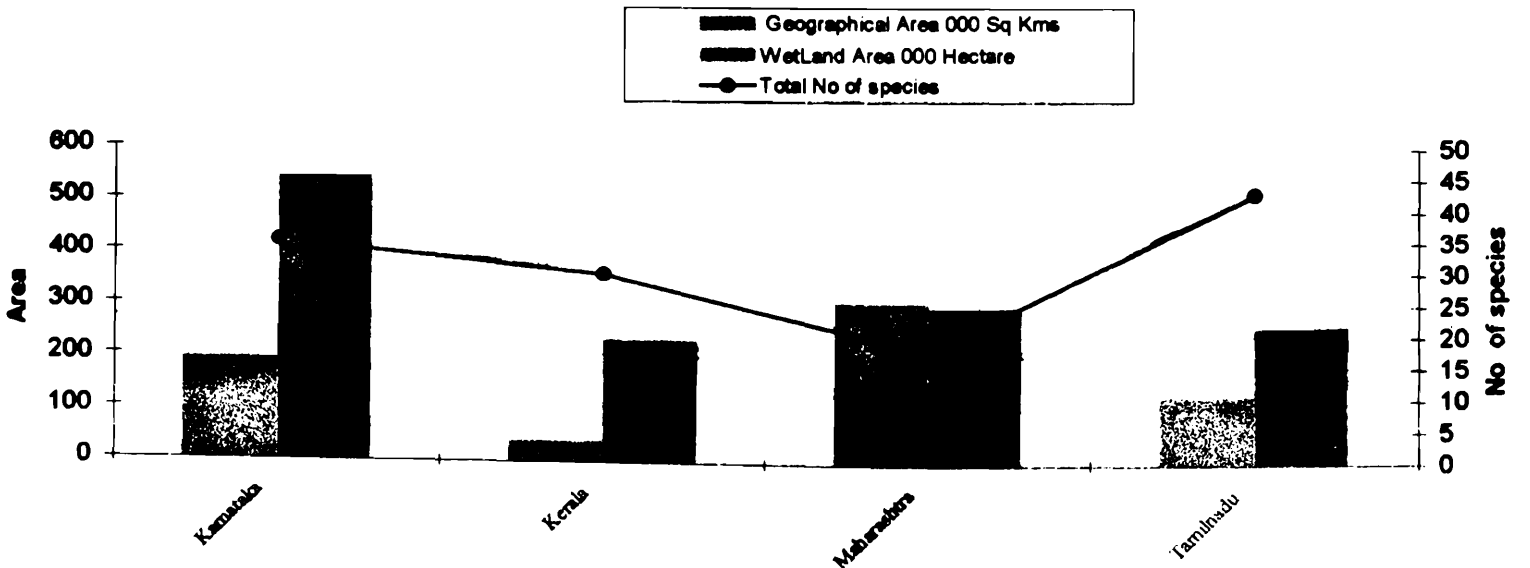


Map 1 : Western Ghats States

**Fig. 1. Total Common and Percentage of Gerromorpha**



**Fig. 2. Geographical Wetland areas and number of species**



Sorensen Indices and Koch's Indices of Biotal Dispersion are presented in table 2 and 3. The highest of Sorensen Indices is found for Karnataka-Kerala (65) and the lowest for Karnataka-Maharashtra (38). The highest of IBD is for Kerala-Maharashtra (54) where as the lowest for Karnataka-Tamil Nadu (21). The total, common and percentage of common occurrence of species in all the combination of states are projected in Fig. 1. To render the data more useful, comparison has been made between the geographical and wetland areas of the four states with the total number of species in each state (Fig. 2.).

## DISCUSSION

The aquatic and semi-aquatic groups of insects represent a significant level of diversity (Ghosh, 1996). In India, 123 species of Gerromorpha constituting 8.3% of global occurrence command taxonomic work. It is further felt that every effort should be made to have data bases of local and provincial biodiversity especially of globally important areas like Western Ghats (Daniels, 1997). In this context, the present work signifies the necessity to authentically record 64 species from the province consisting of Karnataka, Kerala, Maharashtra and Tamil Nadu to dispel taxonomic uncertainties existing at various levels (Daniels, 1997) in Western Ghats biodiversity. It is interesting to note that more than 50% of the known Gerromorpha species of India are found in this province where Western Ghats run through. There is little doubt that the Ghats states have an array of various forest types and complex assemblages of ecosystems providing home to diverse gerromorphan faunistic constituents. Besides, the original fauna of peninsula constitute the true Indian elements derived from the Indian part of Gondwana land (Mani, 1974). Hence, inventorisation of aquatic insect resources becomes a high priority area to study the functional aspects of community structure incorporated in food webs that provide information on energyflow (Ananthkrishnan, 1999).

The highest number of species in common is in Karnataka-Tamil Nadu sector (24 species) where as the Sorensen Index is the highest for the Karnataka-Kerala sector (65). On the contrary, the lowest number of species in common is in the Karnataka-Maharashtra sector (10 species) and Sorensen Index is also the lowest for the same area (38). Even though Karnataka-Kerala and Kerala-Tamil Nadu have a similar numerical strength (21 species), the Sorensen indices differ. The same trend is seen in Kerala-Maharashtra and Maharashtra-Tamil Nadu sectors also (Table 2). The highest of IBD for Kerala-Maharashtra sector (54) indicates the possibilities of less exploration, diverse habitats and different biogeographic conditions (Table 3). It is evident from Fig. 2 that, though wetland area is more in Karnataka and Maharashtra states, the number of species reported is less than Tamil Nadu which ranks third in wetland availability. Hence, it invites more efforts for systematic exploration of this group in Maharashtra intensively.

As has been aptly pointed out by Ganeshiah *et al* (1997), variety of indices quantifying biodiversity treat all species as equivalent, ignoring taxonomy, morphological and biological differences among species of community. Thus, one will have to rely on hard core taxonomy for a meaningful approach to understand issues concerning bio-diversity.

### SUMMARY

Diversity of semi-aquatic bugs of the infraorder Gerromorpha in the Western Ghats states, Karnataka, Kerala, Maharashtra and Tamil Nadu has been studied and taxonomically analysed.

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Table 1 : Distribution of Gerromorpha

S. NO.	GERROMORPHAN SPECIES	K A R N A T A K A	K E R A L A	M A H A R A S H T R A	T A M I L N A D U
1.	<i>Amemboa (Amemboa) dentata</i>	P?			
2.	<i>Amemboa (Amemboa) kumari</i>	P	P		P
3.	<i>Amemboa (Amemboides) perlata</i>	P			
4.	<i>Aquarius adelaidis</i>	P	P	P	P
5.	<i>Asclepios annandalei</i>				P
6.	<i>Baptista angulata</i>	P			
7.	<i>Cryptobates raja</i>		P		
8.	<i>Cylindrostethus productus</i>	P	P	P	P
9.	<i>Gnomobates kuiterti</i>	P			
10.	<i>Halobates elephanta</i>			P	
11.	<i>Halobates flaviventris</i>				P
12.	<i>Halobates formidabilis</i>			P	
13.	<i>Halobates galatea</i>			P	
14.	<i>Hebrus bombayensis</i>			P	
15.	<i>Hydrometra bifurcta ?</i>				P
16.	<i>Hydrometra butleri</i>	P	P		P
17.	<i>Hydrometra greeni</i>	P	P	P	P
18.	<i>Hyrceanus reichli</i>		P		
19.	<i>Limnogonus (Limnogonus) fossarum fossarum</i>	P	P	P	P

S. NO.	GERROMORPHAN SPECIES	K A R N A T A K A	K E R A L A	M A H A R A S H T R A	T A M I L N A D U
20.	<i>Limnogonus (Limnogonus) nitidus</i>	P	P		P
21.	<i>Limnogonus (Limnogonus) pectoralis</i>	P			
22.	<i>Limnometra anadyomene</i>	P	P		P
23.	<i>Limnometra fluviorum</i>	P	P	P	P
24.	<i>Mesovelgia horvathi</i>				P
25.	<i>Mesovelgia indica</i>				P
26.	<i>Mesovelgia vittigera</i>	P	P	P	P
27.	<i>Metrocoris communis</i>			P	P
28.	<i>Metrocoris communoides</i>	P			P
29.	<i>Metrocoris indicus</i>	P	P		P
30.	<i>Metrocoris malabaricus</i>	P	P		P
31.	<i>Metrocoris variegans</i>	P	P		
32.	<i>Metrocoris velamentus</i>		P		P
33.	<i>Microvelia (Microvelia) annandalei</i>				P
34.	<i>Microvelia (Microvelia) diluta</i>			P	P
35.	<i>Microvelia (Microvelia) douglasi douglasi</i>	P	P	P	P
36.	<i>Microvelia (Microvelia) javadiensis</i>				P
37.	<i>Microvelia (Microvelia) santala</i>				P?
38.	<i>Naboandelus signatus</i>		P		P

S. NO.	GERROMORPHAN SPECIES	K A R N A T A K A	K E R A L A	M A H A R A S H T R A	T A M I L N A D U
39.	<i>Neogerris parvula</i>	P	P		P
40.	<i>Neotimasius orientalis</i>	P			P
41.	<i>Onychotrechus major</i>		P	P	
42.	<i>Onychotrechus rhexenor</i>	P	P	P	P
43.	<i>Onychotrechus spinifer</i>	P	P	P	
44.	<i>Onychotrechus rupestris</i>	P			
45.	<i>Perittopus campbelli</i>				P
46.	<i>Perittopus horvathi</i>				P
47.	<i>Pleciobates indicus</i>		P		
48.	<i>Pleciobates nostras</i>		P		
49.	<i>Pleciobates tuberculatus</i>	P			P
50.	<i>Pseudovelvia (Pseudovelvia) sexualis</i>	P			
51.	<i>Ptilomera (Ptilomera) agroides</i>	P	P	P	P
52.	<i>Rhagadotarsus (Rhagadotarsus) kraepelini</i>		P		P
53.	<i>Rhagovelia (Rhagovelia) ceylanica</i>		P	P?	P
54.	<i>Rhagovelia (Rhagovelia) nilgiriensis</i>				P
55.	<i>Rhagovelia (Rhagovelia) tibialis</i>	P?	P		P
56.	<i>Rheumatogonus custodiendus</i>		P		
57.	<i>Strongylovelia sp.</i>				P
58.	<i>Tarsotrechus polhemi</i>	P	P		
59.	<i>Tenagogonus ceylonensis</i>	P			

S. NO.	GERROMORPHAN SPECIES	K A R N A T A K A	K E R A L A	M A H A R A S H T R A	T A M I L N A D U
60.	<i>Tetraripis asymmetricus</i>	P			P
61.	<i>Timasius spinifer</i>				P
62.	<i>Timasius splendens</i>	P			P
63.	<i>Ventidius (Ventidius) aquarius</i>	P	P		P
64.	<i>Xenobates sp.</i>				P
	TOTAL	35	30	18	43

**Table 2 :** Sorensen indices for Gerromorpha from four states.

STATES	KARNATAKA	KERALA	MAHARASHTRA	TAMIL NADU
KARNATAKA	0	65	38	62
KERALA	65	0	50	58
MAHARASHTRA	38	50	0	39
TAMIL NADU	62	58	39	0

**Table 3 :** Koch's IBD for Gerromorpha from four states.

STATES	KARNATAKA	KERALA	MAHARASHTRA	TAMIL NADU
KARNATAKA	0	31	46	21
KERALA	31	0	54	24
MAHARASHTRA	46	54	0	36
TAMIL NADU	21	24	36	0

## NEW RECORDS OF BATS FROM NAGALAND, INDIA

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### INTRODUCTION

In connection with the study of mammalian fauna of Nagaland, faunistic surveys were undertaken during September-October, 1996; March-April, 1997; November, 1977 and March-April, 1998. The collection made during these surveys contain several species of bats of which five, viz. *Megaerops niphanae* Yenbutra and Felten, *Taphozous longimanus longimanus* Hardwicke, *Megaderma lyra lyra* Geoffroy, *Rhinolophus lepidus lepidus* Blyth and *Pipistrellus dormeri* (Dobson) have not yet been recorded from the present State of Nagaland (Blanford 1891, Mills 1923, Hinton and Lindsay 1926, Ellerman and Morrison Scott 1966, Lekagul and McNeely 1977, Corbet and Hill 1992, Agarwal *et al.* 1992, Wilson and Reeder 1993, Das *et al.* 1995, Bates *et al.* 1997, Sinha 1999). Since the final report on the faunal account of the State will take some more time for completion, it was considered worthwhile to publish the new distributional records of these bats hereunder.

External measurements have been taken in the field from freshly killed specimens and skull measurements in the laboratory. All measurements are in millimetres and have been taken after Khajuria (1953).

List of abbreviations used for various measurements :

- c<sup>1</sup>-c<sup>1</sup> = distance between outer surface of upper canines;
- ccl = condylocanine length;
- cw = cranial width;
- E = length of ear;
- Fa = length of forearm;
- F & Cl = length of foot and claw;
- iw = least interorbital width;
- l = greatest length of skull;
- m<sup>3</sup>-m<sup>3</sup> = distance between outer surface of third upper molars;
- ml = mandibular length;
- mtr = length of maxillary tooth-row;
- Tb = length of tibia;

TI = length of tail;  
 zw = zygomatic width.

### SYSTEMATIC ACCOUNT

Order CHIROPTERA

Family PTEROPODIDAE

#### *Megaerops niphanae* Yenbutra & Felten, 1983 (Niphan's Fruit Bat)

1983. *Megaerops niphanae* Yenbutra & Felten, *Senckenberg Biol.* 64 : 2 (Thailand).

*Material examined* Nagaland Kohima district 1♂, 2♀ Kohima, 7.iv.1998; 2♂ : Dimapur, 5.iv.1998. Mokokchung district 2♂, 2♀ Mokokchung, 14.xi.1997, 3.iv.1997, coll. J. P. Srivastava.

*Measurements* External : 2♂ : Fa 59.0, 60.2; E 18.0, 18.4; Tb 22.5, 24.2; F & CI 12.5, 13.5. 2♀ Fa 60.0, 61.2; E 17.9, 18.1; Tb 12.8, 13.0; F & CI 13.0, 13.5. Cranial 1♂, 1♀ l 28.1, 28.8; ccl 23.9, 25; mtr 9.0, 9.1; c'-c' 5.5, 5.6; iw 5.3, 5.8; cw 12.1, 12.3; zw 17.9, 18.2; m<sup>1</sup>-m<sup>2</sup> 8.4, 8.5; ml 20.6, 21.0.

*Distribution* : Within the Indian limits, *Megaerops niphanae* is known only from Pashok (Darjeeling district, West Bengal, India). Mandal *et al.* (1993 & 1997) recorded it from Manipur and Mizoram respectively. The present specimens, therefore, constitute the first record of this species from Nagaland.

Family EMBALLONURIDAE

#### *Taphozous longimanus longimanus* Hardwicke, 1825 (Long-armed Sheath-tailed Bat)

1825. *Taphoyous longimanus* Hardwicke, *Trans. Linn. Soc. London*, 14 : 525, Calcutta, Bengal, India.

*Material examined* Nagaland Kohima district : 1♂ Dimapur, 24.ix.1996, coll. J. P. Srivastava.

*Measurements* External 1♂ Fa 58.5; TI 11.5; E 12.1, Tb 25.0; F & CI 11.8. Cranial : 1♂ : l 20.9; c'-c' 4.8; iw 5.8; cw 10.5; zw 12.7; m<sup>1</sup>-m<sup>2</sup> 8.5; ml 15.5.

*Distribution* This species is widely distributed in the Indian peninsula; northwards to Gujarat and Rajasthan on the west and West Bengal, Assam (Sinha 1996) and Tripura on the east. Hence, the specimen constitutes the first authentic record of this species from Nagaland.

Family MEGADERMATIDAE

#### *Megaderma lyra lyra* Geoffroy, 1810 (Indian False Vampire)

1810. *Megaderma lyra* E. Geoffroy, *Ann. Mus. Hist. nat. Paris*, 15 : 190 (India, probably Madras, Madras district, Tamil Nadu).

**Material examined** : Nagaland : Kohima district : 2♂; 1♀ : Kohima, 22.iii.1997; 2♀ : Dimapur, 22.ix.1996; coll. J. P. Srivastava.

**Measurements** : External : 1♂, 1♀ : Fa 63.0, 62.0; E 37.0, 36.0; Tr 16.2, 16.4; Tb 33.0, 34.0; F & Cl 20.2, 19.5. Cranial : 1♂, 1♀ : l 29.2, 28.9; mtr 11.6, 11.0; c'-c' 5.5, 5.3; iw 5.2, 5.0; cw 12.5, 12.4; zw 16.2, 16.1; m<sup>3</sup>-m<sup>3</sup> 10.3, 10.1; ml 19.7, 19.2

**Distribution** : This species is widely distributed throughout Indian mainland from Jammu & Kashmir to Cape Comorin and from Gujarat to Assam (Hinton & Lindsay 1926) and Arunachal Pradesh (Chakraborty & Sen 1991; Sinha 1999). The present specimens, therefore constitute the first authentic record of this species from Nagaland.

Family : RHINOLOPHIDAE

***Rhinolophus lepidus lepidus*** Blyth, 1844 (Little Indian Horse-shoe Bat)

1844. *Rhinolophus lepidus* Blyth. *J. Asiat. Soc. Beng.*, 13 : 486 (Vicinity of Calcutta, West Bengal, India).

**Material examined** : Nagaland : Wokha district : 1♂ : Wokha, 25.ix.1996, coll. J. P. Srivastava.

**Measurements** : External : 1♂ : Fa 38.2; E 14.7; Tb 16.0; F & Cl 7.5; Cranial 1♂ : l 16.0; ccl 13.8; mtr 6.0; c'-c' 3.9; iw 2.3; cw 6.5; zw 7.9; m<sup>3</sup>-m<sup>3</sup> 5.3; ml 10.0.

**Distribution** : In India, *Rhinolophus lepidus lepidus* has been recorded from Delhi, Rajasthan, Uttar Pradesh, Madhya Pradesh, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Orissa, Bihar, West Bengal, Assam (Kurup 1968), Meghalaya and Mizoram (Mandal *et al.* 1997). The present specimens thus constitute the first authentic record of this species from Nagaland.

Family : VESPERTILIONIDAE

***Pipistrellus dormeri*** (Dobson, 1875) (Dormer's Bat)

1875. *Scotozous dormeri* Dobson, *Proc. zool. Soc. Lond.*, 373 (Bellary Hills, Bellary district, Karnataka, India).

**Material examined** : Nagaland : Kohima district : 1♂ : Kohima, 23.iii.1997, coll. J. P. Srivastava.

**Measurements** : External : 1♂ : Fa 35.6; E 11.9; Tb 13.8; F & Cl 8.3. Cranial : 1♂ : l 14.6; mtr 5.4; c'-c' 4.8; iw 4.3; cw 8.2; zw 9.8; m<sup>3</sup>-m<sup>3</sup> 7.1; ml 10.1.

**Distribution** : Within the Indian limits, this species is known to be widely distributed from Jammu & Kashmir south at least to Karnataka and from Gujarat east to West Bengal and very recently from Meghalaya (Sinha 1995), Manipur and Mizoram (Mandal *et al.* in press). This specimen therefore constitute the first authentic record of this species from Nagaland.

### SUMMARY

Five species of bats namely, *Megaerops niphanae*, *Taphozous longimanus longimanus*, *Megaderma lyra lyra*, *Rhinolophus lepidus lepidus*, *Pipistrellus dormeri* have been recorded for the first time from Nagaland, India. Their collection locality, measurements and distribution in India have been given.

### ACKNOWLEDGEMENTS

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## DESCRIPTION OF TWO NEW SPECIES OF TERMITES (ISOPTERA : INSECTA) FROM ASSAM, INDIA

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### INTRODUCTION

While studying a small collection of termites from Assam made recently by one of us (PKM), two new species, namely, *Neotermes assamensis* and *Bulbitermes bulbiceps* have been recognised and described here. The genus *Neotermes* is represented by 32 species in India (Roonwal and Chhotani, 1987). The genus *Bulbitermes* was unknown in India till Maiti (1977) reported its occurrence in the sub-Himalayan West Bengal with description of *B. emersoni* Maiti which was also recorded from Bhutan by Roonwal and Chhotani (1977). One more species of this genus is described here from Assam.

### MATERIALS AND METHODS

The study is based on the termite material collected by the senior author during a field trip to Assam in 1985. The material preserved in 70 per cent alcohol was studied under a Binocular Microscope and the diagrams are drawn with help of a Camera lucida.

### SYSTEMATIC ACCOUNT

Family : KALOTERMITIDAE

Subfamily : KALOTERMITINAE

*Neotermes assamensis* sp. nov.

(Fig. 1, A-C)

1. *Imago* : Unknown.

2. *Soldier* (Fig. 1, A-B) : Head chestnut brown, darker anteriorly; mandibles black, paler towards condyle; antennae and labrum light brown; pronotum, legs and abdomen comparatively more hairy. Body length, ca. 12.00-13.15 mm.

Head-capsule rectangular, head width slightly more than half the head length, lateral sides sub-parallel, frons distinctly sloping anteriorly. Eyes whitish, elongately rectangular to somewhat oval and separated from antennal socket by slightly more than its maximum width. Y-suture indistinctly marked. Ocelli absent. Antennae with 15 segments, 3rd segment somewhat more chitinised, slightly

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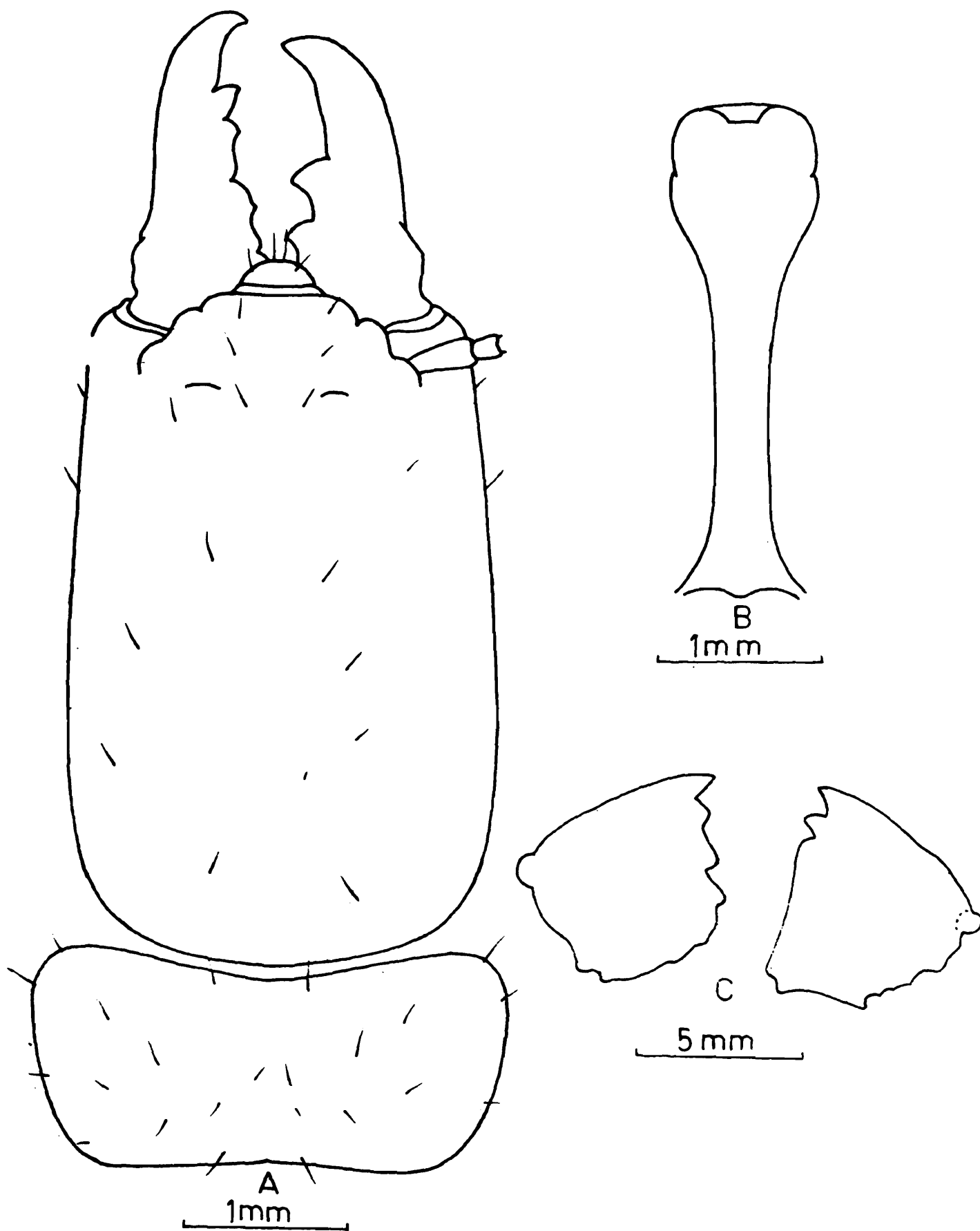
\* Emeritus Scientist. Z. S. I., Calcutta

longer than 2nd and much more longer than 4th. Anteclypeus strip like. Postclypeus much broader than long. Labrum somewhat dome-shaped, much wider than long, with a few erect hairs apically. Mandibles stout with bluntly incurved apices and almost half the head length; left mandible with 5 marginal teeth, 1st marginal blunt, directed upwards, 2nd blunt and much shorter than 1st, 3rd smaller and placed much below the second, margin in between them broadly concave, 4th indistinct and separated from the 3rd with a deep cut margin, 5th prominent and highly raised. Right mandible with 2 large marginal teeth, 1st directed laterally with weakly incurved posterior margin; 2nd directed slightly downwards with long incurved posterior margin. Postmentum long and club-shaped, anterior broader portion with a weak lateral notch, anterior lobe narrower than the posterior lobe and subquarish in shape and two and a half times broader than the minimum width, anterior margin straight and posterior margin concave.

Pronotum somewhat rectangular, slightly wider than head, anterior margin deeply concave and devoid of any median notch, lateral margin distinctly outcurved, posterior margin substraight or weakly incurved medially, entire margins with some scattered hairs and on disc fewer. Legs slender and hairy, tibial spur formula 3 3 3; tarsi four jointed. Cerci short with two segments.

**Table 1** - Measurements (in mm) and indices of *Neotermes assamensis*, Soldier caste.

Body parts	Range (6 examples)	Holotypes
Total body-length (excluding antennae)	12.00-13.15	12.50
Length of head to lateral base of mandibles	3.26-4.14	4.03
Max. width of head-capsule	2.11-2.73	2.73
Max. height of head-capsule	1.73-2.23	2.11
Head index (Width/Length)	0.64-0.68	0.67
Max. length of labrum	0.19-0.26	0.19
Max. width of labrum	0.46-0.62	0.46
Max. diameter of eye	0.23-0.28	0.24
Min. diameter of eye	0.11-0.16	0.14
Min. eye-antennal distance	0.15-0.19	
Length of left mandible	1.65-2.00	1.84
Head-mandibular length index (Left mandible length/Head-Length)	0.46-0.54	0.45
Min. median length of postmentum	2.30-3.07	3.00
Max. width of postmentum	0.76-0.96	0.92
Width of postmentum at waist	0.22-0.42	0.38
Max. length of pronotum	1.00-1.42	1.26
Max. width of pronotum	2.55-2.87	2.73
Pronotum index (Length/Width)		
Number of antennal segments	15	15



**Fig. 1. A-C.** *Neotermes assamensis* sp. nov. A. Head and pronotum in dorsal view (Soldier); B. Postmentum (Soldier); C. Mandibles (Worker).

*Pseudoworker* Head, pronotum and abdomen yellowish white; labrum, clypeus and antennae slightly darker. Body length 9.46-10.20 mm. Head as long as broad, subround and sparsely hairy. Labrum broader than long. Anteclypeus trapizoidal and whitish. Labrum subsquarish, broader than long, with a few hairs at the tip. Mandibles of typical *Neotermes* type. Eyes visible only under strong light. Ocelli absent. Pronotum subrectangularish, slightly wider than head.

**Table 2** - Measurements (in mm) and indices of *Neotermes assamensis* Pseudoworker caste.

Body parts	Range
Length of head to lateral base of mandible	1.61-1.76
Max. width of head	1.76-2.03
Max. length of labrum	0.38-0.42
Max. width of labrum	0.69-0.76
Max. length of pronotum	1.11-1.34
Max. width of pronotum	2.19-2.30

*Material* Holotype A soldier (ZSI Reg. No. 3188/H11), in a vial, in spirit, Dibrugarh, Assam, India, collector P. K. Maiti, 23rd Feb., 1985, ex. 'felled log'; deposited in the National Zoological Collection, Zoological Survey of India (Z. S. I.), Calcutta.

*Paratype* (i) *Paratype* One soldier and paramorphotype five pseudoworkers (ZSI Reg. No. 3189/H11) from the holotype lot and with same data deposited in ZSI, Calcutta. (ii) *Paratype* : one soldier and *Paramorphotype* five pseudoworkers (ZSI Reg. No. 3190/H11) from Sibsagar, Maranhat, Assam, India, collector P. K. Maiti and R. K. Ajmi, 23rd Feb., 1985, ex. 'Gura patta tree'; deposited in Forest Research Insititute, Dehra Dun.

*Distribution* Dibrugarh, and Sibsagar (Maranhat), Assam, India. Known from the type-localities only.

*Comparison* *Neotermes assamensis* sp. nov. is very close to *N. bosei* Snyder from the northern India and *N. megaoculatus megaoculatus* Roonwal and Sen-Sarma from Assam, but differs from them as follows

From *N. bosei* (i) Mandibles comparatively short, robust, with somewhat blunt apices; teeth more prominent and stout; angle between 1st and 2nd marginal tooth on left mandible less than right angle, wider gap between 3rd and 4th. anterior margin of 1st marginal tooth of right mandible somewhat convex and directed laterally (vs. mandible comparatively elongated, thin and teeth not much prominent; angle between 1st and 2nd marginal teeth of left mandible more than right angle, gap between 3rd and 4th very narrow; 1st tooth or right mandible placed much below the apex; its anterior margin substraight or concave, tooth directed downwards); (ii) Antero-lateral corner of head not prominent (vs. antero-lateral corners of head very much prominent); (iii) Eyes placed close to antennal socket, eye-antennal distance 0.15-0.19 mm (vs. eyes placed slightly below the antennal base, eye-antennal distance 0.18-0.25 mm and (iv) Posterior margin of pronotum with weak median emargination (vs. posterior margin of pronotum without any median emargination).

From *N. megaoculatus* : (i) Eyes of moderate size, max. diameter 0.23-0.28 mm and placed slightly below the antennal socket, distance 0.15-0.19 mm (vs. eyes of larger in size, max. diameter 0.30-0.42 mm min. diameter - nil and placed much below the antennal socket, distance 0.30-0.36 mm); (ii) Left mandible with its 3rd marginal teeth prominent and always present (vs. left mandible with its 3rd marginal teeth small or sometimes absent); (iii) Anterior lobe of postmentum narrower than posterior lobe (vs. anterior lobe subequal or wider) and (iv) 3rd antennal segment shorter than 2nd (vs. 3rd antennal segment longer than 2nd).

Family : TERMITIDAE

Subfamily NASUTITERMITINAE

*Bulbitermes bulbiceps*, sp. nov.

(Fig. 2, A-C)

1. *Imago* : Unknown.

2. *Soldier* (Fig. 2, A-B) : Head-capsule straw yellow, light brown at the level of constriction of head and dark brown at the apex of rostrum; antennae, pronotum, abdomen and legs straw yellow; antennae darker. Head dorsum with a few minute hairs, along with a pair of erect hairs posteriorly. Body-length, ca. 2.90-3.15 mm.

Head-capsule excluding rostrum pear-shaped, with moderate constriction behind the bases of antennae; basal third fairly bulging out laterally; less than twice as broad at the widest point as on constriction; posterior margin broadly rounded with a very weak median emargination; in profile, dorsal margin weakly depressed; posterior bulge of head moderate. Rostrum somewhat cylindrical, a little longer than half the head-length without rostrum; basal hump weakly marked with a pair of erect hairs on it and a few at the tip of the rostrum. Fontanelle gland and tube prominent. Antennae with 12 segments, 3rd segment longer than 2nd and slightly smaller or subequal to 4th. Labrum small, broader than long, anterior margin weakly convex and provided with minute hairs. Mandible without any apical process or tooth, molar plate with irregular margin. Postmentum as broad as long, lateral margins subparallel upto a little above the middle and then converging anteriorly, anterior margin substraight.

Pronotum saddle-shaped, width more than double the length and less than width of head, anterior margin weakly raised without any median notch, posterior margin convex.

**Table 3** - Measurements (in mm) and indices of *Neotermes assamensis*, Soldier caste.

Body parts	Range (6 examples)	Holotypes
Total body-length (without antennae)	2.90-3.15	2.90
Total length of head with rostrum	1.10-1.26	1.26
Total length of head without rostrum	0.76-0.80	0.80
Total length of rostrum	0.42-0.46	0.46

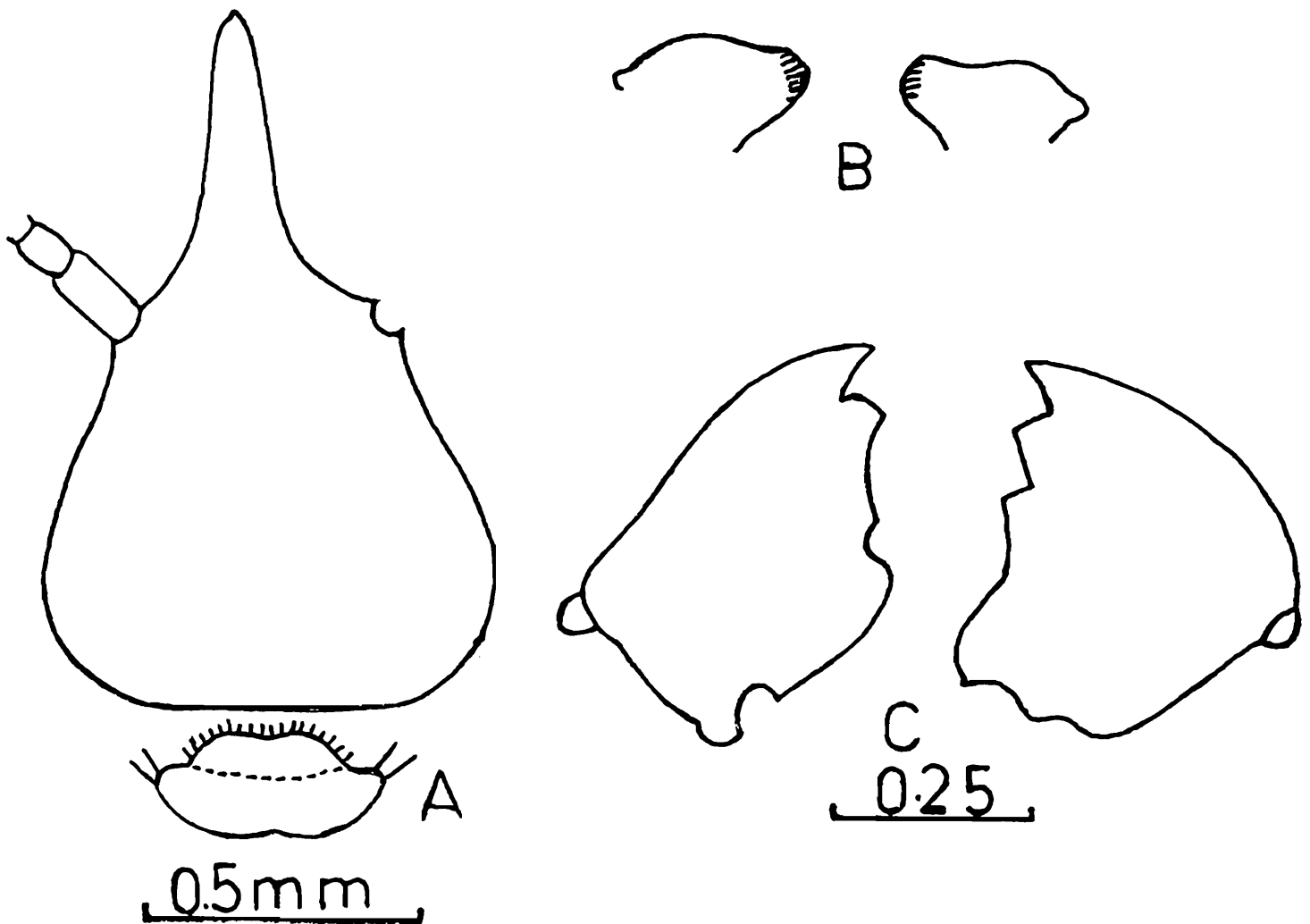


Fig. 2. A-C. *Bulbitermes bulbiceps* sp. nov. A. Head and pronotum in dorsal view (Soldier); B. Mandible (Soldier); C. Mandibles (Worker).

Body parts	Range (6 examples)	Holotypes
Max. width of head	0.73-0.80	0.80
Min. width (at constriction behind the antennae) of head	0.43-0.48	0.48
Posterior bulge of head	0.26-0.34	0.34
Max. height of head	0.46-0.54	0.54
Rostrum-head index I (rostrum-length/head-length without rostrum)	0.55-0.57	0.57
Head bulge Index (Posterior head-bulge/head-length without rostrum)	0.34-0.42	0.42
Head contraction Index (min. head width/max. head-width)	0.58-0.60	0.60
Head index I (max. width/length without rostrum)	0.96-1.00	1.00
Max. (median) length of postmentum	0.18-0.21	0.21
Max. width of postmentum	0.24-0.26	0.24
Max. width of pronotum	0.30-0.34	0.34
Length of pronotum	0.11-0.12	0.11
Pronotum index (length/width)		
No. of antennal segments	12	12

**Worker** : Head pale yellow to fuscus brown, with brownish extremities; labrum and antennae paler than head; legs, thorax and abdomen whitish. Head thorax and abdomen fairly pilose. Body length, ca. 3.00-4.10 mm.

Head globose, broader than long. Antennae with 14 segments; segment 1 longest, stout and cylindrical, 2 longer than 3 and 4 smallest. Postclypeus divided into two equal halves by a median suture. Labrum broader than long, pilose, anterior margin convex. Left mandible with an apical and two marginal teeth, apical a little shorter than first marginal; the latter well developed and posterior margin longer than the anterior one; 2nd marginal small, right mandible also with an apical and two marginal teeth; apical pointed, conical and subequal to first marginal, the latter close to apical; 2nd marginal small with long posterior margin; molar plate stout and serrated.

Pronotum saddle-shaped, pilose, much narrower than head width, anterior lobe and posterior margin with weak median emargination, tibial spur formula 2 : 2 : 2; tarsi four-segmented; abdominal tergites sparsely and sternites fairly pilose; cersi two segmented.

**Table 4** - Measurements (in mm) and indices of *Bulbitermes bulbiceps*, worker caste.

Body parts	Range
Length of head to lateral base of mandible	0.70-0.75
Max. width of head	0.88-0.92

Body parts	Range
Max. length of postclypeus	0.16-0.20
Max. width of postclypeus	0.34-0.38
Max. length of labrum	0.13-0.15
Max. width of labrum	0.34-0.38
Max. length of pronotum	0.14-0.16
Max. width of pronotum	0.46-0.50

*Type Material* *Holotype* A soldier (ZSI Reg. No. /H11), in a vial, in spirit, ca, 20 km. S. W. of Jorhat towards Colaghat, Jorhat District, Assam, India, collector P. K. Maiti (No. A4/1-3.85), 2 March 1985, ex. 'log lying on the ground'; deposited in the National Zoological Collection, Zoological Survey of India (Z.S.I.) Calcutta.

*Paratype* *Paratype* : soldiers and Paramorphotype workers, all from the holotype-lot and with same data, deposited as follows (i) 11 soldiers and 4 workers in a vial (ZSI Reg. No.) in ZSI. (ii) 2 soldiers and 2 workers in Forest Research Institute, Dehra Dun.

*Distribution* Known only from the type-locality.

*Comparison* *Bulbitermes bulbiceps* sp. nov. belongs to a group of *Bulbitermes* species, namely, *B. laticephalus* Ahmad, *B. deltocephalus* Tsai and Chen, *B. emersoni* Maiti and *B. flavicans* holmagren, which are characterised by having mandibles without any apical spine-like processes. However, the species differs from them as follows :

1 From *B. flavicans* (i) Rostrum subconical (vs., rostrum cylindrical in *B. flavicans*); (ii) Hump at the base of nasus either indistinct or absent (vs., hump present); (iii) Dorsal profile of head almost straight (vs., dorsal profile of head concave).

2. From *B. laticephalus* (i) Rostrum subconical, rostrum head index (rostrum-length/head-length) 0.55-0.57. (vs., rostrum weakly conical, rostrum-head index 0.46 in *B. laticephalus*); (ii) Head laterally less bulging out (vs., head laterally more bulging out).

3. From *B. deltocephalus* (i) Head less prominently bulging out laterally, head-width 0.73-0.80 mm (vs., head more prominently bulging out, head-width 0.97-1.11 mm. in *B. deltocephalus*); (ii) Smaller species, head length with rostrum, 1.19-1.26 mm. (vs., larger species, head length with rostrum 1.53-1.64 mm.).

4. From *B. emersoni* (i) Rostrum sub-conical (vs., rostrum conical in *B. emersoni*); (ii) Head less constricted, head contraction index 0.64-0.66); (iii) Posterior margin of head with prominent median emargination (vs., posterior margin without any emargination); (iv) Basal hump of rostrum indistinct (vs., basal hump somewhat distinct).

### SUMMARY

The paper deals with the illustrated description of two new species of termites, namely, *Neotermes assamensis* sp. nov. and *Bulbitermes bulbiceps* sp. nov. from Assam based on the characteristic features of soldier and worker castes.

### ACKNOWLEDGEMENTS

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## **IMPACT OF OIL SPILL ON AQUATIC FAUNA AT HALDIA**

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### **INTRODUCTION**

The occurrence of oil spills in the major ports of the world and oil spill identification are well known problems. The literature on the problems of oil pollution in the marine environment and its effect on the fauna and flora has been summarised by Ferguson Wood and Johannes (1975). The impact of oil spills on animal life requires exhaustive investigations (Blumer, 1957; Englington, *et al.*, 1975).

To study the effects of oil spills occurring at Haldia Port caused during transportation of oil from oil tanker in May, 1996, a survey was undertaken by a team of scientists of the Zoological Survey of India, Calcutta, in August, 1996.

Our objective was to determine the impact of oil spill on the population density in the polluted and non-polluted areas.

### **STUDY AREA**

The team surveyed the intertidal areas in and around Haldia Port i. e., Oil jetty, Passenger jetty, Patikhali, Nayachar and Roychak for faunal collection and Physio-chemical analysis.

### **MATERIAL AND METHODS**

Water samples and plankton samples (high tide and low tide) were collected at three points - Tug jetty, mid-channel and northern bank of Nayachar Island in the Hooghly estuarine stretch in a cross-section manner.

(a) *Physio-chemical estimation* Salinity and pH of the aquatic medium were analysed by means of refractometer and pH meter respectively. Temperature of the surface water was measured by Celsius thermometer. The water for heavy metal analysis was passed through a 0.45µm Millipore membrane and the filtered water was treated with diethyl-dithiocarbamate and extracted in  $\text{CCl}_4$ . The extract was evaporated to dryness and the residue was mineralized with 0.1 ml of conc.  $\text{HNO}_3$ . Analytic blanks were treated with same reagent. The results obtained were expressed in  $\mu\text{g l}^{-1}$ . For analysing nutrients in water i.e.,  $\text{NO}_3\text{-N}$ ,  $\text{PO}_4\text{-P}$  and  $\text{SiO}_4\text{-Si}$ , water samples were processed and their absorbances were measured as per standard method (Spelleberg, 1991). For estimating heavy metals in animal tissue, the soft tissue portions of the barnacle and fish after

being treated with metal free double distilled water were oven-dried at 110°C overnight. 1 gm of each sample was digested with conc. HNO<sub>3</sub> and the resulting solution was analysed through AAS along with a simultaneous blank analysis. The results obtained were expressed in µg gm<sup>-1</sup>.

(b) *Plankton collection* Zooplankton samples were collected from the ambient aquatic medium by means of Nansen type plankton net made of bolting silk with 60 meshes per linear centimetre. Collected zooplankton samples after washing by water and filtering were preserved in 4% formalin.

(c) *Intertidal faunal collection* Animal communities inhabit the intertidal zone, i.e., between highest high tide mark and lowest low tide mark on that particular day, were collected. The collected specimens were washed properly and narcotised and afterwards transferred to 5% formalin.

(d) *Physico-chemical analysis* Water samples were analysed for nutrients (NO<sub>3</sub>, PO<sub>4</sub> and SiO<sub>4</sub>), Salinity, pH and dissolved heavy metals (Zn, Mn, Fe, Ni and Pb). Trace metals were analysed because crude oil is a complex mixture of hydrocarbons and some metals.

The entire network of present study involved *in situ* analysis of salinity (by mean of refractometer) and pH with a portable pH meter. Concentrations of nitrate, phosphate and silicate in the ambient aquatic medium were also analysed *in situ* with a colorimeter. Water samples collected in clean tarson bottles were sent to the Susama Devichoudhurani Marine Biological Institute for analysis of trace metals. Soft parts of fish and barnacle were also sent to the same institute for analysis by AAS for checking bio-accumulation of heavy metals.

## RESULTS

The results of the analysis are given in Table 1. Salinity and pH of the surface water showed direct relationship among themselves. No interrelationship was found among the nutrients (nitrate, phosphate and silicate). The high phosphate concentration in the present investigation near Tug jetty might be correlated to its proximity of fertilizer factory. Phosphate is an essential and important nutrient for the growth of phytoplankton and other estuarine plants, but its presence above the critical value results in the increased growth of nuisance algae.

In the domain of conservative pollutants the dissolved metals were found to be present in the following descending order Fe, Mn, Zn, Cu, Pb, Ni. In the low tide samples the concentrations of dissolved metals showed an increase in comparison to high tide samples (Table 1). This might be due to the effect of relatively low salinity and pH during low tide that favours the process of dissolution of metals from the sediment bed to the water column.

In barnacle, *Balanus amphitrite* Darwin and fish, *Nibea soldado* (Lacepede) accumulation of heavy metals in the soft parts of the body is shown in Table 2.

### *Faunal composition in and around Haldia*

In the intertidal area in and around Haldia Port, i.e., Oil jetty, Passenger jetty, Patikhali and Nayachar the macro-faunal components are mainly Annelida, Arthropoda, Mollusca and Pisces, as listed below.

- Phylum Annelida  
 Class Polychaeta  
 1. *Dendronereides heteropoda* Southern  
 2. *Dendronereis aestuarina* Southern  
 3. *Mastobranchus* sp.
- Phylum Arthropoda  
 Class Crustacea  
 Subclass Cirripedia  
 Order Thoracica  
 1. *Balanus amphitrite* Darwin
- Subclass Malacostraca  
 Order Decapoda  
 1. *Metaplex distincta* H. M. Edwards  
 2. *Metaplex dentipes* (Heller)  
 3. *Macrophthalmus transversus* (Latreille)  
 4. *Macrophthalmus depressus* Ruppell
- Phylum Mollusca  
 Class Gastropoda  
 Order Archaeogastropoda  
 1. *Neritina violacea* (Gmelin)
- Order Mesogastropoda  
 2. *Stenothyra deltae* (Benson)  
 3. *Assiminea brevicula* (Pfeiffer)  
 4. *Thiara scabra* (Müller)
- Order Basommatophora  
 5. *Melampus pulchella* Petit
- Order Soleolifera  
 6. *Onchidium typhae* Buchanan
- Class Bivalvia  
 Order Arcoida  
 1. *Polymesoda bengalensis* (Lamarck)
- Order Myoida  
 2. *Bactronophorus thoracites* (Gould)

- Phylum Chordata  
 Class Pisces  
 Order Perciformes  
 1. *Periophthalmodon schlosseri* (Pallas)  
 2. *Glossogobius giuris* (Ham.-Buch.)

*Prawn and Fish collected from fisherman's catch*

- Phylum Arthropoda  
 Class Crustacea  
 Subclass Malacostraca  
 Order Decapoda  
 1. *Palaemon* sp.  
 2. *Metapenaeus* sp.  
 3. *Exopalaemon* sp.  
 4. *Macrobrachium* sp.

- Phylum Chordata  
 Class Pisces  
 Order Clupeiformes  
 Family Engraulidae  
 1. *Setipinna tenuifilis* Valenciennes  
 2. *Thryssa hamiltoni* (Gray)

- Order Cypriniformes  
 Family Cyprinidae  
 3. *Puntius sophore* (Ham.-Buch.)  
 4. *Puntius ticto* (Ham.-Buch.)

- Order Siluriformes  
 Family Bagridae  
 5. *Mystus gulio* (Ham.-Buch.)  
 6. *Mystus vittatus* (Bloch)

- Order Perciformes  
 Family Centropomidae  
 7. *Lates calcarifer* (Bloch)

- Family Chandidae  
 8. *Chanda baculis* (Ham.-Buch.)  
 9. *Chanda nama* (Ham.-Buch.)

- Family Sciaenidae  
10. *Nibea soldado* (Lacepede)
- Family Mugilidae  
11. *Liza parsia* (Ham.-Buch.)
- Family Polynemidae  
12. *Eleutheronema tetradactylum* (Shaw)
- Family Gobiidae  
13. *Periophthalmus pearsei* Eggert  
14. *Glossogobius giuris* (Ham.-Buch.)
- Family Teraponidae  
15. *Terapon jarbua* (Forsk.)
- Family Eleotrididae  
16. *Eviota zonura* Jordan-Seale
- Order Pleuronectiformes
- Family Cynoglossidae  
17. *Cynoglossus lingua* (Ham.-Buch.)

#### *Planktonic components in and around Haldia*

In the plankton samples copepods are the most dominant group. Copepod population was followed by immature brachyurans and other crustacean larvae.

*Copepods* : A good assemblage of oligohaline forms, e.g., *Acartiella* sp., *Neodiaptomus* sp., *Pseudodiaptomus* sp., *Cyclops* sp. and *Mesocyclops* sp. were encountered.

*Other crustaceans* : Immature brachyurans conceivably represented the bulk of other crustaceans followed by nauplius and zoea stages.

Crustacean groups like Mysidacea, Cladocera, Ostracoda and non-crustaceans like Chaetognatha and Hydromedusae were totally absent.

#### *Faunal composition at Roychak*

In the intertidal area at Roychak the macro-faunal components were mainly Annelida, Arthropoda, Mollusca and Pisces.

- Phylum Annelida  
Class Polychaeta  
1. *Dendronereides gangeticus* Misra (in press)  
2. *Namalycastis fauveli* Rao

- Phylum Arthropoda  
 Class Crustacea  
 Subclass Malacostraca  
 Order Decapoda  
 1. *Metaplex intermedia* de Man  
 2. *Sesarma kraussi* de Man  
 3. *Tympanomerus stapletoni* de Man
- Phylum Mollusca  
 Class Gastropoda  
 Order Mesogastropoda  
 1. *Littorina melanostoma* Gray  
 2. *Assiminea brevicula* (Pfeiffer)  
 3. *Stenothyra blanfordiana* Nevill
- Phylum Chordata  
 Class Pisces  
 Order Perciformes  
 1. *Glossogobius giuris* (Ham.-Buch.)  
 2. *Periophthalmus vulgaris* Eggert

**Table 2** Concentration of heavy metals in the tissue sample of *Balanus amphitrite* Darwin

Tissue Zn	8683.29µg	gm <sup>-1</sup> dry weight
Tissue Cu	4682.10µg	gm <sup>-1</sup> dry weight
Tissue Mn	567.72µg	gm <sup>-1</sup> dry weight
Tissue Fe	6820.06µg	gm <sup>-1</sup> dry weight
Tissue Pb	19.85µg	gm <sup>-1</sup> dry weight

Concentration of heavy metals in the muscle of fish, *Nibea soldado* (Lacepede)

Zn	83.89µg	gm <sup>-1</sup> dry weight
Cu	15.48µg	gm <sup>-1</sup> dry weight
Pb	6.93µg	gm <sup>-1</sup> dry weight

**Table 1** : Variations of physio-chemical parameters and heavy metals during high tide and low tide in water samples collected from Haldia zone in August, 1996.

Parameter	Tug jetty		Mid-Channel		Nayachar Island-West Bank	
	High tide	Low tide	High tide	Low tide	High tide	Low tide
Zn ( $\mu\text{g l}^{-1}$ )	541.62	602.84	499.57	521.23	488.76	503.81
Cu ( $\mu\text{g l}^{-1}$ )	318.87	463.29	302.23	367.84	298.31	317.65
Mn ( $\mu\text{g l}^{-1}$ )	613.21	687.75	565.28	605.66	520.08	581.62
Fe ( $\mu\text{g l}^{-1}$ )	2024.85	2781.29	1937.70	2368.10	1673.21	2001.57
Ni ( $\mu\text{g l}^{-1}$ )	51.48	81.62	46.23	53.29	31.72	50.85
Pb ( $\mu\text{g l}^{-1}$ )	130.63	141.89	59.76	102.34	66.93	111.80
NO <sub>3</sub> ( $\mu\text{g l}^{-1}$ )	27.93	Not done	20.65	Not done	15.23	Not done
PO <sub>4</sub> ( $\mu\text{g l}^{-1}$ )	11.23	Not done	5.21	Not done	3.85	Not done
SiO <sub>4</sub> ( $\mu\text{g l}^{-1}$ )	120.83	Not done	89.75	Not done	63.83	Not done
Sur. water temp. ( $^{\circ}\text{C}$ )	31.3	30.9	30.2	30.0	31.0	31.0
Salinity (ppt)	0.42	0.20	0.35	0.10	0.46	0.21
pH	8.10	8.04	8.17	8.14	8.19	8.16
D. O. ( $\text{mg l}^{-1}$ )	6.32	5.97	6.97	5.83	6.36	5.98

**Table 3** : Concentration of dissolved Zinc (Zn) ( $\mu\text{g l}^{-1}$ ) in three stations along the Hooghly estuary from Jan., 95 to Dec., 96

	Station 1 (Chemaguri)		Station 2 (Nayachar Island)		Station 3 (Haldia Tug jetty)	
	High tide	Low tide	High tide	Low tide	High tide	Low tide
1995						
January	323.64	389.21	406.35	433.20	485.62	502.85
February	206.29	283.28	Not done	Not done	Not done	Not done
March	216.36	313.70	Not done	Not done	Not done	Not done
April	300.23	406.22	397.15	431.62	370.23	400.82
May	356.28	495.28	385.29	400.17	399.26	432.37

**Table 3** (Contd.)

	Station 1 (Chemaguri)		Station 2 (Nayachar Island)		Station 3 (Haldia Tug jetty)	
	High tide	Low tide	High tide	Low tide	High tide	Low tide
June	208.52	313.08	Not done	Not done	Not done	Not done
July	363.28	402.21	Not done	Not done	Not done	Not done
August	286.39	340.25	Not done	Not done	Not done	Not done
September	407.65	491.11	Not done	Not done	Not done	Not done
Ocotober	413.70	488.26	Not done	Not done	Not done	Not done
November	298.65	333.30	320.54	397.66	401.82	454.76
December	308.70	373.29	Not done	Not done	Not done	Not done
1996						
January	319.00	416.26	Not done	Not done	Not done	Not done
February	330.21	Not done	Not done	Not done	Not done	Not done
March	Not done	Not done	356.27	398.12	380.50	432.57
April	Not done	Not done	Not done	Not done	Not done	Not done
May	313.60	373.82	Not done	Not done	Not done	Not done
June	320.51	391.62	Not done	Not done	Not done	Not done
July	Not done	Not done	Not done	Not done	Not done	Not done
August	304.52	337.89	488.76	503.81	541.62	602.84
Sept. to Dec.	Not done	Not done	Not done	Not done	Not done	Not done

**Table 4** Concentration of dissolved Lead (Pb) ( $\mu\text{g l}^{-1}$ ) in three stations along the Hooghly estuary from Jan., 95 to Dec., 96

	Station 1 (Chemaguri)		Station 2 (Nayachar Island)		Station 3 (Haldia Tug jetty)	
	High tide	Low tide	High tide	Low tide	High tide	Low tide
1995						
January	3.96	5.13	15.82	21.36	39.28	46.23
February	6.00	7.19	11.23	17.85	34.84	41.35
March	9.33	13.66	13.08	19.66	37.28	46.20
April	5.00	11.23	10.00	14.65	29.85	33.64
May	4.32	7.19	16.28	21.80	Not done	Not done

**Table 4 : (Contd.)**

	Station 1 (Chemaguri)		Station 2 (Nayachar Island)		Station 3 (Haldia Tug jetty)	
	High tide	Low tide	High tide	Low tide	High tide	Low tide
June	4.00	6.38	Not done	Not done	Not done	Not done
July	13.33	17.20	Not done	Not done	Not done	Not done
August	14.38	20.70	Not done	Not done	Not done	Not done
September	11.85	16.20	20.60	29.32	50.35	57.83
October	9.23	13.85	16.45	19.88	48.11	53.54
November	8.11	12.44	Not done	Not done	Not done	Not done
Dec. 95 to Feb. 96	Not done	Not done	Not done	Not done	Not done	Not done
March	10.65	15.28	14.28	18.99	Not done	Not done
April	Not done	Not done	Not done	Not done	Not done	Not done
May	3.98	7.66	Not done	Not done	Not done	Not done
June	6.01	10.42	Not done	Not done	Not done	Not done
July	Not done	Not done	Not done	Not done	Not done	Not done
August	Not done	Not done	66.93	111.80	130.63	141.89
Sept. to Dec.	Not done	Not done	Not done	Not done	Not done	Not done

(Data of the Table 3 and 4 are taken from "Cybernetics and the biological world with special reference to coastal ecosystem" by A. Chowdhury & A. Mitra, pp. 48-52, In : The Living World, (Ed.) Sivaprasad Dasgupta, 1997).

**Table 5 : Metals in water ( $\mu\text{g l}^{-1}$ ) around Haldia**

Location	Tide	Cu	Fe	Cd	Pb
1	Low	0.86	25.9	0.21	0.08
2	High	0.67	29.3	0.21	0.19
3	Low	0.22	74.0	0.20	0.09
4	High	0.11	7.9	0.20	0.11

**Table 6** Variation of Temperature, pH, Salinity around Haldia

Season	Mean surface water temp (°C)	Mean pH	Mean Salinity (%)
Post-monsoon (Nov. to Feb.)	24.1	7.91	4.07
Monsoon (July to October)	31.7	7.23	1.04
Pre-monsoon (March to June)	32.3	8.12	9.17

(Data of Table 5 and 6 are taken from "Role of bio-chemical variables in the sedimentation of the Hooghly estuary, India" by K. Chakraborty, A. Mitra, T. Sanyal and A. Chowdhury, pp. 2089-2096, Seminar on International Coastal Zone Management, Halifax, Canada, 1994).

**Table 7** Mean metal concentrations (in  $\mu\text{g gm}^{-1}$  drywt.) in *Balanus balanoides* of Nayachar Island from March, 1993 to February, 1994 (Body part-Flesh)

Season	Zn	Cu	Mn	Fe	Pb	Cd
Pre-monsoon (Mar. to June)	5638.10	1987.94	185.67	3446.12	5.29	8.25
Monsoon (July to Oct.)	7031.84	3205.15	236.49	5298.46	12.62	14.72
Post-monsoon (Nov. to Feb.)	6876.24	2056.72	197.21	4981.75	8.86	9.11

Data of Table 7 is taken from "*Balanus balanoides* as an indicator of heavy metals" by A. Mitra, et. al., 1995, *Indian J. Environ. Hlth.*, Vol. 37, No. 1 42-45.

**Table 8** : Fish juveniles collected around Haldia during 1995

1. *Thryssa hamiltonii* (Gray)
2. *Rhinomugil corsula* (Ham.-Buch.)
3. *Mugil cephalus* Linnaeus
4. *Pisodonophis boro* (Ham.-Buch.)
5. *Liza parsia* (Ham.-Buch.)
6. *Eupleurogrammus glossodon* (Bleeker)
7. *Coilia* sp.
8. *Pseudorhombus* sp.
9. *Stolephorus* sp.
10. *Hilsa* sp.

(Data of Table 8 is collected from "Impact of mass collection of prawn seeds in Sundarban mangrove ecosystem" by S. D. Marine Biological Research Institute - Report submitted to Ministry of Environment & Forests, Zoological Survey of India, in 1996, Sanction No. J - 22014/93).

**Table 9** : Faunal composition reported from intertidal area in and around Haldia

Phylum	Annelida
Class	Polychaeta
	1. <i>Dendronereides heteropoda</i> Southern
	2. <i>Dendronereides gangetica</i> Misra (in press)
	3. <i>Dendronereis aestuarina</i> Southern
	4. <i>Goniada emerita</i> Audouin & M. Edwards
	5. <i>Mastobranchus</i> sp. (cf. <i>indicus</i> Southern)
	6. <i>Marphysa sanguinea</i> (Montagu)
	7. <i>Namalycastis fauveli</i> Rao
	8. <i>Namalycastis indica</i> (Southern)
	9. <i>Neanthes chingrighattensis</i> (Fauvel)
	10. <i>Neanthes meggitti</i> (Monro)
Phylum	Arthropoda
Class	Crustacea
Subclass	Cirripedia
Order	Thoracica
	<i>Balanus amphitrite</i> Darwin
Subclass	Malacostraca
Order	Decapoda
	1. <i>Metaplax distincta</i> H. M. Edwards
	2. <i>Metaplax dentipes</i> (Heller)
	3. <i>Macrophthalmus transversus</i> (Latreille)
	4. <i>Macrophthalmus depressus</i> Ruppell
	5. <i>Uca dussumieri spinata</i> Crane
	6. <i>Uca lactea annulipes</i> (Milne-Edwards)
	7. <i>Uca rosea</i> (Tweedie)
Phylum	Mollusca
Class	Gastropoda
	1. <i>Neritina violacea</i> (Gmelin)
	2. <i>Neritina smithi</i> Wood
	3. <i>Pseudonerita sulculosa</i> (von Martens)
	4. <i>Stenothyra deltae</i> (Benson)
	5. <i>Assiminea brevicula</i> (Pfeiffer)
	6. <i>Assiminea francesiae</i> (Wood)

7. *Thiara scabra* (Müller)
8. *Melampus pulchella* Petit
9. *Littorina scabra scabra* (Linnaeus)
10. *Larina burmana* Blanford
11. *Onchidium tenerum* Stoliczka
12. *Onchidium typhae* Buchannan

Class Bivalvia

1. *Polymesoda bengalensis* (Lamarck)
2. *Bactronophorus thoracites* (Gould)

Phylum Chordata

Class Pisces

1. *Sideria picta* (Ahl)
2. *Pisodonophis boro* (Ham.-Buch.)
3. *Periophthalmodon schlosseri* (Pallas)
4. *Periophthalmodon tredecemaradiatus* (Ham.-Buch.)
5. *Pseudapocryptes borneensis* (Bleeker)
6. *Scartelaos histophorus* (Valenciennes)
7. *Odontamblyopus rubicundus* (Ham.-Buch.)
8. *Trypauchenichthys typus* Bleeker

(Data of Table 9 is taken from "Hooghly Matla Estuary, West Bengal", Estuarine Ecosystem Series, Part 2, Zoological Survey of India, Calcutta, 1995, 542 pp.)

## DISCUSSION

A survey conducted in August, 1996 after the oil spill at Haldia revealed an increase in dissolved heavy metals in the water. These were analysed as crude oil is a complex mixture of hydrocarbons (of varying molecular weights) and various metals. In general, level of dissolved metals in the estuarine water becomes high during monsoon due to huge run off from adjacent industrial belt and also dissolved chemicals in the sediment beds. The abrupt rise of Zn, Fe, Cu, and Pb concentrations in August, 1996 as compared to that of the previous years (Table 3 & 4 for 1995 and 1996 and Table 5 for 1994) might be related to the recent oil spill at Haldia.

The bio-accumulation of metals in the body tissue of Crustacea, *Balanus amphitrite* Darwin, as sampled from the boulders and hard substrata and in the muscle of Fish, *Nibea soldado* as samples from fisherman's catch in the vicinity of Haldia Port-cum-industrial complex, also revealed high metal concentrations in the body. Previous data on concentration of heavy metals in *Balanus balanoides* is given in Table 7 but the same for the particular species of fish is not available.

Any environmental hazard has a direct impact on the biological diversity of the area. The influence may be directed towards the depletion of a large number of species from the affected area due to accumulation of toxic substances beyond their lethal doses of contamination of their food resources. In comparison to Table 9 the present survey showed the presence of less number of the phyla Annelida, Arthropoda, Mollusca (Gastropoda) and Chordata (Pisces). In class Polychaeta under phylum Annelida only 3 species were recorded after the oil spill against 10 species reported earlier from the area and Crustacea was represented by 5 species against 8 species reported earlier. The gastropods have a wide range of tolerance to environmental variables. Even then reduction in the species number of this faunal group during the present survey indicates a deterioration of their habitat. In Pisces 6 species particularly represented by their intertidal forms were not found in and around Haldia. The fact may explain that the effect of oil spill worked even in the secondary level of the ecosystem.

During the period of survey no shoot net for the collection of fish juveniles was found to be operated in the Haldia region although it was a very common practice as learnt from the local fishermen as well as information given in Table 8.

#### ACKNOWLEDGEMENTS

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## FIRST RECORD OF GENUS *NEODONTOCRYPTUS* UCHIDA FROM INDIA (HYMENOPTERA : ICHNEUMONIDAE)

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### INTRODUCTION

The genus *Neodontocryptus* Uchida belongs to the tribe Ishnini of the family Ichneumonidae. This genus is known from Taiwan and South-eastern China. Townes (1970 : 204) and Gupta (1987: 793), referred only one species, viz. *Odontocryptus brilliantus* Uchida, 1932 from Taiwan and China. Saxena (1978) described a new species viz. *Neodontocryptus hyalina* Saxena from India, Nepal and Indonesia. On examination of the type of *N. hyalina*, it was found that this is a synonym of *Chlorocryptus coeruleus* Cameron (New synonymy). This is the first record of this genus from India.

### Genus *Neodontocryptus* Uchida

1932. *Odontocryptus* Uchida, *Jour. Faculty Agr. Hokkaido Imp. Univ.*, **33** : 187, Name preoccupied by Saussure, 1890, by Cameron, 1903 and by Szepliget, 1961. Type : *Odontocryptus brilliantus* Uchida. Original designation.
1940. *Neodontocryptus* Uchida, *Insecta Matsumurana* **14** : 122. New name.
1970. *Neodontodryptus* Uchida : Townes, *Mem. Amer. Ent. Inst.*, **12** : 204. Syn., des.
1987. *Neodontocryptus* Uchida : Gupta, *Mem. Amer. Ent. Inst.*, **41** : 793. Syn.

Body stout. Clypeus moderately large, about 2x as long as wide, moderately convex, its apex truncate; clypeal foveae deep. Malarspace wide, about 1.0x as long as basal width of mandible (Fig. 1a). Mesoscutum polished with large, deep and scattered punctures, notauli deep and very short. Upper margin of pronotum in front of notauli strongly swollen like tubercles. Mesopleurum divided into upper and lower halves by a moderately deep and broad groove, groove with strong vertical ridges (Fig. 1b). Propodeal spiracle slit-like, about 4x as long as wide, basal carina of propodeum not defined. First tergite stout, with basal lateral tooth, dorso-median carinae weak or absent, ventro-lateral carinae opposite to spiracle, expended like a triangular tooth in male, in female not seen (Fig. 1c). Second tergite polished, strongly convex and broad, its punctures in both sexes rather large, deep and separated by 1-4x their diameter. Ovipositor sheath about 1.1x as long as hind tibia. Ovipositor weakly compressed, its tip long and without nodules (Fig. 1e). Wing venation as shown in fig. 1d.

*Length* : Female and male about 12 mm.

*Type-species* : *Odontocryptus brilliantus* Uchida, 1932

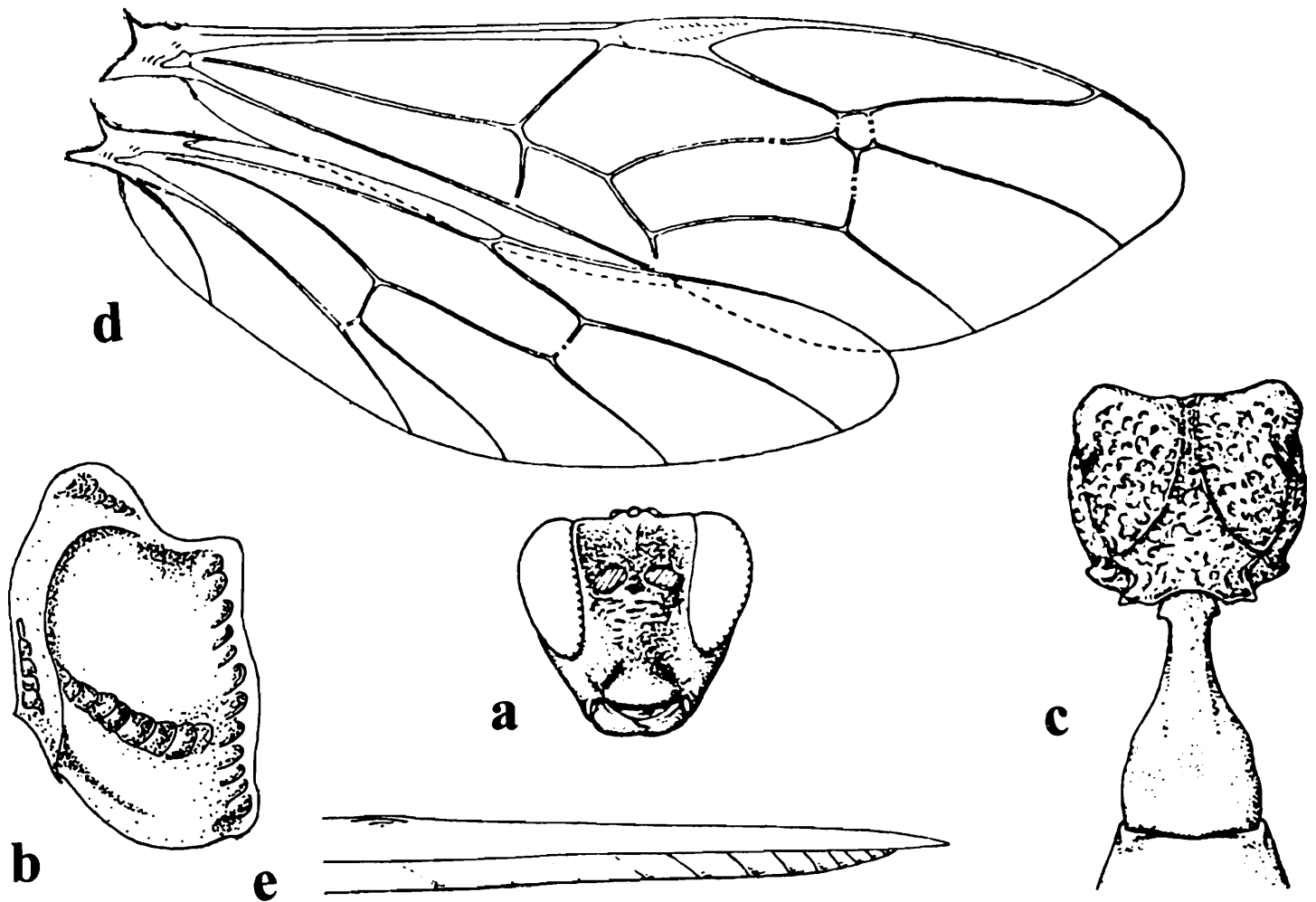


Fig. 1. *Neodontocryptus Uchida* : a. front view of head; b. mesopleurum; c. dorsal view of propodeum and first tergite; d. wing venation of fore and hind wings; e. ovipositor tip (after Townes, 1970).

### *Neodontocryptus brilliantus* (Uchida)

1932. *Odontocryptus brilliantus* Uchida, *Jour. Faculty. Agr. Hokkaido Imp. Univ.* **33** : 186. Female, des., fig. type : Female. Taiwan : Suisharyo (Eberswalde Museum).
1940. *Neodontocryptus brilliantus* : Uchida, *Insecta Matsumurana*, **14** : 122. China, Taiwan.
1970. *Neodontocryptus brilliantus* (Uchida) : Townes, *Mem. Amer. Ent. Inst.*, **12** : 204. Taiwan, S. E. China.
1987. *Neodontocryptus brilliantus* (Uchida) : Gupta, *Mem. Amer. ent. Inst.* **41** : 793. Syn.

This species is known by its female. The male of this species has been discovered for the first time which is described below.

*Male* Body polished, metallic blue in colour, wings hyaline dark brown. Face largely finely punctate, strongly rough and trans-rugose in the middle. Clypeus minutely and moderately closely punctate, besides these minute punctures a few scattered large punctures also present. Malarspace with minute and closely placed punctures. Frons moderately shallow, smooth and polished. Vertex and temple more or less smooth and polished, except for a few scattered small punctures. Mandible with minute close punctures, a few large punctures also present. Pronotum along the posterior margin with short strong ridges, its upper margin with large deep punctures, middle area with minute sparse punctures. Scutellum with small sized scattered punctures, its lateral carina not

extending more than 0.3. Metascutellum in the form of two lateral tubercles. Upper lobes of mesopleurum largely smooth and shiny, except for a few large deep punctures near subtegular ridge, middle groove strongly striate, lower lobe with large deep and sparse punctures. Metapleurum with large deep punctures, juxtacoxal carina strong. Propodeum between apical carina and base with very large, deep, close to moderately spaced punctures, at sides appears to be reticulate, apical of apical carina reticulo-winkled and with a median longitudinal carina, apophyses strong and tuberculate, below the apophyses additional pair of strong tubercles present. First tergite with moderately large, close to moderately spaced punctures, ventral longitudinal carina with a flange-like tooth below spiracle. Second and third tergites with small to moderate sized punctures, punctures close to dense at apex, sparse towards the base, second and third tergites large by shield-shaped, following tergites short and somewhat retracted, seventh tergite at apex with a fringe of thick bristles.

*Female* : Not seen. Body structure similar to male and as detailed under generic description.

*Length* : Male, about 13 mm. Fore wing 11 mm.

*Specimen examined* : 1 Male, INDIA : MEGHALAYA : Above Tura in Garo Hills (formerly Assam), 1000-1115 m, 15.vii-30.viii.1917 coll. S. Kemp. (Z. S. I., Calcutta).

*Distribution* : India : Meghalaya. Taiwan, South-eastern China.

### SUMMARY

The genus *Neodontocryptus* Uchida has been recorded for the first time from India. This genus was previously known from Taiwan and southern China. A detailed description of the male of the only known species viz. *N. brilliantus* Uchida, which was known by its female, has been given.

### ACKNOWLEDGEMENT

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## NEMATODES FROM RAJASTHAN. II. SIX NEW RECORDS OF ORDER DORYLAIMIDA FROM INDIA

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### INTRODUCTION

During the years 1993-1998, a number of faunistic surveys were conducted by the scientists of Desert Regional Station, Zoological Survey of India, Jodhpur in districts of Rajasthan State. These scientists have brought many soil samples from around roots of economically important agricultural crops for the study of phytophagous, predaceous and saprophagous nematodes. These soil samples have yielded a wide variety of nematodes and thus a series of paper entitled "Nematodes from Rajasthan" has been initiated by Baqri and Bohra (in press).

This is the second paper of the series which records the following six species of order Dorylaimida for the first time from India : *Laimydorus thornei* Andrassy, 1969; *Mesodorylaimus litoralis* Loof, 1969; *Mesodorylaimus margaritus* Basson & Heyns, 1974; *Tubixaba parva* Pretorius, Kruger & Heyns, 1987; *Labronema virgo* Monteiro, 1970; and *Tylencholaimus gertii* Kruger, 1965. Of these, the genus *Tubixaba* Monterio & Lordello, 1980 is being reported for the first time from India.

*Material and Methods* : The nematodes were fixed in hot 4% formalin, and mounted in anhydrous glycerine.

*Laimydorus thornei* Andrassy, 1969

(Fig. 1. A & B)

*Dorylaimus filicaudatus* nec Daday, 1905 apud Thorne & Swanger, 1936.

*Measurements* : Female (1) : L = 1.90 mm, a = 32, b = 4.9, c = 5.5 V =  $947^{10}$ .

*Diagnostic characters* : Body almost straight upon fixation. Lip region continuous with body; lips amalgamated. Odontostyle 20  $\mu$ m; its aperture 7 $\mu$ m or 35% of odonto style length. Odonophore 22 $\mu$ m long. Guiding ring double, 8  $\mu$ m from anterior extremity. Basal expanded part of oesophagus occupies 44% of total oesophageal length. Vulva a transverse slit. Vagina distally sclerotised. Female reproductive system amphidelphic. Prerectum 70  $\mu$ m or 2.5 anal body-width long. Tail 345  $\mu$ m or 12 anal body-width long, first concave then setaceous.

*Male* : Not found.

*Remark* The present specimen fits well with the original description provided by Daday, 1905 (Throne & Swanger, 1936).

*Material* : Single female mounted on slide no. IV/1156.

*Habitat and locality* : Collected from soil around roots of wheat (*Triticum aestivum*) at Darrah, district Kota.

*Elsewhere* Paraguay, Paramaribo, Surinam and Brazil.

***Mesodorylaimus litoralis* Loof, 1969**

(Fig. 1, C & D)

*Measurements* : Females (2) L = 1.20-1.43 mm, a = 29-31, b = 4.5-4.7, c = 15-17, V = <sup>15</sup>47-50<sup>16</sup>

*Diagnostic characters* : Body almost straight upon fixation. Lip region marked by slight depression. Odontostyle 13-15  $\mu\text{m}$  long; aperture 4-5  $\mu\text{m}$  or 30-33% of odontostyle length. Odontophore 24-26  $\mu\text{m}$  long. Guiding ring 7-8  $\mu\text{m}$  or about 3/4th of head-width from anterior end. Basal expanded part of oesophagus occupies 45-46% of total oesophageal length. Prerectum 110-112  $\mu\text{m}$  or 4 times anal body-width long. Female reproductive system amphidelphic. Female tail elongate, 80-82  $\mu\text{m}$  or 2.8 anal body-width long.

*Male* : Not found.

*Material* : Two females mounted on slide no. IV/1152.

*Habitat and Locality* : Collected from soil around roots of rice (*Oryza sativa*) at Gogunda, district Udaipur.

*Elsewhere* : Holland, South Dakota (United States of America).

***Mesodorylaimus margaritus* Basson & Heyns, 1974**

(Fig. 1, E & F)

*Measurements* : Females (2) : L = 1.54-1.56 mm, a = 48-49, b = 4.8-5.0, c = 19.0-19.5, V = <sup>7-8</sup>58-59<sup>8-9</sup>.

*Diagnostic characters* : Body slightly ventrally bent upon fixation. Lip region distinctly set off. Odontostyle 12-13  $\mu\text{m}$  long; aperture 4-5  $\mu\text{m}$  or 33-38% of odontostyle length. Odontophore 18-19  $\mu\text{m}$  long. Guiding ring 8-9  $\mu\text{m}$  from anterior end. Basal expanded part of oesophagus occupies 45-47% of total oesophageal length. Female reproductive system amphidelphic. Female tail 78-80  $\mu\text{m}$  or 3 anal body-width long, elongate conoid dorsally bent in its posterior third.

*Male* : Not found.

*Remarks* The present population agrees with the original description of *M. margaritus* Basson & Heyns, 1974, except more posteriorly situated vulva (V = 58-59 against 41-46 in type population).

**Material** : Two females mounted on slide no. IV/1154.

**Habitat and locality** : Collected from soil around roots of wheat (*Triticum aestivum*) at Peeh, district Nagaur.

***Tubixaba parva*** Pretorius, Kruger & Heyns, 1987

(Fig. 1, G & H)

**Measurements** : Females (4) : L = 3.12-3.78 mm, a = 45-52, b = 4.0-6.0, c = 89-96, V =  $7.854-557.8$ .

**Diagnostic characters** : Body ventrally curved in its posterior third upon fixation. Lip region distinctly set off by deep constriction. Lips twice as wide as high, separated. Odontostyle 15-17  $\mu\text{m}$  or about one lip region-width long; aperture 5-6  $\mu\text{m}$  or 33-35% of odontostyle length. Odontophore rod-like, 26-30  $\mu\text{m}$  or 1.6-1.7 times the odontostyle length. Guiding ring thin, situated 9-10  $\mu\text{m}$  or 0.5-0.6 lip region-width from anterior end. The basal expanded part of oesophagus occupies 51-54% of total oesophageal length. Vulva a transverse slit. Vagina encircled by sphincter, sclerotized distally. Female reproductive system amphidelphic. Prerectum 240-264  $\mu\text{m}$  or 4.8-6.8 anal body-width long, with four caudal pores on each side.

**Male** : Not found.

**Material** : Females of Nagaur population mounted on slide no. IV/1173-1175 and Pali population mounted on slide no. IV/1176.

**Habitats and localities** : Collected from soil around roots of guar (*Cyamopsis tetragonoloba*) and millet (*Pennisetum typhoides*) at Nagaur, district Nagaur and Bijapur, district Pali.

**Elsewhere** : South Africa.

***Labronema virgo*** Monteiro, 1970

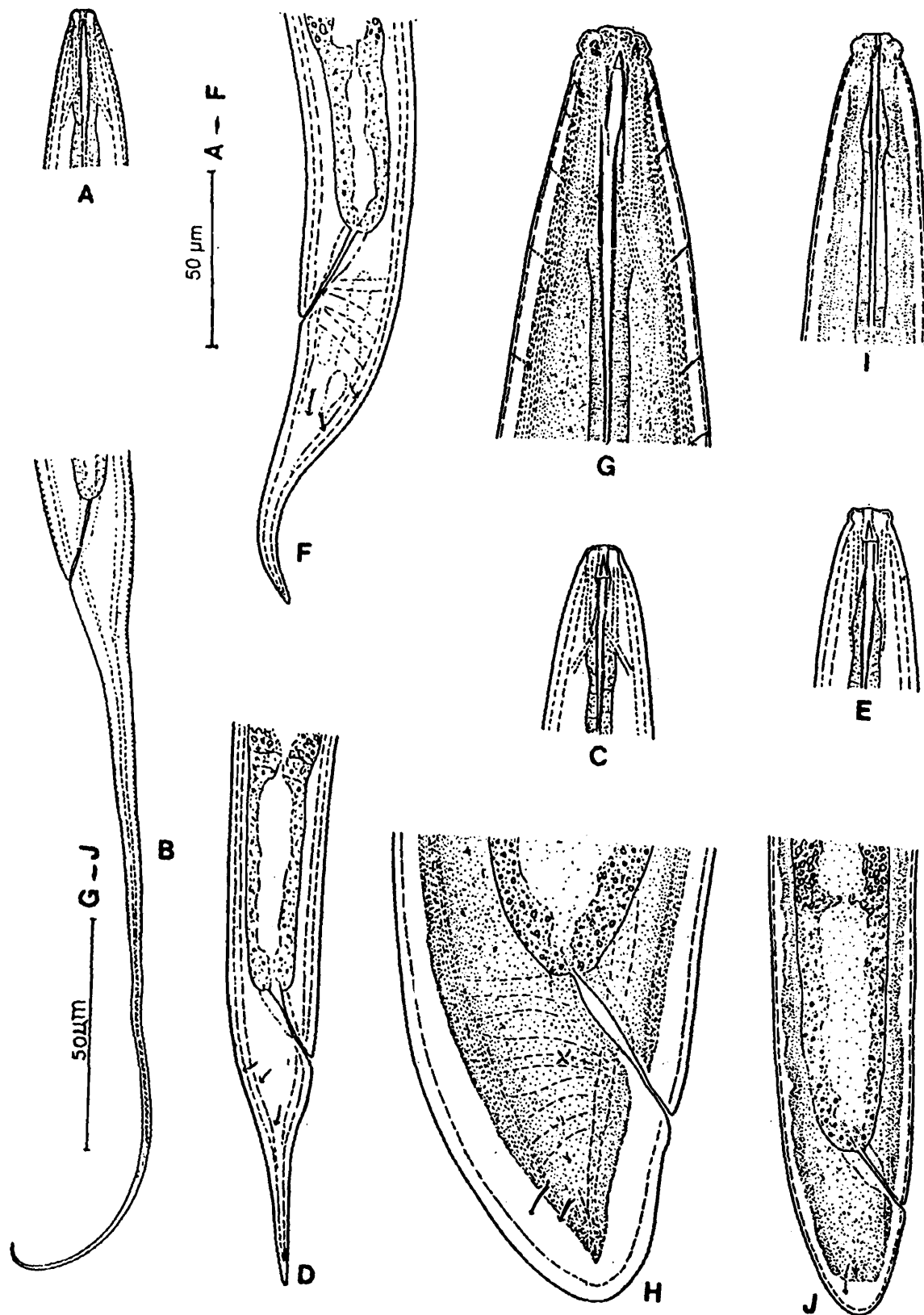
**Mesurements** : Female (1) : L = 1.98 mm, a = 36, b = 7.35, c = 65, V =  $1251^{12}$ .

**Diagnostic characters** : Body more or less straight upon fixation. Lip region set off by constriction. Odonostyle 15  $\mu\text{m}$  long. Guiding ring double, 6  $\mu\text{m}$  from anterior extremity. Odontophore 27  $\mu\text{m}$  long. Basal expaned part of oesophagus occupies about more than half of oesophageal length. Female reproductive system amphidelphic. Vulva longitudinal. Prerectum 4 times the anal body-width long. Tail 30  $\mu\text{m}$  long, rounded conoid.

**Male** : Not found.

**Remarks** : The lone specimen has become dorsoventrally flattened during the study and thus it was difficult to draw the camera lucida diagram. Fortunately the identification of the specimen had been confirmed before it was slightly damaged.

The present specimen fits well with the original description provided by Monterio, (1970).



**Fig. 1. A-B :** *Laimydorus thornei* Andrassy, 1969 : A-Female anterior end; B-Female tail.

**C-D :** *Mesodorylaimus litoralis* Loof, 1969. C-Female anterior end; D-Female tail.

**E-F :** *Mesodorylaimus margaritus* Basson & Heyns, 1974. E-Female anterior end; F-Female tail.

**G-H :** *Tubixaba parva* Pretorius, Kruger & Heyns, 1987. G-Female anterior end; H-Female anterior end; H-Female tail.

**I-J :** *Tylencholaimus gertii* Kruger, 1965. I-Female anterior end; J-Female tail.

*Material* : Single female mounted on slide no. IV/1203.

*Habitat and localitiy* : Collected from soil around roots of unidentified grasses around Sam area, district Jaisalmer.

*Elsewhere* : Spain and Brazil.

***Tylencholaimus gertii* Kruger, 1965**

(Fig. 1, I & J)

*Measurements* : Females (5) : L = 0.68-0.75 mm, a = 21-23, b = 3.7-4.2, c = 30-37, V = 44-46<sup>16-23</sup>.

*Diagnostic character* : Body almost straight upon fixation. Lip region cap-like, marked off from body by constriction. Lips amalgamated, with their inner parts forming an offset perioral disc. Odontostyle 8-9  $\mu\text{m}$  or 0.8 lip region-width long; aperture 3-4  $\mu\text{m}$  or 37-40% of odontostyle length. Odontophore with small basal thickenings, 11-12  $\mu\text{m}$  or about 1.3 times the odontostyle length. Guiding ring single, 6  $\mu\text{m}$  or about 0.54-0.56 lip region-width from anterior end. Basal expanded portion of oesophagus occupies 43-45% of oesophageal length. Vulva a tranverse slit. Female reproductive system mono-opisthodelphic. Prerectum 52-55  $\mu\text{m}$  or about 2.5 anal body-width long. Tail rounded conoid, 22-25  $\mu\text{m}$  or 1.0-1.1 anal body-width long.

*Male* : Not found.

*Material* : Five females mounted on slide no. IV/1183-1184, IV/1192-1193 and IV/1195.

*Habitat and locality* : Collected from soil around roots of sorghum (*Sorghum vulgare*) at Sumerpur Road, district Pali.

*Elsewhere* : Pertoria (South Africa), Australia.

**ACKNOWLEDGEMENTS**

The authors are thankful to Dr. J. R. B. Alfred, Director, Zoological Survey of India, Calcutta for providing research facilities.

**SUMMARY**

The following six species of the Order Dorylaimida have been recorded for the first time from India : *Laimydorus thornei* Andrassy, 1969; *Mesodorylaimus litoralis* Loof, 1969; *Mesodorylaimus margaritus* Basson & Heyns, 1974; *Tubixaba parva* Pretorius, *et. al.*, 1987; *Labronema virgo* Monteiro, 1970; and *Tylencholaimus gertii* Kruger, 1965.

The genus *Tubixaba* Monteiro & Lordello, 1980 has been reported for the first time from India.

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## Short Communication

# ABNORMAL VULVA POSITION IN *NYGOLAIMUS HARISHI* AHMAD & JAIRAJPURI, 1980

### INTRODUCTION

During the survey of plant and soil nematodes in the state of Rajasthan, six females of *Nygolaimus harishi* Ahmad & Jairajpuri, 1980 were collected from around roots of millet (*Pennisetum typhoides*) at Jhunjhunu, district Jhunjhunu, Rajasthan. The population includes three abnormal females which are having their vulva (vulval opening) on dorsal side. (fig. 1).

All the body measurements of the present population of *Nygolaimus harishi* agree with the original description of the species provided by Ahmad & Jairajpuri (1980). However, the abnormality observed in three females of Jhunjhunu population is rare in the nematodes.

#### *Measurements :*

Females (6) : L = 1.25-1.30 mm; a = 3.0-3.5; b = 3.9-4.2; c = 65-69; V =  $3.44-45^{6-7}$

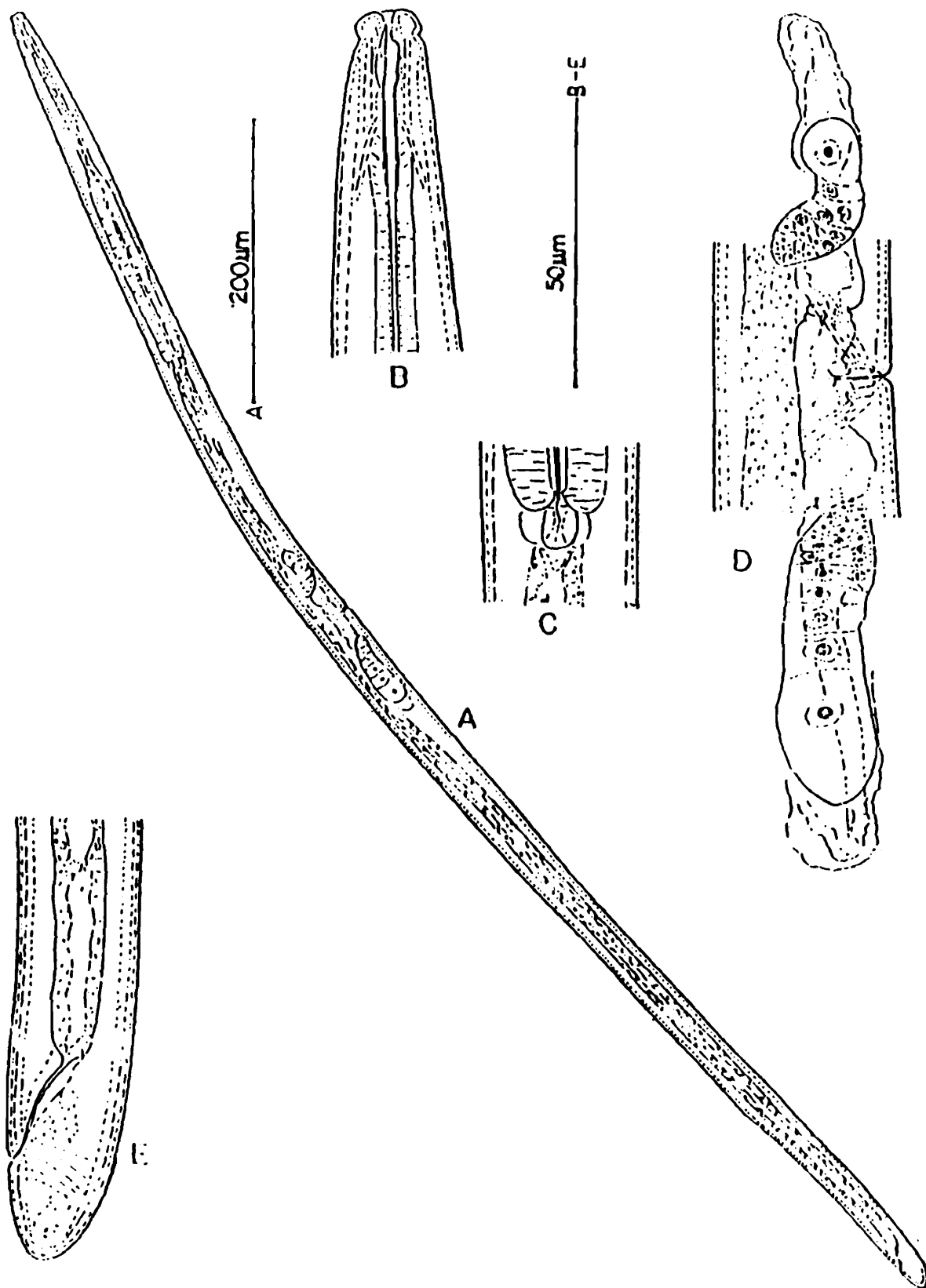
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**Fig. 1.** *Nygolaimus harishi* Ahmad & Jairajpuri, 1980.

A - Entire female showing abnormal position of vulva

B - Anterior end

C - Oesophago-intestinal junction

D - Female reproductive system

E - Female tail