Wetland Ecosystem Series 2

Fauna of Renuka Wetland

ZOOLOGICAL SURVEY OF INDIA

Wetland Ecosystem Series **2**

Fauna
of
Renuka Wetland
(Himachal Pradesh)

Edited by

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FOREWORD

The picturesque Renuka lake is one of the most sacred places in northern India. Named after the goddess Renuka, the mother of Lord Parashuram, it has favourable environs of thickly forested catchment. Of late, there has been a great concern about its ecological deterioration - silting due to recent developmental activities in the catchment area, high levels of organic pollution, extensive macrophyte encroachments, dumping of non-biodegradable materials by tourists and pilgrims, etc. It also faces the problem of eutrification. The National Wetland Management Committee identified Renuka lake as one of the wetlands of national importance for conservation and preparation of management plan.

As a part of ongoing programme of the Zoological Survey of India on national wetlands, the High Altitude Zoology Field Station at Solan conducted several surveys of the Renuka lake to assess its faunal wealth which is an important input for preparing management plan of the wetland. The present document embodies the results of these investigations. The faunal resources of this wetland appear to be still very rich at species level, and well protected because of its sacredness and remote location amidst a wildlife sanctuary of the same name. It is expected that this document will be useful not only to researchers and students but also to the management authority of this wetland.

I would like to put on record my sincere thanks to all the contributors of this volume. My sincere thanks are also due to Dr. J.M. Julka and Dr. H.S. Mehta, who coordinated this programme.

December, 2000
Place : Calcutta

J.R.B. Alfred
Direrctor
Zoological Survey of India

FAUNA OF RENUKA WETLAND

2000

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INTRODUCTION

J.M. JULKA
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Himachal Pradesh is bestowed with several natural lakes with altitude ranging from 400 to 5000m above mean sea level. In the low subtropical zone, Renuka is an important lake located about 60 km from Nahan in district Sirmour. It is one of the most sacred lakes of northern India and visited by thousands of pilgrims during a week-long fair in November every year. It is also of great tourist attraction for its picturesque location.

Renuka lake, covering an area of about 30 hectares, is oblong in shape and resembles a female figure believed to symbolise the body of goddess Renuka, the mother of Lord Parashuram. Because of its biological richness, the National Committee on Wetlands has designated Renuka lake as a wetland of national importance. The wetland is well protected as it is located amid a wildlife sanctuary of the same name. An effective decomposing bottom layer is maintained due to its moderate depth.

Despite many favourable conditions, Renuka wetland is not free from threats. It has already started showing symptoms of prognosis of eutrification (Singh *et al.*, 1987). The eastern and western sides have been enchroached by extensive growth of macrophytes, and the northern side has silted up due to construction of communication links (Zutshi, 1995). Non-biodegradable materials are being dumped into the wetland by tourists and pilgrims.

Some conservation measures have been introduced by the Government of Himachal Pradesh to save the wetland from further ecological degradation but at the same time it has plans to develop the area for tourism and pilgrimage. A thorough knowledge of the living forms of a wetland is imperative for any effective conservation action. Keeping this in view, it was decided to prepare a comprehensive inventory of the fauna of Renuka wetland. Consequently, the wetland was extensively surveyed during 1992-1993 for its faunal resources. A total of 443 species of 26 faunistic groups from microscopic Protozoa to mammals have been recorded (Table 1). In all, 24 species of mammals, 103 species of birds, 14 species of reptiles, 9 species of amphibians and 19 species of fishes among vertebrates, and 225 species of insects and 49 species of other invertebrates have been listed from the wetland and surrounding fringe area of the sanctuary.

Interestingly, Renuka wetland does not attract waterfowl and other aquatic birds since it is very narrow with a maximum width of 204m. All waterfowl and swimming water birds are known to prefer large water bodies to evade terrestrial predators by virtue of distance from shore (Weller *et al.*, 1995).

I am grateful to the former Director, Dr. A.K. Ghosh for various facilities and keen interest during the present studies. I am also thankful to Dr. J.R.B. Alfred, Director for his valuable suggestions during the entire project, and to the Chief Conservator of Forests (Wildlife), Himachal Pradesh, Shimla for

permission to collect fauna from the Renuka wetland. Grateful thanks are due to my colleagues Dr. H.S. Mehta, Mr. I.J. Gupta and Dr. R. Paliwal for their help in preparing this document.

Table 1. Faunal resources of Renuka wetland.

Faunal group	No. of species
Protozoa	5
Porifera	1
Cnidaria	1
Bryozoa	1
Mollusca	8
Oligochaeta	12
Hirudinea	4
Araneae	4
Crustacea	13
Ephemeroptera	6
Odonata	37
Mantodea	7
Dermaptera	7
Orthoptera	50
Aquatic Hemiptera	10
Aquatic Coleoptera	20
Lepidoptera	66
Hymenoptera	8
Diptera	14
Pisces	19
Amphibia	9
Reptilia	14
Aves	103
Mammalia	24
Total	443

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PHYSIOGRAPHY

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INTRODUCTION

The Renuka wetland (longitude 77° 27'E, latitude 30° 36'N) is located at an altitude of 645 m, and 173 km southwest of Shimla in Sirmour district of Himachal Pradesh (Fig. 1). The wetland comprises a large oblong-shaped Renuka lake with a small outlet to an adjoining pond, the Parashuram Tal which ultimately drains into the river Giri through a small channel. Lying in a narrow valley between two parallel

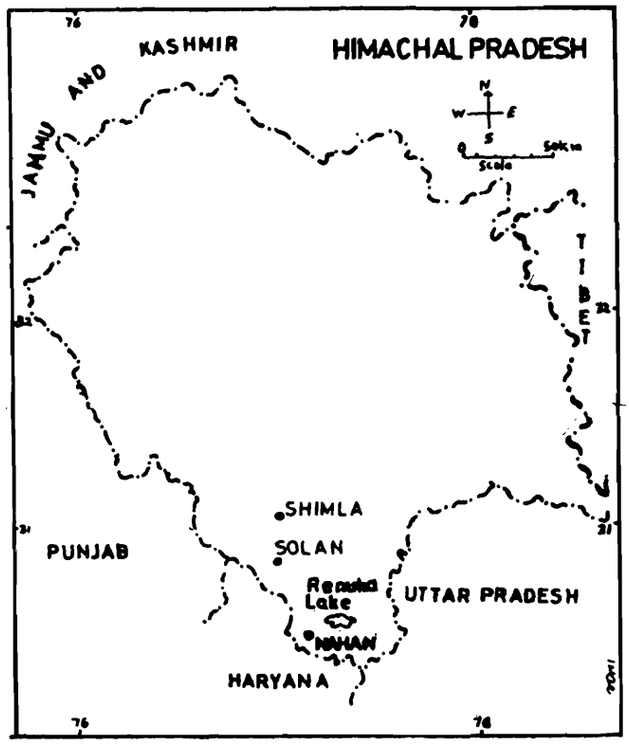

Fig. 1. Location of Renuka Wetland (Himachal Pradesh)

steep hills, the lake is about five times as long as its breadth having an area of approximately 30 hectares. Its catchment area includes about 250 hectares of mostly sub-tropical deciduous reserve forest of broad leaves, bamboos, palms and other wild plants. The wetland receives water primarily from the south-west monsoons through seasonal streams which also bring large quantities of silt and debris from the denuded catchment. A perennial underground seepage water supply possibly from the upper Giri river has also been reported (Singh *et al.*, 1987).

ORIGIN

The basin of Renuka lake is believed to be a remanant of a former river valley that was filled by fluvial deposits (Singh *et al.*, 1987). The river Giri, which flowed along the length of Renuka lake in the past, was possibly blocked by a massive landslide forming a lake in its upstream. As a result, the river Giri occupied the course of its tributary, the river Jalal. The receding water of the blocked river deposited enormous amount of debris; thus forming the present day lake. The sedimentary rocks in the area comprise of carbonaceous shale, siltstone, slate, purpled dolomitic limestone and intrabedded red shales of tertiary period.

MORPHOMETRY

The maximum length and breadth of Renuka lake during a post-monsoon period in 1983 have been recorded as 1050m and 204m respectively (Singh *et al.*, 1987). The lake has two basins: a western 12m deep basin with steep slopes and slightly deeper (13m) but wider eastern one having gentler slopes. About one fourth of its surface area is encroached by marshy growth on the eastern end (Fig. 2).

PHYSICO-CHEMICAL CHARACTERISTICS

Variations in the physico-chemical characteristics of Renuka lake have been recorded by Singh *et al.* (1987). The lake water is alkaline at surface with pH value ranging from 8.0 to 8.2, and slightly acidic to alkaline at bottom (pH range 6.9-7.4). Periods of stratification (May-October) and overturn (November-April) have been recognized. During the stagnant period, temperature, transparency and dissolved oxygen with values of 27° C, 250 cm and 8 ppm respectively, are higher than in the overturn period with corresponding values of 16.5°C, 204 cm and 4.3 ppm. On the contrary, free carbon dioxide (7.4 ppm) and total alkalinity (245 ppm) were more during the overturn period than in the stagnant period with corresponding values of negligible and 192 ppm. As compared to the surface, dissolved oxygen concentrations of the bottom layers were lower during both periods (negligible in stagnant period and 1.5 ppm in overturn period), indicating eutrophic nature of the lake.

VEGETATION

The forest around the lake and on nearby hills are of dry deciduous type. The vegetation of the area can be classified as follows:

1. Hydrophytes: *Phragmites* sp., *Typha* sp., *Carex* sp., *Sparganium* sp., *Utricularia* sp., *Hydrilla* sp.

2. Overwood: *Terminalia tomentosa, Moringa pterygosperma, Ougeinia dalbergioides, Cassia fistula, Lagerstroemia parviflora, Bauhinia variegata, Albizia lebbeck, Salmalia malabarica, Machilus gamblei, Eugenia jambolana, Ficus palmata, Salix tetrasperma, Pyrus pashia, Dalbergia sissoo, Bambusa arundinacea, Aegle marmelos, Ficus religiosa, Phoenix humilis, Shorea robusta.*

3. Shrubs: *Adhatoda vasica, Arisaema wallichianum, Berberis aristata, Cannabis opaca, Girardinia heterophylla, Jasminum humila, Lantana camara, Rosa sericea.*

4. Climbers: *Bauhinia vahlii, Heaera helix, Porana paniculata, Rosa moschata.*

Eucalyptus trees have been planted on a small patch on the bank of the lake.

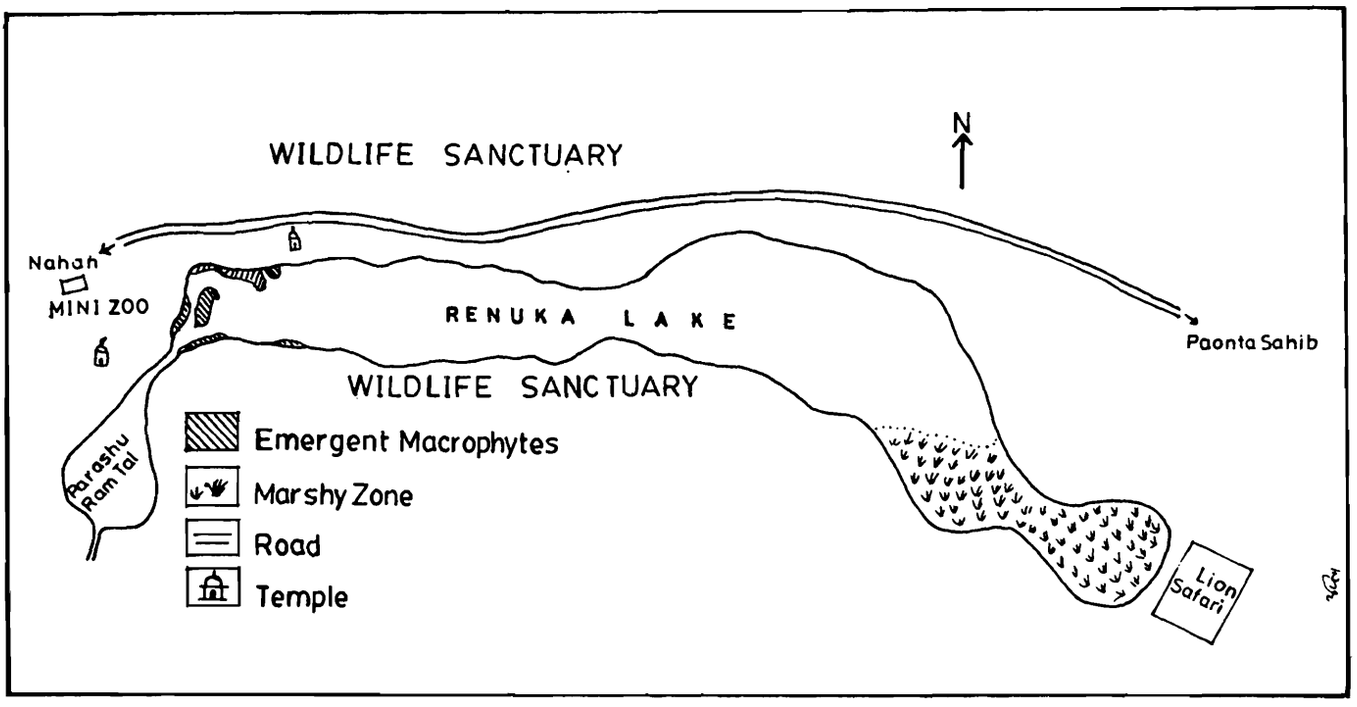

Fig. 2. Different zones of Renuka Wetland, H.P.

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PROTOZOA*

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INTRODUCTION

The Protozoa are microscopic unicellular organisms, occurring as parasitic or free living in all possible niches. Mandal *et al.* (1991) have reviewed extensive literature on Indian protozoans and also discussed their orrurrence in different environs. This article deals with a small collection of freshwater ciliates identified by the first author.

KEY TO THE IDENTIFICATION OF PROTOZOA OF RENUKA WETLAND

1. Oral ciliature clearly distinct from somatic ciliature 2

   Oral ciliature slightly distinct from somatic ciliature 4

2. Adoral zone of multiple membranellae conspicuous, often extending out of buccal cavity onto or around anterior end of body.....*Strobilidium gyrans*

   Adoral zone of multiple membranellae lacking, buccal cavity well-defined containing membranellae.....3

3. Body oval, girdles of cilia and eccentric posterior ciliary tuft absent.....*Monochilum ovale*

   Body short, resembling two closely compressed spheres, each sphere encircled with a broad ciliary girdle, posterior ciliary tuft very conspicuous..... .....*Urocentrun turbo*

4. Body barrel-shaped, cytostome located apically..... .....*Coleps inermis*

   Body reniform, cytostome in ventral depression leading into peristomial cavity.....*Colpoda cucullus*

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* Based on the registered collections deposited at High Altitude Zoology Field Station, ZSI, Solan determined by Late Sh. R.N. Mukherjee.

SYSTEMATIC LIST

Phylum : CILIOPHORA
Class : KINETOFRAGMINOPHOREA
Order : PROSTOMATIDA
Family : COLEPIDAE
Genus : ***Coleps*** Nitzsch

1. ***Coleps inermis*** Perty

Distribution: India: Himachal Pradesh, Rajasthan.

Elsewhere: Cosmopolitan.

Order : COLPODIDA
Family : COLPODIDAE
Genus : ***Colpoda*** Mueller

2. ***Colpoda cucullus*** Mueller

Distribution: India: Himachal Pradesh, Andhra Pradesh, Assam, Jammu and Kashmir, Karnataka, Maharashtra, Madhya Pradesh, Meghalaya, Orissa, Punjab, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere: Cosmopolitan.

Class : OLIGOHYMENOPHOREA
Order : HYMENOSTOMATIDA
Family : GLAUCOMIDAE
Genus : ***Monochilum*** Schewiakoff

3. ***Monochilum ovale*** (Schewiakoff)

Distribution: India: Himachal Pradesh, Rajasthan, Meghalaya.

Elsewhere: Cosmopolitan.

Family : UROCENTRIDAE
Genus : ***Urocentrum*** Nitzsch

4. ***Urocentrum turbo*** (Mueller)

Distribution: India: Himachal Pradesh, Jammu and Kashmir, Rajasthan, Maharashtra, West Bengal.

Class : POLYHYMENOPHOREA
Order : OLIGOTRICHIDA
Family : STROBILIDIIDAE
Genus : ***Strobilidium*** Schewiakoff

5. ***Strobilidium gyrans*** (Stokes)

Distribution: India: Himachal Pradesh, Rajasthan, West Bengal, Meghalaya, Tripura.

Elsewhere: Cosmopolitan.

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PORIFERA

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INTRODUCTION

Freshwater sponges commonly occur in clean streams, lakes and ponds. They are sessile, usually with green, brown or yellowish coloration, which make them inconspicuous against the habitat. As a result, they are often overlooked by the collectors. All freshwater sponges belong to the family Spongillidae. More than 100 species are known from the world, of which 33 species have so far been reported from Indian freshwaters (Pattanayak, 1991).

Early noteworthy taxonomic studies on Indian freshwater sponges are those of Annandale (1911) and Penney and Racek (1968). Recently, Khera and Chaturvedi (1976) have presented a checklist of Indian freshwater sponges, and Soota (1991) has published a consolidated and comprehensive account on these organisms. In a review on the state of researches on Indian sponges, Pattanayak (1991) has reported the occurrence of three species from freshwaters of Himachal Pradesh. In the present work one species from Renuka wetland is reported which was earlier studied by Soota (1991).

SYSTEMATIC LIST

Class : DEMOSPONGIAE
Order : HAPLOSCLERIDA
Family : SPONGILLIDAE
Genus : ***Ephydatia*** Lamouroux

1. ***Ephydatia meyeni*** (Carter)

Distribution: India: Himachal Pradesh, Haryana, Uttar Pradesh, Rajasthan, West Bengal, Maharashtra, Kerala, Tamil Nadu.

Elsewhere : China.

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CNIDARIA (COELENTERATA)

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INTRODUCTION

Majority of cnidarians are marine but a few species also occur in freshwaters. They exhibit two body forms: an erect cylindrical polyp typically attached to a firm substratum, and a solitary pelagic discoid medusa which is commonly known as jellyfish. Tilak *et al.* (1976) were the first to study freshwater medusae from Renuka lake. These belonged to the genus *Limnocnida* Günther, which contains two species, *L. tanganyicae* Günther from Africa and *L. indica* Annandale from India. Ecologically, *Limnocnida* appears to be restricted to streams and lakes in hilly regions with altitude ranging between 686 and 853 metres (Tilak *et al.*1976).

During a survey in September 1991, swarms of *Limnocnida* medusae were observed in Renuka lake. They exhibited some periodicity, being most abundant from 11.00 to 15.00 hrs. Several medusae were also observed drifting through an outflow to adjoining Parashuram Tal.

The specimens from Renuka lake significantly differ from the known species of *Limnocnida* in certain morphological characteristics as pointed out by Tilak *et al.* (1976).

SYSTEMATIC LIST

Class : HYDROZOA
Order : HYDROIDA
Suborder : LIMNOMEDUSAE
Family : LIMNOCNIDIDAE
Genus : ***Limnocnida*** Günther

1. *Limnocnida* sp.

Material examined: 64 ex, 24 Sep 1992, J.M. Julka and R. Paliwal.

Distribution: India: Renuka lake, Himachal Pradesh.

Remarks: In India, the genus *Limnocnida* (*L. indica* Annandale) has been reported from the Krishna, Cauvery, Sharavati and Periyar drainage systems, Pampadampara Tank and Chhotanagpur (Tilak *et al.* 1976). Malhotra *et al.* (1976) have described a new freshwater medusa, *Mansariella lacustris*,

from Mansar lake in Jammu & Kashmir. The status of *Mansariella*, however, is still doubtful (Dunn, 1982).

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Zool. Surv. India
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BRYOZOA

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INTRODUCTION

Bryozoans are colonial organisms which consist of more or less elongate individuals called zooids. They are mostly marine but about 40-50 species are strictly restricted to freshwaters (Rao, 1991). The freshwater bryozoans (Phylactolaemata) are present in most permanent water bodies, especially on submerged stones and vegetation. Occasionally, they are also attached to molluscan shells, back of tortoise, floating bark and other submerged objects. Because of their tiny size, bryozoans are found with difficulty. Most of the gelatinous freshwater Bryozoa are not consumed as food by fish but are avoided probably due to their epidermal toxins (Rao, 1991). Recently their importance has been recognized as bioindicators of various levels of pollution.

Important taxonomic studies on Indian freshwater Bryozoa are those of Annandale (1911), Rao (1973, 1976) and Rao *et al.* (1985). The present state of knowledge on freshwater Bryozoa of India has been assesed by Rao (1991).

This article is based on the studies conducted earlier by Tilak and Julka (1978).

The author is grateful to Dr. A.K. Ghosh, Director, Zoological Survey of India, Calcutta, for providing necessary facilities.

SYSTEMATIC LIST

Class : PHYLACTOLAEMATA
Order : PLUMATELLIDA
Family : LOPHOPODIDAE
Genus : ***Lophopodella*** Rousselete

1. *Lophopodella carteri* (Hyatt)

Distribution: India: Himachal Pradesh, Kumaon Hills of Uttar Pradesh, Haryana, Maharashtra, Tamil Nadu.

Elsewhere: Cosmopolitan.

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MOLLUSCA

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INTRODUCTION

The Phylum Mollusca, the second largest group in the animal kingdom (in number of species) includes soft-bodied animals, usually protected by a shell. They occupy different habitats, *viz*., marine, freshwater and land. Indian molluscs are represented by five classes, *viz*., Polyplacophora, Gastropoda, Bivalvia, Scaphopoda and Cephalopoda out of seven classes in the world. Out of 415 families in the world, 257 families occur in the Indian subcontinent (Subba Rao, 1991).

Freshwater molluscs are represented in two classes, *viz*., Gastropoda and Bivalvia which include 210 species under 52 genera and 21 families (Subba Rao, 1993).

Freshwater molluscs play a very important role in the aquatic ecosystem. These animals serve as food for many other aquatic animals like fishes, birds etc. Species such as *Bellamya bengalensis*, *Pila globosa*, *Brotia costula*, *Angulyagra oxytropis*, etc. are regularly consumed by human beings in many parts of the country (Subba Rao and Dey, 1989). Reports of pearls being produced by common freshwater mussels, *Lamellidens marginalis* and *L. corrianus* are available from different parts of the country. Several species are widely used in the button industry especially in Bihar and the shells are used in manufacturing of poultry feed.

Some of the freshwater snails serve as vectors in spreading diseases in livestock as well as human beings and are intermediate hosts for trematode parasites.

The authors are grateful to Dr. A.K. Ghosh, Director, Zoological Survey of India for giving the opportunity to undertake the studies and to the Officer-in-Charge, High Altitude Zoology Field Station, Solan for the material at our disposal.

KEY TO THE IDENTIFICATION OF MOLLUSCA OF RENUKA WETLAND

1. Shell univalve; turreted, turbinate or pyramidal, large, more than 5 mm in size.....2

   Shell with two valves, attached by hinge; ovately trigonal; small, less than 5 mm in size; valves sculptured.....*Sphaerium indicum*

2. Shell with operculum.....3

   Shell without operculum.....4

3. Shell turreted, whorls 8 to 10; sculptured with vertical ridges and spiral striae; aperture pear shaped.....*Thiara tuberculata*

   Shell turbinate; whorls less than eight; smooth with dark spiral bands; aperture rounded.....*Bellamya bengalensis*

4. Shell small, less than 5 mm, flattened, discoidal; spire depressed; columella not twisted..... .....*Gyraulus labiatus*

   Shell large, more than 5 mm, pyramidal, spire raised; columella twisted.....5

5. Shell broader, spire very short, sunken; body whorl very much inflated, outer lip not expanded; columellar fold abruptly narrow below umbilicus.....*Lymnaea auricularia*

   Shell narrow, spire acuminate, not sunken; body whorl less inflated, outer lip much expanded; columellar fold not narrow below umbilicus.....*Lymnaea acuminata rufescens*

SYSTEMATIC LIST

Class : GASTROPODA
Order : MESOGASTROPODA
Family : VIVIPARIDAE
Genus : ***Bellamya*** Jousseaume

1. *Bellamya bengalensis* f. *typica* (Lamarck)

Material examined: 2 ex, 26 Mar 1994, H.S. Mehta.

Distribution: India: Common throughout

Elsewhere: Bangladesh, Myanmar, Sri Lanka.

Remarks: Depending on differences in shell characters a number of infra-specific forms have been described under this species. As Annandale (1921) observed, these differences are mainly due to the physical factors of the environment rather than the geographical isolation of the race. Though fairly constant these forms also intergrade into each other to a certain extent.

2. *Bellamya bengalensis* f. *mandiensis* (Kobelt)

Material examined: 2 ex, 27 Mar 1994, H.S. Mehta.

Distribution: Common throughout north-western India, Allahabad to Punjab and West Bombay.

Remarks: Shell thinner, narrower and more conical than in typical form, umbilical opening slightly wider.

Family : THIARIDAE
Genus : ***Thiara*** Roeding

3. ***Thiara (Melanoides) tuberculata*** (Muellar)

Material examined: 2 ex, 27 Mar 1994, H.S. Mehta; 18 ex, 24 Sep 1994, J.M. Julka.

Distribution: Widely distributed in India except Kashmir.

Elsewhere: North & south Africa, Eastern Mediterranean countries, S.E. Asia, S. China, Malaysia, Malay Archipelago, North Australia, Pacific Islands, north to the Ryu Kyu Islands of Japan.

Remarks: The species has a very wide range of distribution, occurring in all types of fresh water bodies, often extending to brackish water.

Order : BASOMMATOPHORA
Family : LYMNAEIDAE
Genus : ***Lymnaea*** Lamarck

4. ***Lymnaea (Pseudoscuccinea) acuminata*** f. ***typica*** Lamarck

Material examined: 6 ex, 27 Mar 1994, H.S. Mehta.

Distribution: Common throughout India.

Elsewhere: Bangladesh, Myanmar, Pakistan.

Remarks: A large number of infra-specific forms were described under this species. Annandale and Rao (1925) pointed out that these differences in shell characters are not constant and it is often difficult to assign a shell definitely to a particular form. However, two forms, *viz*., *typica* and *rufescens* are fairly constant and are generally recongised (Subba Rao, 1989).

5. ***Lymnaea (P.) acuminata*** f. ***rufescens*** Gray

Material examined: 1 ex, 23 Sep 1994, R. Paliwal.

Distribution: Throughout India.

Elsewhere: Bangladesh, Myanmar, Pakistan.

Remarks: Species comparatively more exerted, body whorl narrower, aperture short and less expanded than typical form.

6. ***Lymnaea (Radix) auricularia*** Linnaeus

Material examined: 1 ex, 22 Sep 1992, J.M. Julka.

Distribution: A palaearctic species, hitherto recorded from Kashmir in India, now for the first time recorded from Himachal Pradesh (Renuka).

Elsewhere: Europe as far south as Spain and Italy, N. Asia, Afghanistan.

Remarks: This species is recognised by its inflated body whorl, spire sunken into the body whorl. Subba Rao (1989) discussed the affinity of this species. Earlier Rajagopal and Subba Rao (1968) recorded this species from the Kashmir valley.

Family : PLANORBIAE
Genus ; *Gyraulus* Charpentier

7. *Gyraulus labiatus* (Benson)

Material examined: 14 ex, 26 Mar 1994, H.S. Mehta.

Distribution: India: Himachal Pradesh, Madhya Pradesh, Maharashtra, Tamil Nadu, West Bengal.

Elsewhere: Myanmar.Remarks: Shell small, depressed, obliquely striate, whorls 3 1/2, body whorl remarkably deviating from the central axis.

Class : BIVALVIA
Order : VENEROIDA
Family : PISIDIIDAE
Genus : *Sphaerium* Scopoli

8. *Sphaerium (S.) indicum* Deshayes

Material examined: 12 ex, 27 Mar 1994, J.M. Julka.

Distribution: Indian plains, Himalaya.

Remarks: Shell very small, thin and inequilateral.

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Zool. Surv. India
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OLIGOCHAETA

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INTRODUCTION

The wet soil on margins and around marshy zone of Renuka wetland provides suitable habitat for the propagation of both aquatic and terrestrial oligochaetes. The terrestrial forms (earthworms) play an important role in enhancing soil fertility by changing its physico-chemical properties. They break up accumulated organic matter on the margins of the wetland and incorporate it into the soil. A considerable amount of nutrients released during this process are washed into the lake alongwith rain water. Aquatic oligochaetes are significant indicators of organic pollution, and form important components in the food web of the wetland.

Barring a record of *Lennogaster chittagongensis* (Stephenson) by Julka (1988), the oligochaete fauna of Renuka wetland has remained unexplored. A few species, however, have been described from the surrounding areas in Sirmour district (Julka, 1988). Information on the oligochaetes of neighbouring districts of Dehra Dun and Saharanpur in Uttar Pradesh is available in the works of Stephenson (1923), Gates (1951, 1972), Julka (1988, 1994) and Paliwal (1994: unpublished).

The authors are grateful to Dr. A.K. Ghosh, Director, Zoological Survey of India, Calcutta for his keen interest and providing necessary facilities during the project.

KEY TO THE IDENTIFICATION OF OLIGOCHAETA OF RENUKA WETLAND

1. Setae arranged in 4 bundles; body thread-like; aquatic ..... *Limnodrilus hoffmeisteri*

   Setae not in bundles; body robust; terrestrial.....2

2. Setae lumbricine.....3

   Setae perichaetine.....6

3. Male pores on segment xviii in seminal grooves.....4

   Male pores on segment xv, seminal grooves absent..... .....*Allolobophora parva*

4. Prostatic pores 2 pairs, at ends of seminal grooves on xvii and xix.....5

   Prostatic pores one pair, at anterior ends of short diagonal seminal grooves on xvii.....
   .....*Lennogaster chittagongensis*

5. Short worms, 19-23 mm long; clitellum xiv-xx; spermathecal pores in furrows 7/8/9..... .....*Dichogaster bolaui*

Long worms, 40-123 mm long; clitellum xiii-xvii; spermathecal pores on segments viii and ix..... .....*Octochaetona beatrix*

6. Colour usually reddish to violet; gizzard vestigeal in v or vi; holonephric.....7

Colour usually brown to grey; gizzard large in viii; meronephric.....9

7. Male genital field with elongated penes; last pair of hearts in xiii.....*Perionyx simlaensis*

Male genital field without penes; last pair of hearts in xii.....8

8. Male pores widely separated, 0.10-0.16 body circumference apart; tag-like tubercles present lateral to male pores.....*Perionyx bainii*

Male pores close to midventral line, 0.04-0.05 body circumference apart; tag-like tubercles absent.....*Perionyx excavatus*

9. Male pores discharging directly onto body surface .....*Amynthas corticis*

Male pores discharging into copulatory pouches opening onto body surface through secondary male pores.....10

10. Spermathecal pores 4 pairs, in furrows 5/6-8/9 .....*Metaphire posthuma*

Spermathecal pores 3 pairs.....11

11. Spermathecal pores in furrows 5/6/7/8.....*Metaphire birmanica*

Spermathecal pores in furrows 6/7/8/9.....*Metaphire houlleti*

SYSTEMATIC LIST

Family : TUBIFICIDAE
Genus : ***Limnodrilus*** Claparede

1. *Limnodrilus hoffmeisteri* Claparede

Material examined: 0-2-3, 26 Mar 1994, R. Paliwal.

Distribution: India: Cosmopolitan.

Elsewhere: World-wide.

Remarks: Collected from the littoral benthic zone of Renuka lake.

Family : OCTOCHAETIDAE
Genus : ***Dichogaster*** Beddard

2. ***Dichogaster bolaui*** (Michaelsen)

Material examined: 0-0-2, 23, 27 Sep 1992, J.M. Julka.

Distribution: India: Cosmopolitan, restricted to habitats with rich organic matter.

Elsewhere: Endemic in tropical Africa, but attained word-wide distribution due to transportation.

Genus : ***Lennogaster*** Gates

3. ***Lennogaster chittagongensis*** (Stephenson)

Distribution: India: Himachal Pradesh, Jammu and Kashmir.

Elsewhere: Bangladesh, Myanmar.

Remarks: Previously recorded from Renuka wetland by Julka (1988).

Genus : ***Octochaetona*** Gates

4. ***Octochaetona beatrix*** (Beddard)

Material examined: 0-0-3, 23 Sep 1992, J.M. Julka.

Distribution: India: Low altitudes of western and central Himalaya, Indo-Gangetic Plain, central Highlands, Karnataka, Kerala.

Elsewhere: Pakistan, Nepal, Myanmar, Malay Peninsula, the Philippines.

Remarks: Inhabits decaying plant organic matter.

Family : MEGASCOLECIDAE
Genus : ***Amynthas*** (Kinberg)

5. ***Amynthas corticis*** (Kinberg)

Material examined: 0-1-2, 27 Sep 1992, J.M. Julka.

Distribution: India: Himalaya, Khasi and Jaintia Hills (Meghalaya), low hills of Assam, Nilgiri and Palni Hills (Tamil Nadu).

Elsewhere: World-wide.

Genus : ***Metaphire*** Sims & Easton

6. ***Metaphire birmanica*** (Rosa)

Material examined: 0-0-11, 23, 25, 29 Sep 1992, J.M. Julka.

Distribution: India: Lowlands in western Himalaya.

Elsewhere: Myanmar.

Remarks: Inhabits muddy areas.

7. ***Metaphire houlleti*** (Perrier)

Material examined: 0-0-1, 22 Sep 1973, H.P. Aggarwal; 0-0-2, 27 Sep 1975, Arun Kumar; 0-0-11, 13 Dec 1976, J.M. Julka.

Distribution: India: Lowlands in western Himalaya, West Bengal, Meghalaya, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Kerala, Tamil Nadu, Andaman & Nicobar Islands.

Elsewhere: Pakistan, Nepal, Bangladesh, Sri Lanka, Myanmar, Vietnam, Thailand, Malay Peninsula. Singapore, Indonesia, China, the Philippines and other oceanic islands, Australia, Sierra Leone, Madagascar, France, Bahamas, Cuba, U.S.A., Salvador, French Guiana.

8. ***Metaphire posthuma*** (Vaillant)

Material examined: 0-1-16, 23 Sep 1992, J.M. Julka.

Distribution: India: Indo-Gangetic Plain, low hills of western Himalaya, Orissa, Madhaya Pradesh, Gujarat, Maharashtra, Andaman and Nicobar Islands.

Elsewhere: Endemic in southeast Asia, attained distribution in other countries due to transportation.

Genus : ***Perionyx*** Perrier

9. ***Perionyx bainii*** Stephenson

Material examined: 0-1-0, 16 Dec 1976, J.M. Julka.

Distribution: India: Himachal Pradesh, Garhwal and Kumaon Hills of Uttar Pradesh.

Remarks: Inhabits organic matter trapped amongst stones and boulders of streams.

10. ***Perionyx excavatus*** Perrier

Material examined: 0-1-0, 13 Dec 1976, J.M. Julka.

Distribution: India: Cosmopolitan.

Elsewhere: Southeast Asia, Indonesia, the Philippines, Formosa, Fiji, Samoa, Hawaii, South Africa, Madagascar, Comoro, Mauritius, Seychelles Archipelago, Reunion, Dominica.

Remarks: It is the common tropical compost worm with great potential in vermicomposting.

11. ***Perionyx simlaensis*** (Michaelsen)

Material examined: 0-0-1, 7 Apr 1974, Arun Kumar.

Distribution: India: Himachal Pradesh, Uttar Pradesh.

Family : LUMBRICIDAE
Genus : ***Allolobophora*** Eisen

12. ***Allolobophora parva*** Eisen

Material examined: 0-1-2, 27 Sep 1992, J.M. Julka.

Distribution: India: Himalaya, Aravali and Palni Hills, some places in Gangetic Plain.

Elsewhere: Endemic in North America, attained distribution all over the world at places with temperate climate.

Remarks: Inhabits rotten wood, decaying leaves and dung.

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Zool. Surv. India
Wetland Ecosystem Series 2 : Fauna of Renuka Wetland : 27-28, 2000

HIRUDINEA

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INTRODUCTION

The leeches are aquatic (both freshwater and marine), amphibious or terrestrial occurring at damp places. They are either parasitic or predaceous. They can be easily recognised by their looping movements and presence of suckers at one end or both ends of the body. Approximately 500 species are known in world. The Indian leech fauna comprises 59 species, of which 19 are marine, 40 freshwater and 9 terrestrial.

The leech fauna of Himachal Pradesh is diverse comprising both freshwater and terrestrial forms. Because of low rainfall, the terrestrial forms are few as compared to freshwater representatives. A total of 18 species are known so far from Himachal Pradesh (Chandra, 1977, 1978, 1981). Based on earlier studies, four species have been recorded from Renuka wetland (Chandra and Mahajan, 1976).

The author is grateful to Dr. A.K. Ghosh, Director, Zoological Survey of India, Calcutta and Dr. J.M. Julka, Officer-in-Charge, High Altitude Zoology Field Station, Zoological Survey of India, Solan for providing necessary facilities.

KEY TO THE IDENTIFICATION OF LEECHES OF RENUKA WETLAND

1. Jawless, protrusible proboscis present.....2

   Jawed, protrusible proboscis absent.....*Salifa indica*

2. Eyes two pairs.....3

   Eyes three pairs.....*Alboglossiphonia weberi*

3. Head somewhat dilated, eyes on annuli 4 and 5.....*Batracobdelloides reticulata*

   Head dilated and distinct from body, eyes on annuli 3 and 4.....*Hemiclepsis marginata asiatica*

SYSTEMATIC LIST

Order : RHYCHOBDELLIDA
Family : GLOSSIPHONIIDAE
Genus : ***Iboglossiphonia*** Sawyer

1. ***Alboglossiphonia weberi*** (Blanchard)

Distribution: India: Widely distributed.

Elsewhere: Pakistan, Nepal, Myanmar, Indonesia.

Remarks: It is usually found free living, often attached to submerged objects in lakes, ponds and streams, and parasitic on aquatic beetles, molluscs and amphibians.

Genus : ***Batracobdelloides*** Sawyer

2. ***Batracobdelloides reticulata*** (Kaburaki)

Distributions: India: Himachal Pradesh, Jammu and Kashmir, Punjab and Maharashtra.

Remarks: Easily recognised in the field by more or less reticulated pigmentation.

Genus : ***Hemiclepsis*** Vejdovsky

3. ***Hemiclepsis marginata asiatica*** Moore

Distribution: India: Himachal Pradesh, Jammu and Kashmir.

Remarks: Characterised by presence of a median longitudinal yellow stripe and continuous yellow transverse bands on dorsal surface.

Order : ARHYNCHOBDELLIDA
Family : SALIFIDAE
Genus : ***Salifa*** Sawyer

4. ***Salifa indica*** (Kaburaki)

Distribution: India: Himachal Pradesh, Haryana, Jammu and Kashmir, Rajasthan.

Remarks: Recognised in the field by its reddish colour.

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3-β-44/ZSI/Cal/2K

Zool. Surv. India
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ARACHNIDA : ARANEAE

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INTRODUCTION

The present contribution deals with a small collection of spiders from Renuka wetland. No comprehensive work is available on the spider fauna of Himachal Pradesh. However, the material was determined with the keys provided by Tikader and Malhotra (1980), and Tikader (1982).

The author is grateful to the Director, Zoological Survey of India, Calcutta for providing necessary facilities.

SYSTEMATIC LIST

Family : OXYOPIDAE
Genus : ***Oxyopes*** Latreille

1. ***Oxyopes shweta*** Tikader

Material examined: 1 ♀ , 26 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Sikkim, West Bengal, Meghalaya.

Family : LYCOSIDAE
Genus : ***Pardosa*** Koch

2. ***Pardosa birmanica*** Simon

Material examined: 2 ♂♂ , 4 ♀♀, 23 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh, Punjab, Rajasthan, Uttar Pradesh, Bihar, West Bengal, Meghalaya, Orissa, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu.

Elsewhere: Myanmar, Pakistan, Java,

Family : ARANEIDAE
Genus : ***Leucauge*** White

3. ***Leucauge decorata*** (Blackwall)

Material examined: 2 ♀♀, 29 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Uttar Pradesh, Bihar, West Bengal, Sikkim, Assam, Meghalaya, Orissa, Gujarat, Maharashtra, Kerala, Tamil Nadu, Pondichery.

Elsewhere: Pakistan, Sri Lanka, Myanmar.

Genus : ***Nephila*** Leach

4. ***Nephila maculata*** (Fabricius)

Material examined: 4 ♀♀, 28, 29 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Uttar Pradesh, West Bengal, Sikkim, Assam, Meghalaya, Madhya Pradesh, Gujarat, Maharashtra, Karnataka, Tamil Nadu, Kerala, Andaman and Nicobar Islands.

Elsewhere: Myanmar, Sri Lanka, China, Malaysia, Japan, New Guinea, Australia.

Family : GNAPHOSIDAE
Genus : ***Geodrassus*** Chamberlin

5. ***Geodrassus sirmourensis*** Tikader and Gajbe

Material examined: 2 ♀♀, Renuka Lake (type locality). 5 Apr 1974, Arun Kumar, Reg. No/ 4999-5001/8 (ZSI, Calcutta).

Distribution: India: Himachal Pradesh.

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Zool. Surv. India
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CRUSTACEA : ZOOPLANKTON

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INTRODUCTION

The crustacean zooplankton of freshwater derives its members mainly from Cladocera, Copepoda and a few species of Ostracoda. They play an important role in the trophic dynamics of wetland ecosystems by converting a part of the bound energy from primary products into its body substance. Further, their economic value as fish food is well-known (Alikunhi, 1952; Ivleva, 1973; Venkataraman, 1983). Some of the algae, detritus, dead and decomposed organic matter and a few species of bacteria form the major food for these animals.

The order Cladocera has fascinated man for centuries because of its dominance in the freshwater ecosystem, ease in culturing them, their short life span, lack of free eggs or larval stages and their genetic homogenity (Slobodkin, 1954). It consists of 10 well defined families containing an estimated about 400 species in the world (Frey, 1967). So far, 95 species of Cladocera have been recorded in India. For identification of Indian Cladocera and necessary references, Michael and Sharma (1988) may be consulted.

The copepods are a tremendous group of 10,000 or more species. Most are found in the sea, but some inhabit freshwaters belonging to three main groups: Harpacticoidea, Cyclopoida and Calanoida. The Copepoda brought the typical nauplius larva of the marine crustaceans to freshwaters. In India, about 6 species of Harpacticoidea, 18 species of Calanoida and 12 species of Cyclopoida have been described so far. For identification of common freshwater copepods, Michael (1973) is of great help.

Freshwater ostracodes are common in India. Most species are benthonic, some occur among aquatic vegetation and algal mats, and only a few are planktonic. The role of freshwater ostracodes in an aquatic ecosystem is well established. They form an important component in the food of aquatic macro-organisms, serve as ecological indicators, act as secondary hosts for a number of fish parasites and are found to be epizoic or parasitic in the gills of various species of freshwater cray fishes. Arora (1931) as a part of a study on the entomostracan fauna of Lahore described ten species of freshwater ostracodes. Hartman (1964) in his extensive work on 'Asiatische ostracoden' dealt with 25 species. An eloborate study on the Indian Ostracoda (61 species) with all relevant literature can be found in Victor and Fernando (1979).

This report on crustacean zooplankton of Renuka lake was made on the collections sent to me by Dr. J.M.Julka during one of his surveys in 1994. I record my thanks for the same. Thanks are also due to the Director, Zoological Survey of India, Calcutta for the facilities provided to carry out the study.

KEY TO THE IDENTIFICATION OF CRUSTACEAN ZOOPLANKTONS OF RENUKA WETLAND

1. Body and legs covered with soft valves.....2

   Body and legs not covered ..... *Mesocyclops leuckarti*

2. Body and legs covered with soft valves 3

   Body and legs covered with thick shells 10

3. Dorsal ramus of antenna 3 segmented, ventral ramus four segmented.....4

   Dorsal and ventral ramii of antenna 3 segmented.....7

4. Antennules short and immobile.....5

   Antennules long and mobile.....6

5. Body size less than one mm..... *Ceriodaphina cornuta*

   Body size more than one mm..... *Simocephalus vetulus*

6. Antennules located on ventral side of head.....*Moinodaphnia macleayi*

   Antennules located on anterior side of head.....*Macrothrix spinosa*

7. Head shield with one main head pore with small lateral pores.....8

   Head shield with three main head pores.....*Alona pulchella*

8. Valves with setae on entire posteroventral margin.....9

   Valves with setae situated on ventral margin in anterior half and on inner side of ventral margin of posterior half.....*Chydorus sphearicus*

9. Rostrum long.....*Pleurouxus similis*

   Rostrum short.....*Dunhevedia crassa*

10. Shell punctate and elongate.....11

    Shell tumid, broader than long.....*Cypris subglobosa*

11. Terminal claw of the second thoracic leg denticulate.....*Stenocypris hislopi*

    Terminal claw of the second thoracic leg with terminal denticles.....*Stenocypris* sp.

SYSTEMATIC LIST

Order : CLADOCERA
Family : DAPHNIIDAE
Genus : ***Ceriodaphnia*** Dana

1. ***Ceriodapahnia cornuta*** Sars
(Fig. 1)

Material examined: 10 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: West Bengal, Bihar, Kerala, Rajasthan, Meghalaya, Tripura and Andaman and Nicobar Islands.

Elsewhere: Cosmopolitan.

Remarks: Widely distributed in India and Southeast Asia.

Genus : ***Simocephalus*** Schoedler

2. ***Simocephalus vetulus*** (Mueller)
(Fig. 2)

Material examined: 3 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Punjab, Kashmir, Rajasthan, Bihar, West Bengal, Tamil Nadu, Tripura, Andaman and Nicobar Islands.

Elsewhere: Cosmopolitan Remarks: This species includes *S. vetuloides* Sars and *S. elizabethae* (King) after the works of Michael and Sharma (1988).

Family : MOINIDAE
Genus : ***Moinodaphnia*** Herrick

3. ***Moinodaphnia macleayi*** (King)
(Fig. 3)

Material examined: 6 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Tamil Nadu, Rajasthan, West Bengal, Tripura, Andaman and Nicobar Islands.

Elsewhere: Tropicopolitan.

Family : MACROTHRICIDAE
Genus : ***Macrothrix*** Baird

4. ***Macrothrix spinosa*** (King)
(Fig. 4)

Material examined: 3 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Rajasthan, Tamil Nadu, West Bengal, Tripura, Andaman and Nicobar Islands.

Elsewhere: Cosmopolitan.

Family : CHYDORIDAE
Subfamily : CHYDORINAE
Genus : ***Chydorus*** Leach

5. ***Chydorus sphearicus*** (Mueller)
(Fig. 5)

Material examined: 12 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Kashmir, Rajasthan, West Bengal, Meghalaya, Tripura, Tamil Nadu, Andaman and Nicobar Islands.

Elsewhere: Cosmopolitan.

Genus : ***Pleuroxus*** Baird

6. ***Pleuroxus similis*** Parva
(Fig. 6)

Material examined: 3 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Kashmir, Rajasthan, West Bengal, Tripura, Andaman and Nicobar Islands.

Elsewhere: Australia, Malaysia, Sri Lanka, South America.

Genus : ***Dunhevedia*** King

7. ***Dunhevedia crassa*** King
(Fig. 7)

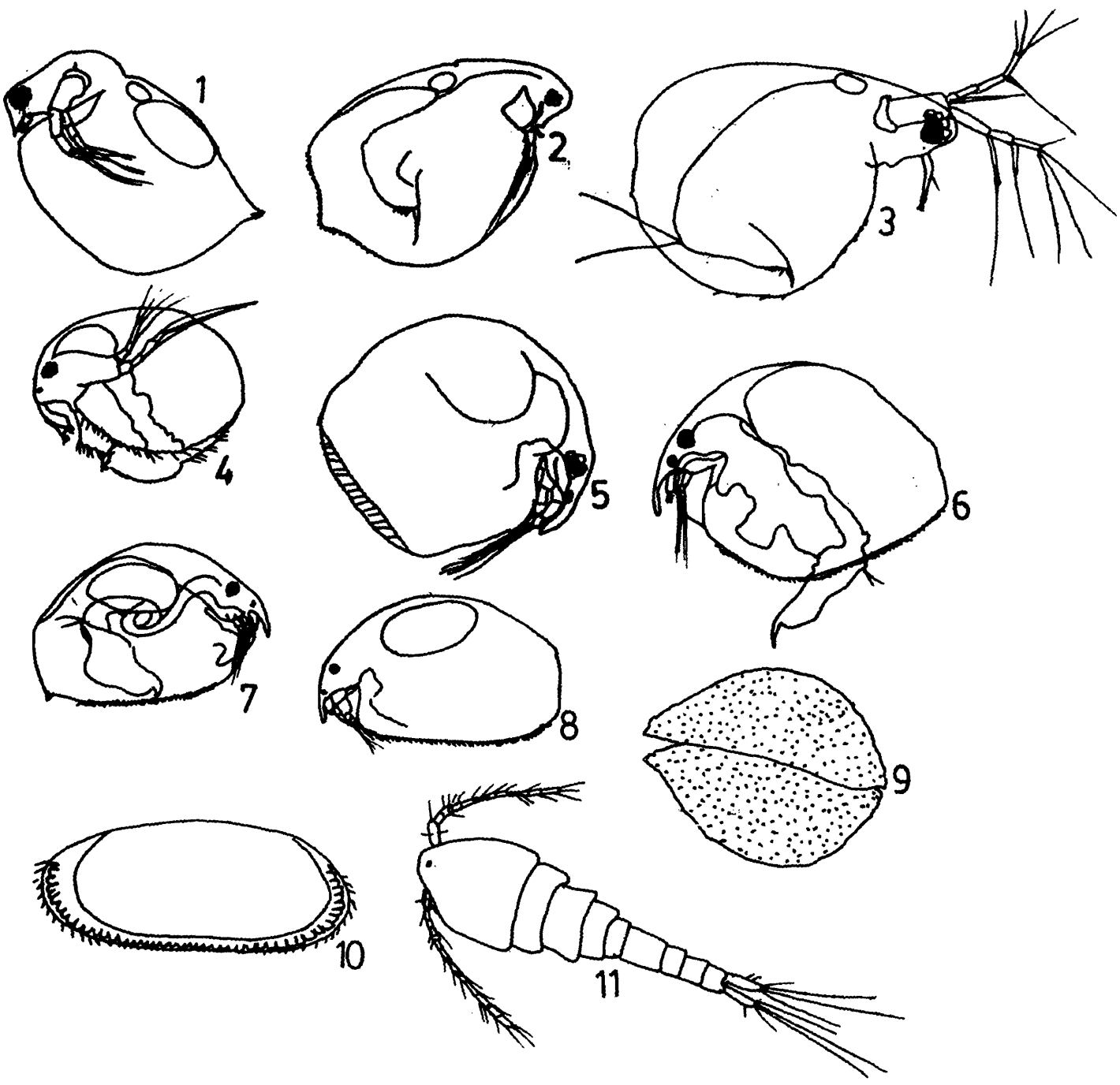
Material examined: 2 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Rajasthan, Gujarat, West Bengal, Tamil Nadu, Andaman and Nicobar Islands. Elsewhere: Holarctic, Ethiopian, Indo-Malayan and Australian regions. Also southern part of European USSR.

Subfamily : ALONINAE
Genus : ***Alona*** Baird

8. ***Alona pulchella*** King
(Fig. 8)

Material examined: 4 ex, 10 Jul 1994, J.M. Julka.



Figs. 1 - 11. Crustacean zoolplanktons of Renuka Lake; 1. *C. cornuta*; 2. *S. vetulus*; 3. *M. macleayi*; 4. *M. spinosa*; 5. *C. sphearicus*; 6. *P. similis*; 7. *D. crassa*; 8. *A. pulchella*; 9. *C. subglobosa*; 10. *S. hislopi*; 11. *M. leuckarti*.

Distribution: India: Rajasthan, Gujarat, West Bengal, Tripura, Andaman and Nicobar Islands.

Elsewhere: Cosmopolitan.

Subclass : OSTRACODA
Order : POPOCOPIDA
Family : CYPRIDIDAE
Genus : *Cypris* Mueller

9. ***Cypris subglobosa*** Sowerby
(Fig. 9)

Material examined: 3 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Maharashtra, Madhya Pradesh, Andhra Pradesh, Tamil Nadu, Kerala.

Remarks: *C. subglobosa* was first described by Baird (1859) from Nagpur, India. He opined that this species was conspecific with a fossil ostracod collected by J.G. Malcomson from Sichel Hills, India and described by Sowerby (1840) as *C. subglobosa*.

Subfamily : STENOCYPRINAE
Genus : *Stenocypris* Sars

10. ***Stenocypris*** sp.

Material examined: 2 ex, 10 Jul 1994, J.M. Julka.

Remarks: The examples of the genus *Stenocypris* in present study could not be identified up to species level due to mutilated specimens.

11. ***Stenocypris hislopi*** Ferguson
(Fig. 10)

Material examined: 3 ex, 10 Jul 1994, J.M. Julka.

Distribution: India: Maharashtra, Andhra Pradesh, Tamil Nadu.

Subclass : COPEPODA
Family : CYCLOPOIDIDAE
Genus : *Mesocyclops* Sars

12. ***Mesocyclops leuckarti*** Claus
(Fig. 11)

Material examined: India: Rajasthan, West Bengal, Tripura, Tamil Nadu, Andaman and Nicobar

Islands.

Elsewhere: Malaysia, Sri Lanka, Africa and South America.

Remarks: Cosmopolitan and eurytopic species.

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CRUSTACEA : DECAPODA

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INTRODUCTION

The Decapoda is the largest order of Crustacea. It comprises prawns and crabs, ranging in size from tiny pelagic shrimp to large rubber crab (king crab). They play an important role in an aquatic ecosystem by recycling dead organic matter. It is quite true that next to fish, prawns and crabs form major source of quality protein to man. *Macrobrachium rosenbergii, Paratelphusa (Barytelphusa) jacquemontii, Paratelphusa (Paratelphusa) spinigera* and *Paratelphusa (Oziotelphusa) hydrodromus* are particularly known for their food value.

The present paper deals with a small collection of crabs, collected from the Renuka wetland in Himachal Pradesh. Important works on the diversity of Indian fresh water crabs are those of Alcock (1909, 1910) and Bott (1970).

SYSTEMATIC LIST

Family : POTAMONIDAE
Genus : ***Potamon*** Savigny

1. ***Potamon koollooense*** Rathbun

Material examined: 1 ex, 27 Sep 1992, R. Paliwal.

Distribution: India: Shimla, Dharamshala, Chamba, Ramnee Garhwal, Bhim Tal, Kumaon (4000-5000 ft.), Naini Tal, R. Rixer.

Elsewhere: Nepal (Tarai), Afghanistan.

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EPHEMEROPTERA

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INTRODUCTION

Ephemeropterans constitute an integral part of fresh water ecosystems of both lotic and lentic nature. The mayflies are amphibiotic and essentially need both aquatic and terrestrial media to complete their life cycles. Aquatic phase comprises of egg and various stages of developing larvae, while terrestrial phase comprises of extremely short-lived subimago. These insects are quite significant in the food chain in aquatic ecosystem. They are also good bioindicators of water quality (Srivastava, 1986).

Indian mayflies comprise of 94 species and 36 genera under 12 families as compared to 2146 species, 213 genera and 20 families in the world. In Himachal Pradesh, about 20 species of mayflies have so far been reported (Hubbard and Peters, 1978; Srivastva, 1983a, 1983b).

Author is thankful to Dr. A.K. Ghosh, Director, Zoological Survey of India, Calcutta for the present assignment and necessary facilities. Thanks are also due to Dr. R.K. Varshney, Addl. Director; Dr. S.K. Tandon and Dr.J.K. Jonathan, Joint Directors, Entomology Division, ZSI, Calcutta for encouragement and also to Dr. J.M. Julka, Joint Director, HAZFS, ZSI, Solan coordinator of the present document on Renuka wetland for its incorporation.

KEY TO THE IDENTIFICATION OF EPHEMEROPTERA OF RENUKA WETLAND

1. Veins M and Cu1 strongly divergent at base, with M2 bent towards Cu basally. Outer fork of RS in hind wing wanting; hind tarsi 4-jointed.....2

   Veins M and Cu1 little divergent at base and fork M more nearly symmetrical; outer fork of RS in hind wing present or absent; hind tarsi 4- or 5-jointed.....3

2. Costal and subcostal area of fore wing very prominently dark brown.....*Ephemera (E.) remensa*

   Costal and subcostal area of fore wing not prominently dark brown but pale.....*Ephemera (E.) consors*

3. Hind wing absent; outer fork of RS of fore wing very deep; eyes of male not turbinate .....*Caenis picea*

   Hind wing present or absent; outer fork of RS of fore wing normal, and posterior branch of M detached basally.....4

4. Posterior margin of head emarginate.....5

Posterior margin of head not emarginate.....*Procloeon bimaculatum*

5. Wings hyaline with no specific pigmentation, costal and subcostal space clear with somewhat faint pigmentation.....*Cloeon kimminsi*

Wings not hyaline, vitreous with bistre brown costal and subcostal space including basal humeral cross veins.....*Cloeon marginale*

SYSTEMATIC LIST

Family : EPHEMERIDAE
Genus : ***Ephemera*** Linnaeus
Subgenus : ***Ephemera*** Linnaeus

1. *Ephemera (E.) consors* Eaton

Material examined: 1 ♂, 23 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Uttar Pradesh, Sikkim.

2. *Ephemera (E.) remensa* Eaton

Material examined: 1 ♀, 23 Sep 1992, J.M. Julka; 1 ♀, 25 Sep 1992, J.M. Julka; 1 ♂, 29 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh, Uttar Pradesh.

Family : CAENIDAE
Genus : ***Caenis*** Stephens

3. *Caenis picea* Kimmins

Material examined: 10 ♀♀, 26 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, West Bengal.

Family : BAETIDAE
Genus : ***Cloeon*** Leach

4. *Cloeon kimminsi* Hubbard

Material examined: 10 ♂♂, 3 ♀♀, 23 Sep 1992, J.M. Julka; 1 ♂, 13 ♀♀, 25 Sep 1992, J.M. Julka; 44 ♂♂, 29 Sep 1992, R. Paliwal; 37 ♂♂, 30 Sep 1992, J.M. Julka; 25 ♂♂, 2 Oct 1992, R. Paliwal.

Distribution: India: Himachal Pradesh, West Bengal, Western Ghats.

Elsewhere: Malaysia.

5. ***Cloeon marginale*** (Hagen)

Material examined: 60 ♂♂, 23 Sep 1992, J.M. Julka; 21 ♂♂, 24 Sep 1992, J.M. Julka; 2 ♂♂, 28 Sep 1992, J.M. Julka; 30 ♂♂, 1 Oct 1992, M.S. Verma; 8 ♂♂, 3 ♀♀, 2 Oct 1992, M.S. Verma.

Distribution: India: Himachal Pradesh, West Bengal, Maharashtra.

Elsewhere: Bangladesh, Sri Lanka, Simalur, Java, Sumatra, the Philippines, Taiwan, Tonkin, China.

Genus : ***Procloeon*** Bengtsson

6. ***Procloeon bimaculatum*** (Eaton)

Material examined: 10 ♂♂, 5 ♀♀, 29 Sep 1992, J.M. Julka, 20 ♂♂, 10 ♀♀, R. Paliwal, 10 ♂♂, 20 ♀♀, J.M. Julka, 11 ♀♀, R. Paliwal; 1 ♀ , 23 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, West Bengal.

Elsewhere: Sri Lanka, Myanmar, Tonkin, Java, Sumatra, Thailand, China, the Philippines, Bangladesh.

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ODONATA (ADULTS)

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INTRODUCTION

The Renuka lake provides an excellent breeding habitat for dragonflies. Kumar and Juneja (1976) listed 31 species of dragonflies from the lake and its vicinity. Further, Kumar (1978) made detailed field notes on the Odonata around this lake.

The present communication is based on the fresh material of odonates received from the High Altitude Zoology Field Station at Solan, and author's earlier studies on these insects from the area.The author is grateful to the Director, Zoological Survey of India, Calcutta, for having alotted the study of above group to him. Thanks are due to the Officer-in-charge, Zoological Survey of India, Solan, for having placed the specimens from the Renuka at his disposal.

LIST OF ODONATA OF RENUKA WETLAND

Suborder : ZYGOPTERA

Family : PLATYCNEMIDIDAE
1. *Copera annulata (Selys)*
2. *Copera marginipes* (Ramb.)
3. *Copera vittata* (Selys)

Family : CALICNEMIDIDAE
4. *Calicnemia eximia* (Selys)
5. *Ceriagrion cerinorubellum* (Brauer)
6. *Ceriagrion coromandelianum* (Fabr.)
7. *Ceriagrion fallax* Ris
8. *Pseudagrion decorum* (Ramb.)
9. *Pseudagrion rubriceps* Selys
10. *Coenagrion dyeri* Fraser
11. *Ischnura delicata* (Hagen)
12. *Ischnura forcipata* Morton
13. *Ischnura senegalensis* (Ramb.)
14. *Agriocnemis pygmeae* (Ramb.)

Family : SYNLESTIDAE
15. *Megalestes major* Selys
16. *Rhinocypha quadrimaculata quadrimaculata* (Selys)
17. *Libellago lineata lineata* (Burm.)

Family : EPALLAGIDAE
18. *Bayadera indica* (Selys)

Family : CALOPTERYGIDAE
19. *Neurobasis chinensis chinensis* (Linn.)

Suborder : ANISOPTERA

Family : GOMPHIDAE
20. *Ictinogomphus rapax* (Ramb.)
21. *Nepogomphus modestus* (Selys)

Family : AESHNIDAE
22. *Anax guttatus* (Burmeister)

Family : LIBELLULIDAE
23. *Orthetrum brunneum brunneum* (Fons.)
24. *Orthetrum chrysostigma luzonicum* (Brauer)
25. *Orthetrum glaucum* (Brauer)
26. *Orthetrum pruinosum neglectum* (Ramb.)
27. *Orthetrum sabina sabina* (Drury)
28. *Orthetrum triangulare triangulare* (Selys)
29. *Brachythemis contaminata* (Fabr.)
30. *Crocothemis servilia servilia* (Drury)
31. *Diplacodes nebulosa* (Fabr.)
32. *Neurothemis fulvia* (Drury)
33. *Neurothemis tullia tullia* (Drury)
34. *Trithemis aurora aurora* (Burm.)
35. *Trithemis festiva* (Ramb.)
36. *Trithemis pallidinervis* (Kirby)
37. *Acisoma panarpoides panarpoides* (Ramb.)

KEY TO THE IDENTIFICATION OF IMAGOS

1. Wings never petiolate; discoidal cell subdivided into a triangle plus supratriangle in fore and hind wings. .....**(Anisoptera) 20**

   Wings petiolate; subpetiolate or non-petiolate; discoidal cell in both wings simple, entire or traversed by nervures .....(Zygoptera) 2

2. Only 2 antenodal nervures.....3

   Never less than 5 antenodals.....17

3. Veins I Riii and Riv+v begining nearer to nodus than to arculus; genital hamules of male quadrate.....4

Veins I Riii and Riv+v begining nearer to arculus than to nodus; genital hamules of male elongate.....*Megalestes major*

4. Discoidal cell elongate, anterior and posterior sides subequal, apex rather obtuse; vein MA and IRiii running straight for greater part of their length, only zigzagged apically or not at all.....5

Discoidal cell short, anterior side considerably shorter than posterior; vein MA and IRiii markedly zigzagged for greater part of their length.....8

5. Costal side of discoidal cell in fore wing one fifth or shorter than posterior side .....*Calicnemia eximia*

Costal side and posterior side of discoidal cell equal or nearly so.....6

6. Hind tibiae white, widely dilated.....*Copera annulata*

Hind tibiae yellow, reddish or brownish, not dilated or moderatly dilated 7

7. Superior and appendages only 1/4 length of inferior; female with posterior lobe of prothorax without spines.....*Copera marginipes*

Superior and appendages at least 1/2 length of inferior, posterior lobe of prothorax of female with a pair of divergent slender forwardly directed spines..... .....*Copera vittata*

8. Arc situated at level of distal antenodal nervures.....9

Arc situated distal to level of distal antenodal nervures.....*Agriocnemis pygmeae*

9. Anal bridges (ab) arising from hind border of wing at a point, the latter joining ac.....13

Anal bridge (ab) arising from hind border of wing more or less proximal to the point, where ac meet it.....10

10. Pterostigma differing in shape and size in fore and hind wings of male.....11

Pterostigma of same colour and shape in fore and hind wings of male.....*Coenagrion dyeri*

11. Abdominal segments 3 to 6 citron yellow.....*Ischnura aurora*

Abdominal segments 3 to 6 black.....12

12. Segment 10 with blue spot on dorsum.....*Ischnura forcipata*

Segment 10 without blue spot.....*Ischnura senegalensis*

13. A prominent ridge on frons, no post ocular coloured spots on head; head and thorax of uniform colour without any dark marking.....15

No ridge on frons, post-ocular coloured spots always present on head; head and thorax not of uniform colour.....14

14. Face, frons and vertex bright reddish orange or dark ochreous.....*Pseudagrion rubriceps*

Face, frons, vertex and occiput blue or green.....*Pseudagrion decorum*

15. Abdomen bright red at base and end.....*Ceriagrion cerinorubelleum*

Adbomen citron yellow.....16

16. Abdomen with black markings on end segments.....*Ceriagrion fallax*

Abdomen without black markings on end segments.....*Ceriagrion coromandelianum*

17. Primary antenodals easily identified from secondaries; base of discoidal cell connected to radius by arculus.....18

Primary antenodels indistinguishable from secondaries; base of discoidal cell not connected to radius by arculus.....19

18. Sectors of arc separated at origin; pterostigma present in forewings of both sexes .....*Rhinocypha q. quadrimaculata*

Sectors of arc arising from a common point, forewing of male without a pterostigma .....*Libellago lineata*

19. Vein Rii+iii not fused with Ri shortly after its origin; discoidal cell short, entire or traversed by very few veins, 1st lateral thoracic suture incomplete .....*Bayadera indica*Vein

Rii+iii fused with Ri near its origin; discoidal cell longer and traversed by many veins; 1st lateral thoracic suture complete.....*Neurobasis ch. chinensis*

20. Discoidal cells approximately of same size and shape in fore and hind wings, situated equally distant from arc; two robust primary antenodals present.....21

Discoidal cells differing in size and shape in fore and hind wings, that of fore wing situated far distal of arc; robust primary antenodals absent.....23

21. Eyes broadly confluent above; ovipositer present.....*Anax guattatus*

Eyes separated; ovipositer absent.....22

22. Abdomen 27-29mm; hind wing 23-25mm.....*Nepogomphus modestus*

Abdomen (with appendages) 52mm; hind wing 40mm.....*Ictinogomphus rapax*

23. Distal antenodal nervure in forewing complete.....24

Distal antenodal nervure in forewing incomplete.....30

24. Only 6 antenodal nervures in forewing.....*Acisoma p. panorpoides*

At least 12 antenodal nervures in forewing.....25

25. Males violaceous-red.....*Orthetrum pruinosum neglectum*

Males brown or black with yellow marking, often pruinosed.....26

26. Abdomen enormously swollen at base and then abruptly slimmed and compressed laterally to the end; abdomen and thorax not pruinosed.....*Orthetrum sabina sabina*

Abdomen variable but never very slim nor compressed laterally mostly with pruinosed abdomen and thorax 27

27. Base of hind wing with a large black triangular marking .....*Orthetrum t. triangulare*

Base of hind wing without a black triangular marking.....28

28. Cuii in hind-wing arising from distal side of discoidal cell well away from its posterior angle .....*Orthetrum chrysostigma luzonicum*

Cuii in hind-wing arising from posterior angle of discoidal cell.....29

29. Membrane black.....*Orthetrum glaucum*

Membrane pure white.....*Orthetrum brunneum brunneum*

30. Lobe of prothorax large and fringed with long hairs .....*Diplacodes nebulosa*

Lobe of prothorax small and usually naked.....31

31. Discoidal field with borders converging strongly at wing margin.....32

Discoidal field with borders parallel or widely divergent at wing margin.....34

32. Legs very large and spidery; ptersotigma bicoloured .....*Trithemis pallidinervis*

Legs of ordinary length; pterostigma unicoloured.....33

33. Thorax and abdomen violaceous black; neuration black.....*Trithemis festiva*

Thorax and abdomen violaceous crimson; neuration crimson.....*Trithemis aurora aurora*

34. Wings coloured amber yellow at base or more broadly dark reddish brown.....35

Wings usually unicloured, red or ochreous species.....36

35. Base of wings of male broadly black; basal area of wings edged outwardly with an opalescent white band.....*Neurothemis tullia tullia*

Wings dark reddish brown from base to about middle of pterostigma; apex of wings also narrowly opaque brown to partly enclose a clear window in each wing .....*Neurothemis fulvia*

36. 9^{1}/2 to 10^{1}/2 antenodal nervure in fore wing.....*Crocothemis s. servilia*

6^{1}/2 to 7^{1}/2 antenodel nervure in fore wing.....*Brachythemis contaminata*

FIELD ECOLOGY

It has been clearly demonstrated that the size and shape of a water body is of great importance in habitat selection of Odonata (Kumar, 1973; 1978; 1985). He has dealt with well marked parochialism in a large number of tropical dragonflies which are confined either to streams, lakes, reservoirs or ephemeral monsoon ponds. The field observations on their distributional pattern around the Renuka Lake (alt. 660m) show a close resemblance with the general pattern elsewhere in western Himalaya. For detailed study, the distribution pattern of odonate species can be broadly classified into three groups (Kumar, 1978): (1) along stream, (2) at perennial ponds with open bank, and (3) along lake shore.

Species near stream:

i) Both banks with vegetation: The stretch A of the hill stream (Fig. 1, stretch A & C) which is about 1.5 m in width and approximately 50 cm in depth has pebbled sandy bed. Both sides of the stream are shaded by bushes. Not many species of dragonflies are present in this stretch. However, the most common one is *Neurobasis chinensis chinensis* (Linn.), which generally flutters over open water surface or perches on overhanging vegetation. Other species occurring here are *Bayadera indica* (Selys), *Nepogomphus modestus* (Selys) and *Trithemis festiva* (Ramb.).

The link stream between Parashuram Tal and Renuka Lake (Stretch C) is almost like stretch A, except that it is a deep channel with scarce vegetation. The common species in this stretch are *Neurobasis chinensis* (Linn.) and *Rhinocypha quadrimaculata quadrimaculata* Selys. At the confluence of the stream and the lake, *Pseudagrion decorum* (Ramb.) and *Coenagrion dyeri* Fraser are most commonly observed fluttering just over water surface. A few imagos of *Trithemis festiva* (Ramb.) can also be found in surrounding areas.

ii) Stream with open beds: This part of the feeder stream to Parashuram Tal (Fig.1, Stretch B) has a number of *R. quadrimaculata* imagos perching on boulders both in the middle and at the banks, while *P. decorum* and *C. dyeri* occur in abundance flying low over water surface at the confluence of stream and pond. A few imagos of *T. festiva* are also found over a short stretch.

Species around perennial pond:

Parashuram Tal (Fig. 1) has an open and shallow bank, and in postmonsoon period it extends almost

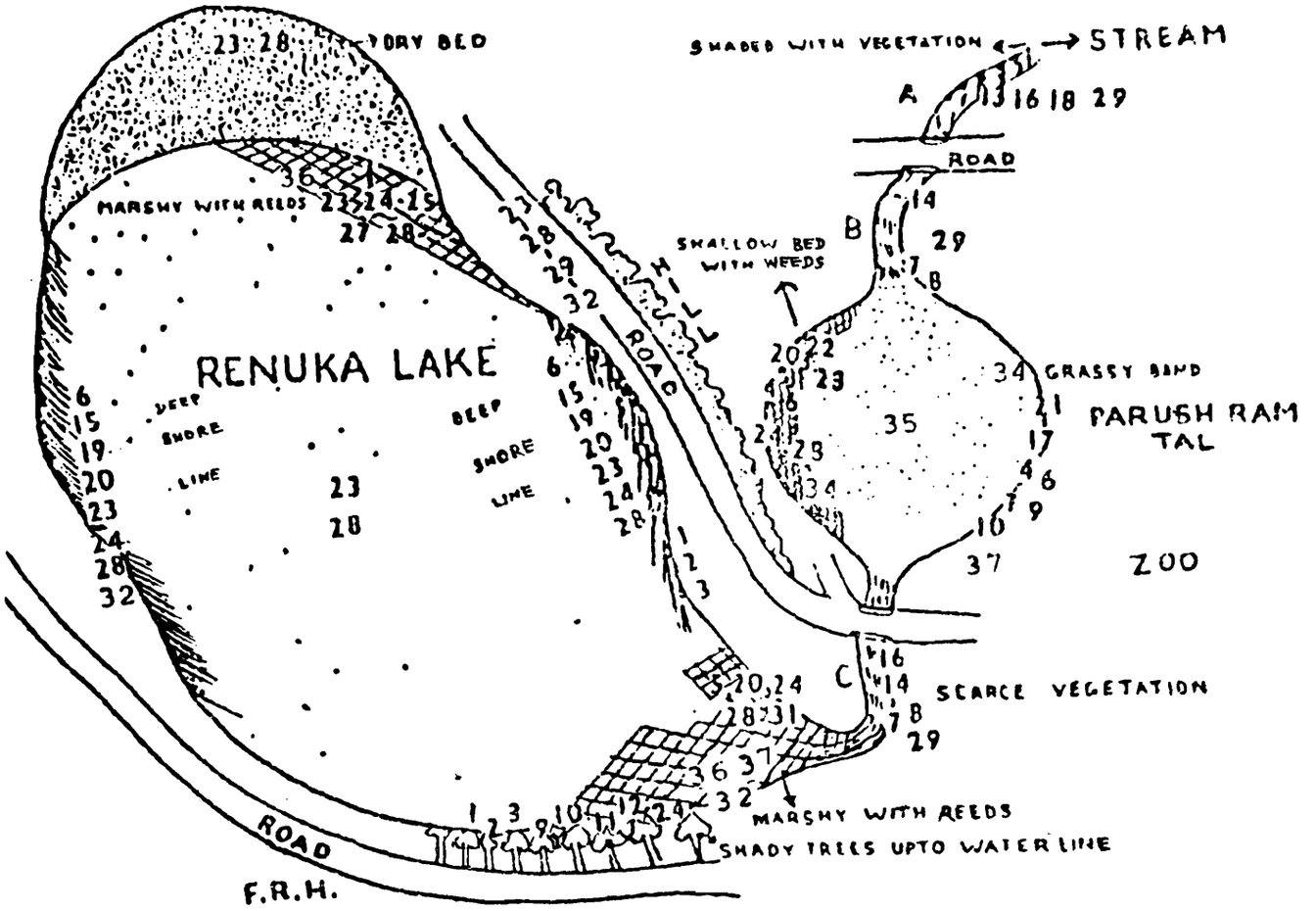

Fig. 1. Field distribution of dragonflies around Renuka lake; 1. *Copera annulata* (Selys); 2. *Copera marginipes* (Ramb.); 3. *C. vittata* (Selys); 4. *Ceriagrion coromandelianum* Fabr.; 5. *C. cerinorubellum* (Brauer); 6. *Pseudagrion rubriceps* Selys; 7. *P. decorum* (Ramb.); 8. *Coenagrion dyeri* Fraser; 9. *Ischnura delicata* (Hagen); 10. *I. forcipata* Morton; 11. *I. senegalensis* (Ramb.); 12. *Agriocnemis pygmeae* (Ramb.); 13. *Bayadera indica* (Selys); 14. *Rhinocypha quadrimaculata* (Selys); 15. *Libellago lineata lineata* (Burm.); 16. *Neurobasis chinensis chinensis* (Linn.); 17. *Ictinogomphus rapax* (Ramb.); 18. *Nepogomphus modestus* (Selys); 19. *Orthetrum b. brunneum* (Fons.); 20. *O. pruinosum neglectum* (Ramb.); 21. *O. s. sabina* (Drury); 22. *O. t. triangulare* (Selys); 23. *Brachythemis contaminata* (Fabr.); 24. *Crocothemis s. servilia* Drury; 25. *Diplacodes nebulosa* (Fabr.); 26. *Neurothemis fulvia* (Drury); 27. *N. t. tullia* (Drury); 28. *Trithemis aurora* (Burm.); 29. *T. festiva* (Ramb.); 30. *T. pallidinervis* (Kirby); 31. *Acisoma p. panarpoides* (Ramb.); 32. *Calicnemia exima* (Selys); 33. *Ceriagrion fallas* Ris; 34. *Megalestes major* Selys; 35. *Anax guttatus* (Burm.); 36. *Orthtrum chrysostigma luzonicum* (Brauer); 37. *O. glaucum* (Brauer).

up to the surrounding road. The western side of the pond has a somewhat deep shore line which is frequented by *C. coromandelianum* Fabr., *P. rubriceps* (Selys), *O. pruinosum neglectum* (Ramb), *O. triangulare triangulare* (Selys), *B. contaminata* (Fabr.), *C. servilia servilia* (Drury) and *T. aurora aurora* (Burm). A few imagos of *Ictinogomphus rapax* (Ramb.) are also seen.

C. coromandelianum, P. rubriceps, P. decorum, I. delicata, I. forcipata, I. rapax, O. sabina and *T. festiva* are common on wings towards shallow eastern part of pond, while *P. decorum* and *O.*

sabina fly frequently over open surface of water. Other species fly low or perch amidst partially submerged vegetation on the bank. Imagos of *B. contaminata* frequent the road around the pond. Often imagos of *O. sabina* are found clashing and chasing each other over open water surface of the pond.

Species around lake (Fig. 1):

i) Among reeds (marshy area): *Neurothemis tullia tullia* Drury and *B. contaminata* are very common in this stretch. A large number of emerging imagos of *N. tullia tullia* were collected during April. This tallies well with the life history pattern of this species in the adjoining Dehra Dun Valley (Kumar, 1988), where it was found to occur in isolated colonies around marshes located amidst thick vegetation. Kumar (*loc. cit.*) further recorded that *N. tullia* is univoltine with oviposition occurring during monsoon period of September-October. The larval development takes about six months and the emergence occurs in March and April. Other species flying amidst reeds are: *C. coromandelianum, C. cerinorubellum* (rare), *O. pruinosum neglectum, C. servilia servilia, T. aurora, Diplacodes nebulosa* and *Asisoma panarpoides panarpoides* (rare). These species were observed perching on vegetation in the eastern side of the lake, which generally remains dry.

ii) Along the deep shore line: *P. rubriceps, Libellago lineata lineata* (Burm.), *O. pruinosum neglectum, B. contaminata, C. servilia servilia, O. brunneum* and *T. aurora* are some of the common species which patrol along shore line of the lake. Among these, *L. lineata lineata* and *P. rubriceps* fly low and lazily above lake surface near shore. The imagos of larger species like *B. contaminata* and *T. aurora* venture deep over the lake chasing each other violently and perform acrobatics over lake surface. Oviposition was not observed at the open lake surface, However, *P.rubriceps* lays eggs in large numbers in submerged shore vegetation.

iii) Away from water amidst shady vegetation: The lake on its western side has thick tree cover with under growth, which harbours a rich population of smaller species like *Copera annulata, C. marginipes, C. vittata, I. delicata, I. forcipata, I. senegalensis, A. pymeae* and *C. servilia servilia*. They are most active in the forenoon and *C. vittata* perches on the hedge of the Forest Rest House or at the surrounding hillock about 30m away from the shore.

iv) On boulders around lake: A large number of *B. contaminata, T. aurora* and *C. servilia* fly over the road or perch over large boulders in sunshine. The females of *Brachythemis* keep away from lake side while the males patrol along the shore. However, the males of *T. aurora* prominently perch on the boulders.

DISCUSSION AND CONCLUSIONS

Subsequent to listing of the Odonata of Renuka lake Kumar & Juneja (1976), Kumar (1982) published an annotated list on 75 species of Odonata from Himachal Pradesh including 31 species from Renuka wetland. The present study adds another six species to the odonate fauna of Renuka, raising the total number of species to 37 from the area. These interestingly form about 50% of the known Odonata fauna of Himachal Pradesh. Thus, it can safely be estimated that Renuka lake provides one of the most ideal aquatic biotope for dragonflies within the western Himalayan ecosystem.

The sense of sight is highly developed in dragonflies, and habitat selection for mating and oviposition are primarily visual. They show a well marked parochialism in relation to shape, size and type of vegetation in a body of water, and also whether the biotope is 'lentic' or 'lotic' Corbet (1962) and Kumar (1978, 1985).

At Renuka wetland, the stream breeding *R. quadrimaculata, B. indica, N. chinensis* and *N. modestus* restrict to the vicinity streams, near the lake, while some of other riverine species like *O. brunneum, L. lineata* and *P. rubriceps* are confined to straight shore line. The typical lotic species like *C. marginipes C. coromandelianum, I. delicata, A. pygmaea, I. rapax. O. sabina, B. contaminata* and *A. panarpoides*, etc., are restricted to reeds in the marshy zone. However, *T. festiva* is irregularly distributed.

The species composition of the Parashuram Tal is poorer than the larger Renuka lake. *I. rapax* is restricted to Parashuram Tal, while *Copera marginipes, C. vittata, C. cerinorubellum, L. lineata lineata, O. brunneum, N. tullia tullia* and *A. panarpoides panarpoides* are confined to Renuka lake. However, the distribution of remaining species overlaps.

On a comparison between the dragonfly fauna of and the proposed Tehri Reservoir area, Kumar (1993) found that 11 species are common between the two localities, notable absentee in Tehri being the species of *Anax, Orthetrum* and *Neurothemis*.

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ODONATA (LARVAE)

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INTRODUCTION

In the first part of this communication the author listed 37 species of adult dragonflies from Renuka wetland and its surroundings. Since this lake provides a more favourable breeding habitat for dragonflies and holds a very rich population of these amphibiotic insects, therefore, studies on their diverse taxonomic and ecological descriptions of their larvae will be significant.

The taxonomy of Odonata larvae is based on combination of a number of characters, like, general body shape, distribution of premental, palpal and other smaller setae on labium, shape of labium, and distal margin of prementum and palpus (Kumar, 1973a; 1973b), and Kumar and Khanna (1983). The habitat preferences of larvae have been tabulated in Table 1.

Plates I-IV depict general morphology, and variations of larval Odonata and explain terms used in the key.

The author is grateful to the Director, Zoological Survey of India, Calcutta, for having alotted the study of the above group to him. Thanks are due to the Officer-in-Charge, Zoological Survey of India, Solan, for having placed the specimens from the Renuka wetland at his disposal.

KEY TO THE IDENTIFICATION OF LARVAE OF ODONATA OF RENUKA WETLAND

1. Abdomen terminating in three caudal lamellae.....(Zygoptera) 2

   Abdomen terminating in five spine-like appendagees.....(Anispotera) 13

2. Antennae with scape longer than length of remaining segments; caudal lamellae saccoid or triqueteral.....3

   Antennae with scape shorter than length of remaining segments; caudal lamellae lamellate.....6

3. Length of scape more than total length of remaining segments; abdomen without paired appendages, lamellae triquiteral.....4

   Length of scape less than total length of remaining segments; caudal lamellae saccoid.... .....*Bayadera indica*

4. Antennae 7- segmented.....5

Antennae 6- segmented.....*Neurobasis chinensis chinensis*

5. Prominent dark markings present on the femur and tibiae.....*Rhinocypha quadrimaculata*

Femur and tibiae without dark markings.....*Libellaqo lineata lineata*

6. Labium greatly narrowing basally, median lobe of prementum with cleft in middle..... .....*Megalestes major*

Labium almost triangular in out-line, median lobe of prementum without cleft in middle.....7

7. Antennae with first segment of flagellum shorter than pedicel; caudal lamellae subnodate.....8

Antennae with first segment of flagellum longer than pedicel; caudal lamellae denodate or nodate.....9

8. Apical spine present on 6th antennal segment, caudal lamellae paddle-like.....*Copera marginipes*

Apical spine absent on 6th antennal segment; caudal lamellae saccoid and hairy..... .....*Calicnemia eximia*

9. Premental setae not exceeding 1+1; caudal lamellae lamellate, rounded at apex.....10

Premental setae exceeding 1+1; caudal lamellae leaf like; narrow and long at apex.....11

10. Caudal lamellae rounded, short, obtusely pointed at apices marked with blotches along periphery..... .....*Ceriagrion coromandelianum*

Caudal lamellae long, typically lamellar type, rounded at apices and divided distinctly into antenodal and postnodal areas.....*Pseudagrion rubriceps*

11. Caudal lamellae broader in middle, apex sharply pointed 12

Caudal lamellae elongate, leaf-like, apices ending into narrow processes.....*Agriocnemis pygmeae*

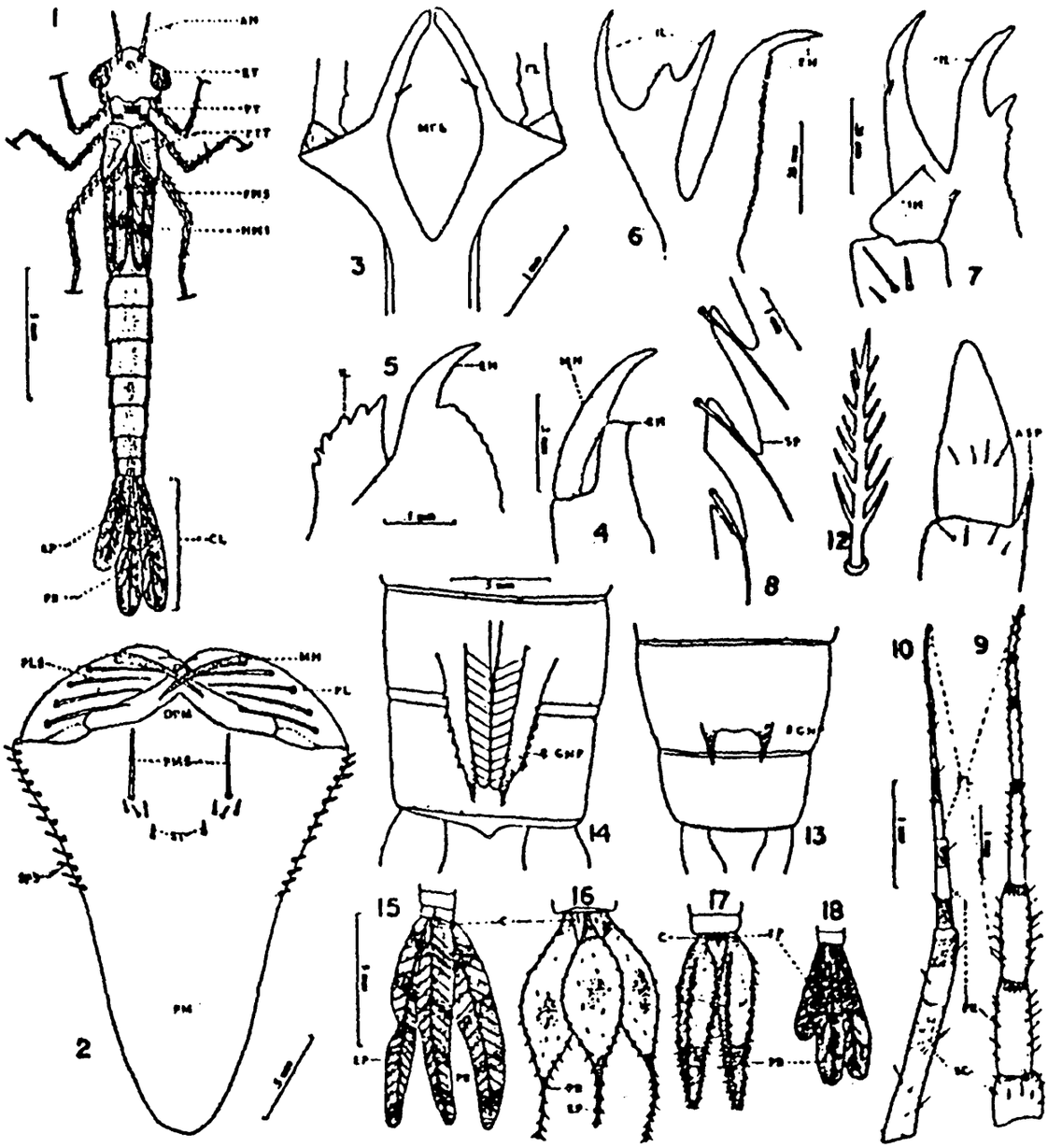
12. Premental setae 5+5; palpal setae 4&4.....*Trithemis aurora aurora*

Premental setae 4+4; palpal setae 5&5 .....*Ischnura senegalensis*

13. Labium flat, without major premental or palpal setae; distal margin of palpus without crenations.....14

Labium spoon-shaped, with a number of major pre-mental and palpal setae; distal margin of palpus with crenations or denticulations.....16

PLATE I



Figs. 1-18. 1. larva (D.V.) *Pseudagrion laidlawi* Fraser (Coenagriidae); 2. labium *P. laidlawi* (Coenagriidae); 3. prementum *Neurobasis c. chinensis* (L.) (Agriidae); 4. distal margin of palpus *Desparoneura campioni* Fraser (Protoneuridae); 5. distal palpus of *P. laidlawi*; 6. distal margin of palpus *Lestes p. praemrosa* Selys (Lestidae); 7. distal margin of palpus *Rhinocypha unimaculata* Selys (Cholorocyphidae); 8. lateral spines of prementum *Bayadera indica* Selys (Epallagidae); 9. antenna *P. laidlawi* (Coenagriidae); 10. antenna *R. unimaculata* (Cholorocyphidate); 11. apical spine of the 4th flagellar segment *Copera marginipes* (Rambur) (Platycnemidae); 12. a pectinate seta; 13. male gonapophyses; 14. female gonapophyses; 15. caudal lamellae *L. p. praemrosa* (Lestidae); 16. caudal lamellae *B. indica* (Epallagidae); 17. caudal lamellae *R. unimaculata* (Cholorocyphidae); 18. caudal lamellae *P. laidlawi* (Coenagriidae). Abbreviations used : - AN - antenna; ASP - Apical spine; C- Cerci; CL - Caudal lamellae; DPM - Distal margin of prementum; EH - End hook; Ep - Epiproct; FL - Flagellum; FWS - Fore wing sheaths; IL - Intermediate lobes; MH - Movable hook; MCL - Median cleft; PE - Pedicel; PL - Palpus; PLS - Palpal setae; PM - Prementum; PMS - Premental setae; PT - Prothorax; PTT - Pterothorax; PR - Paraproct; SC - Scape; SP - Spine; SPS - Spiniform setae; ST - Setella.

PLATE II

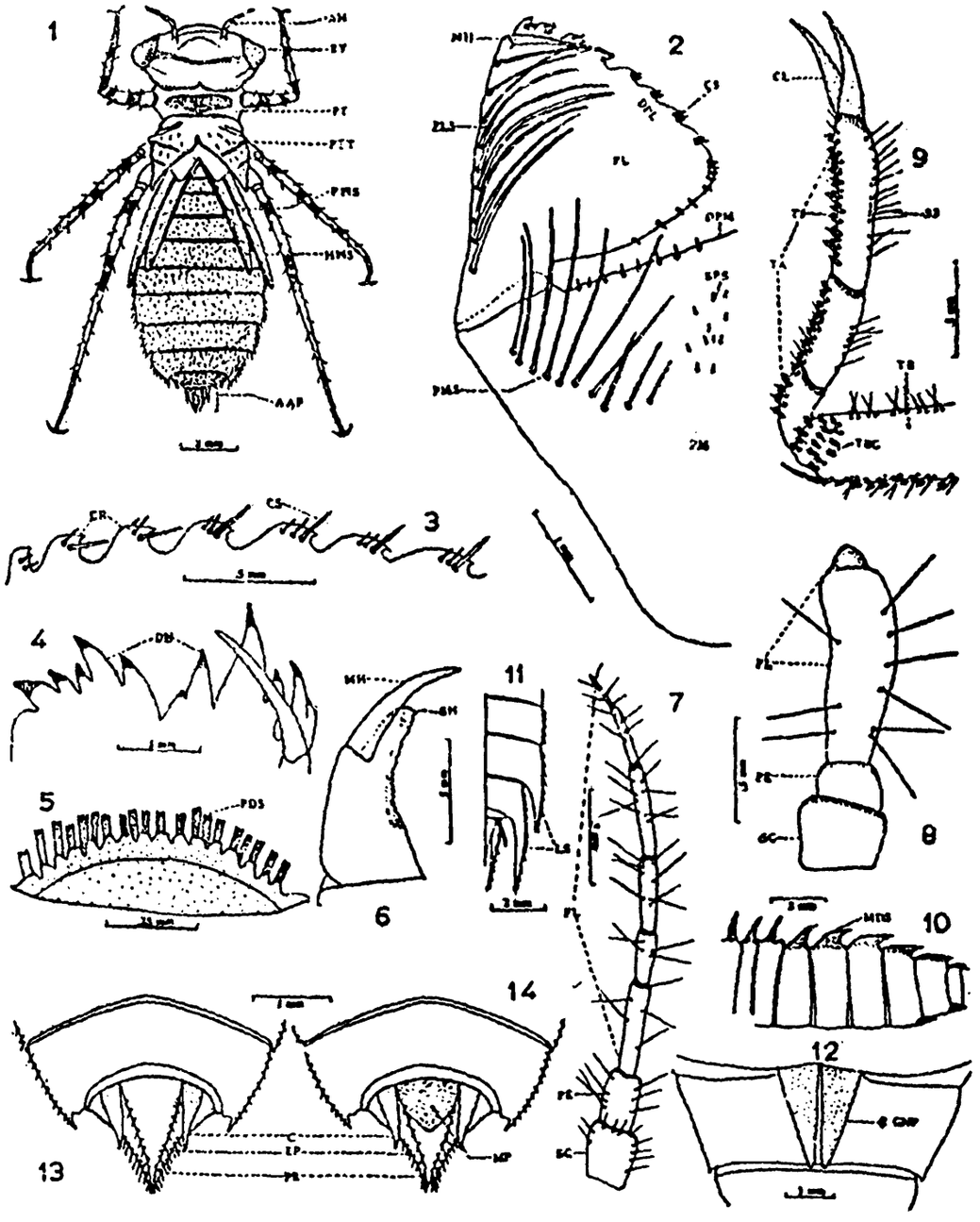


Fig. 1-14. 1, Larva (D.V.) *Crocothemis s. servilea* (Drury) (Libellulidae); 2. labium *Orthetrum sabina* (Drury) (Libellulidae); 3. enlarged view distal margin palpus *O. sabina*; 4. distal margin palpus *Cordulegaster* sp. (Cordulegasteridae); 5. distal margin prementum *Burmagomphus sivalikensis* Laidlaw (Gompeidae); 6. distal margin palpus *B. sivalikensis*; 7. antenna *O. sabina*; 8. antenna *B. sivalikensis*; 9, tibial comb and tarsi *O. sabina*; 10, mid-dorsal abdominal spines *Macromia moorei* Selys (Corduliidae); 11. lateral abdominal spines *Tramea basilaris burmeisteri* Kirby (Libellulidae); 12. female gonapophyses *Cordulegaster* sp.; 13. anal appendages, male *C. s. servilia*; 14. anal appendages, female *C. s. servilia*. Abbreviations used AN - Antenna; AAP Anal appendages; CL - c-cerci claw; CR - Crenation; CS - Claviform seta; DN - Denticle; DPL - Distal margin palpus; DPM - Distal margin prementum; EH - End hook; Ey - Eye; FL - Flagellum; FWS - Fore wing sheaths; GNP-Gonapophyses; HWS - Hind wing sheaths; LS - Lateral spine; MDS - Mid-dorsal spine; MH - Movable hook; PE - Pedicel; PDS - Palisade setae; PL - Palpus; PLS - Palpal setae; PM - Prementum; PMS - Premental setae; PT - Prothorax; PTT - Pterothorax; PR - Paraproct: SC - Scape; SPS - Spiniform seta; SS - Simple seta; TA - Tarsi; TB - Tibia; TBC - Tibial comb; TS - Tridentate setae.

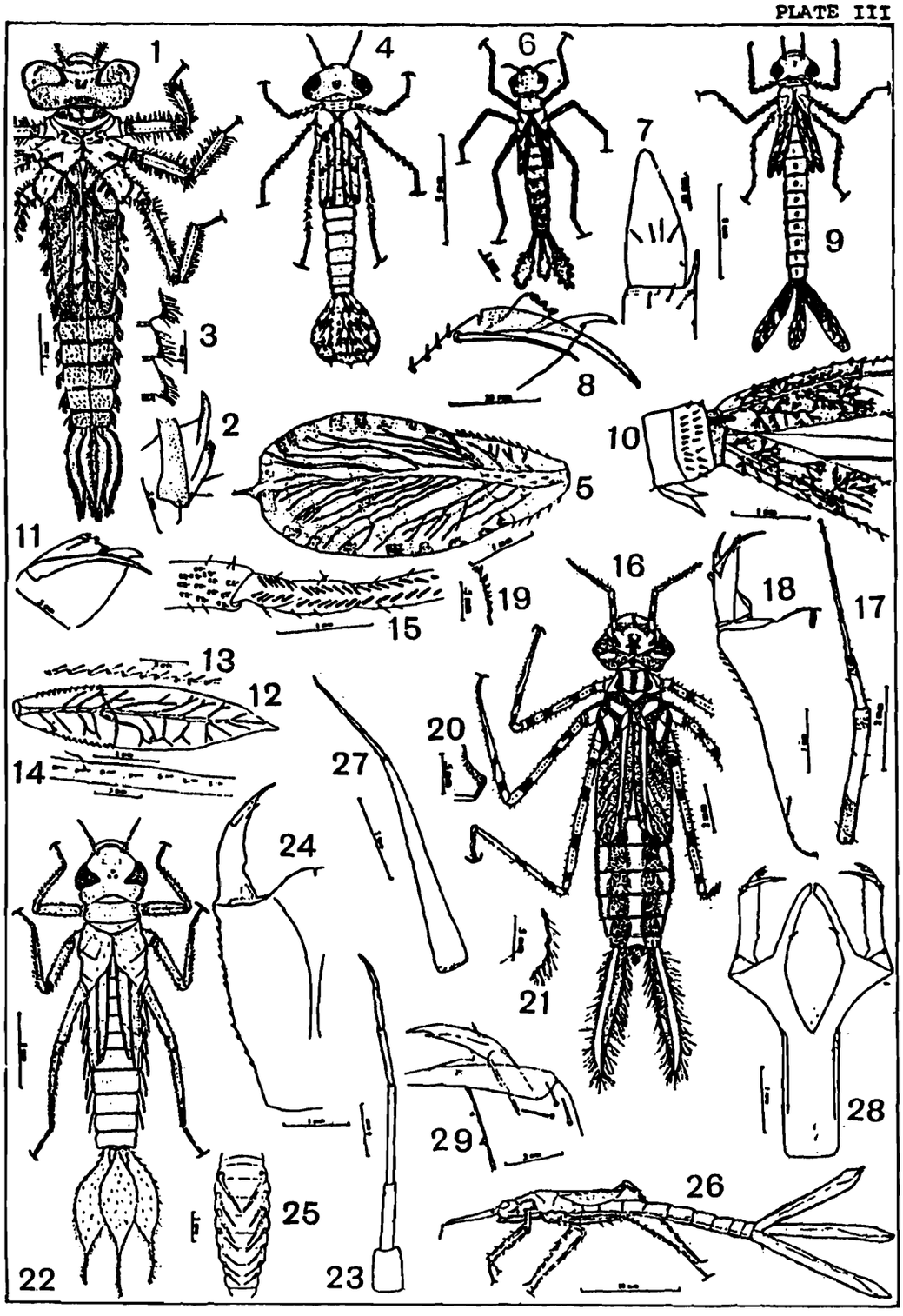
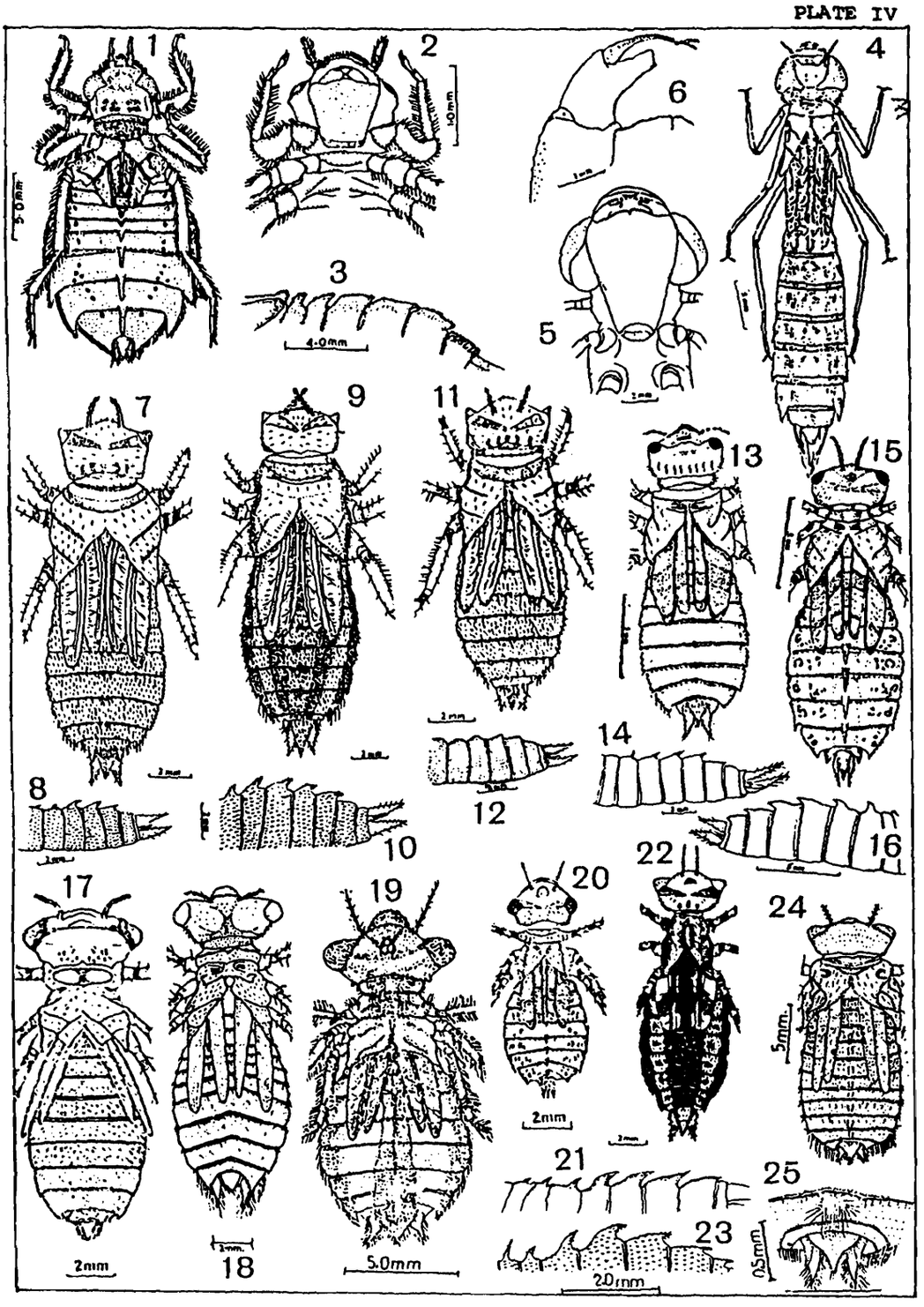


Fig.1-3. *Calicnemia miles* (Laid.): 1. larva; 2. distal margin palpus (e.v.); 3. lateral view terminal abdominal segments; 4-5 *Ceriagrion coromandelianum* (Fabr.) : 4. larva; 5. epiproct; 6-8 *Copera marginipes* (Ramb.) : 6. larva; 7. apical spine on 6th antennal segment; 8. distal margin palpus (e.v.); 9-10. *Pseudagrion rubriceps* Selys : 9. larva; 10. caudal lamellae (e.v.); 11-15. *Ischnura senegalensis* (Ramb.) : 11 distal margin palpus (e.v.); 12. epiproct; 13. lateral margin epiproct; 14. setae on median tract epiproct; 15. tibial and tarsal comb; 16-21. *Rhinocypha q. quadrimaculata* Selys: 16. larva; 17. antenna; 18, labium; 19. ocular spines (v.v); 20. propleural process; 21. lateral spinate process IXth abdomnal segment; 22-25. *Bayadera indica* Selys : 22. larva; 23. antenna; 24. labium; 25. paired ventral abdominal appendages; 26-29. *Neurobasis ch. chinensis* (Linn.) : 26. larva; 27. antenna: 28. labium; 29. distal margin palpus (e.v.).



Figs. 1-3. *Ictinogomphus rapax* (Ramb.) : 1. larva; 2. labium (aboral view); 3. mid-dorsal abdominal spines; 4-6. *Anax guttatus* (Burm.) : 4. larva; 5. labium (aboral view) 6. palpus (e.v.); 7-8. *Orhtetrum b. brunneum* (Fons.): 7. larva; 8. mid-dorsal abdominal spines; 9-10. *O. pruinosum neglectum* (Ramb.) : 9. larva; 10. mid-dorsal abdominal spines; 11-12. *O. taeniolatum* (Schneider): 11. larva; 12. mid-dorsal abdominal spines; 13-14. *O. s. sabina* (Durury): 13. larva; 14. mid-dorsal abdominal spines; 15-16. *Brachythemis contaminata* (Fabr.) : 15. larva; 16. mid-dorsal abdominal spines; 17. *Crocothermis s. servilia* (Drury), larva; 18. *Diplacodes trivialis* (Ramb.), larva; 19. *Neurothemis t. tullia* (Drry), larva; 20-21. *Trithemis a. aurora* (Burm.) : 20. larva; 21. mid-dorsal abdominal spines; 22-23. *Trithemis festiva* (Ramb.): 22. larva; 23. mid-dorsal abdominal spines; 24-25. *Acisoma panarpoides* Ramb. : 24. larva; 25. anal appendages.

14. Antenna 4-segmented; tarsi 2-segmented in fore and middle legs.....15

Antenna 7-segmented; tarsi 3-segmented in all legs.....*Anax guttatus*

15. Larva somewhat flattened; hind tibiae much longer than the first two.....*Ictinogomphus rapax*

Larva not flattened.....*Nepogomphus modestus*

16. Eyes capping frontolateral part of head; palpal setae not exceeding 8+8.....17

Eyes little lower, more broadly rounded and lateral in position; palpal setae may exceed 9+9.....19

17. Premental setae 11+11.....*Orthetrum sabina*

Premental setae more than 11+11.....18

18. Premental setae 21+21.....*Orthetrum pruinosum neglectum*

Premental setae 22+22.....*Orthetrum b. brunneum*

19. Length more than 20mm; palpal setae less than 10&10.....20

Length not more than 20mm; palpal setae always more than 10 & 10 .....(except *Brchythemis*) 21

20. Premental setae 11+11.....*Trithemis festiva*

Premental setae 10+10.....*Trithemis aurora*

21. Premental setae 11+11.....*Acisoma p. panorpoides*

Premental setae more than 11+11.....22

22. Premental setae 14+13.....*Brachythemis contaminata*

Premental setae 13+13.....*Neurothemis tullia tullia*

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Table 1. Habitat preference of odonate larvae in Renuka wetland

	Species 1	2	3	4	5	6	7	8	9	10	11	12
1.	*Copera annulata* (Selys)	-	-	B	-	A	-	-	-	-	-	-
2.	*Copera marginipes* (Ramb.)	-	-	B	-	A	-	-	-	-	-	-
3.	*Copera vittata* (Selys)	-	-	A	-	B	-	-	-	-	-	-
4.	*Calicnemia eximia* (Selys)	-	-	-	-	A	-	-	-	-	-	-
5.	*Ceriagrion cerinorubellum* (Brauer)	-	-	-	-	B	-	-	A	-	-	-
6.	*Ceriagrion coromandelianum* (Fabr.)	-	-	-	B	B	-	-	A	-	-	-
7.	*Ceriagrion fallax* Ris	-	-	-	-	-	-	-	A	-	-	-
8.	*Pseudagrion rubriceps* (Selys)	-	-	C	-	A	-	-	B	-	D	-
9.	*Pseudagrion decorum* (Ramb.)	-	-	-	-	A	-	-	-	-	-	-
10.	*Coenagrion dyeri* Fraser	-	-	A	-	-	-	-	-	-	-	-
11.	*Ischnura delicata* (Hagen)	-	-	C	-	B	-	-	A	-	-	-
12.	*Ischnura forcipata* (Morton)	-	-	-	-	A	-	-	B	-	-	-
13.	*Ischnura senegalensis* (Ramb.)	-	-	-	A	-	-	-	-	-	-	-
14.	*Agriocnemis pygmeae* (Ramb.)	-	-	-	-	-	-	-	A	-	-	-
15.	*Megalestes major* Selys	-	-	-	-	-	-	-	-	-	-	+
16.	*Rhinocypha q. quadrimaculata* (Selys)	A	-	B	-	-	-	-	-	-	-	-
17.	*Libellago lineata lineata* (Burm.)	-	-	A	-	-	-	-	-	-	-	-
18.	*Bayadera indica* (Selys)	A	-	-	-	-	-	-	-	-	-	-
19.	*Neurobasis ch. chinensis* (Linn.)	-	-	A	-	B	-	-	-	-	-	-
20.	*Ictinogomphus rapax* (Ramb.)	-	-	-	-	-	-	A	-	-	-	-
21.	*Nepogomphus modestus* (Selys)	A	-	-	-	-	-	-	-	-	-	-
22.	*Anax guttatus* (Burmeister)	-	-	-	-	-	B	A	-	-	-	-
23.	*Orthetrum b. brunneum* (Fons.)	-	-	-	-	B	-	-	-	-	-	A
24.	*Orthetrum chrysostigma luzonicum* (Brauer)	-	-	-	-	-	-	A	-	-	-	-
25.	*Orthetrum glaucum* (Brauer)	-	-	-	-	-	-	-	A	-	-	-
26.	*Orthetrum pruinosum neglectum* (Ramb.)	-	-	-	-	B	-	A	-	-	-	-
27.	*Orthetrum s. sabina* (Drury)	-	-	-	-	-	A	B	-	-	-	-
28.	*Orthetrum t. triangulare* (Selys)	-	-	-	-	A	-	B	-	-	-	-
29.	*Brachythemis contaminata* (Fabr.)	-	-	-	-	-	-	A	-	-	-	-
30.	*Crocothemis s. servilia* (Drury)	-	-	-	C	B	-	-	A	-	-	-
31.	*Diplacodes nebulosa* (Fabr.)	-	-	-	-	-	-	-	A	-	-	-
32.	*Neurothemis fulvia* (Drury)	-	-	-	-	-	-	A	-	-	-	-
33.	*Neurothemis t. tullia* (Drury)	-	-	-	-	-	-	-	A	-	-	-
34.	*Trithemis a. aurora* (Burm.)	-	-	A	-	-	-	-	B	-	-	-
35.	*Trithemis festiva* (Ramb.)	-	-	B	-	A	-	-	-	-	-	-
36.	*Trithemis pallidinervis* (Kirby)	-	-	A	-	B	-	-	-	-	-	-
37.	*Acisoma p. panarpoides* (Ramb.)	-	-	-	-	-	-	-	A	-	-	-

KEY TO HABITATS: *Fast running water* - (2) clinging to rocks or pebbles, (3) burried in sand, (4) clinging to banks, weeds, roots, etc.; *Slow running water* - (5) burried in mud or algal growth, (6) among weeds, (7) at bottom; *Ponds* - (8) at bottom, (9) among weeds; *Cemented tanks* - (10) attached to walls, (11) at bottom; (12) *Side pools in streams*.
ORDER OF PREFERENCE A>B>C>D

Zool. Surv. India
Wetland Ecosystem Series 2 : Fauna of Renuka Wetland : 63-66, 2000

MANTODEA

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INTRODUCTION

So far two species of Mantodea, *Mantis nobilis* Brunner and *M. indica* Mukherjee are known from Renuka wetland. The present studies record another five species increasing the total number of species to seven from the area. The mantid fauna of Himachal Pradesh comprises 20 species belonging to 13 genera. Notable works on Indian praying mantids are those of Wood-Mason (1882, 1884, 1889-1891), Bolivar (1897), Werner (1930, 1931, 1933, 1935). Mukherjee and Hazra (1983, 1985), and Mukherjee *et al.* (1992, 1995).

The authors are thankful to the Director, Zoological Survey of India, Calcutta, for laboratory facilities. We are also thankful to the Officer-in-Charge, High Altitude Zoology Field Station, Zoological Survey of India, Solan (H.P.) who has handed over the material for our study.

KEY TO THE IDENTIFICATION OF MANTODEA OF RENUKA WETLAND

1. External spines of anterior tibia numerous and beset very close to each other.....2

   External spines of anterior tibia well separated.....3

2. Frontal sclerite without wing-like keel, disc not depressed.....*Ephestiasula intermedia*

   Frontal sclerite with deep groove and with wing-like keel.....*Creobroter laevicollis*

3. Anterior femur with a furrow between 1st and 2nd external spine; eyes large and confluent with level of vertex.....*Humbertiella indica*

   Above furrow absent.....4

4. Anterior femur without discoidal spines.....5

   Anterior femur with 3 discoidal spines.....*Nanomantis lactea*

5. Claw-groove of fore femur distally placed.....*Statiella nemoralis*

   Claw-groove of fore femur medially placed.....6

6. Fore coxa internally with a basal spot.....***Mantis nobilis***

Fore coxa internally without a basal spot.....***Mantis indica***

SYSTEMATIC LIST

Family : HYMENOPODIDAE
Subfamily : ACROMANTINAE
Genus : ***Ephestiasula*** Giglio-Tos

1. ***Ephestiasula intermedia*** Werner

Material examined : 1 ♂, 27 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Jammu and Kashmir, Karnataka, Madhya Pradesh, Rajasthan, Uttar Pradesh.

Remarks: Body length 14.5 mm; pronotun 2.8 mm; fore wing 14.5 mm.

Subfamily : HYMENOPODINAE
Genus : ***Creobroter*** Audinet-Serville

2. ***Creobroter laevicollis*** (Saussure)

Material examined: 3 ♀♀, 24 Jan 1992, J.M. Julka; 1 ♂, 23 Sep 1992, R. Paliwal; 1 ♂, 23 Sep 1992, M.S. Verma; 1 ♂, 2 ♀♀, 6, 24, 25 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh (Sirmour district), Andhra Pradesh.

Elsewhere : Java.

Remarks: Body length ♂ 27.5 mm, ♀ 35.0 mm; pronotum ♂ 6.8, ♀ 8.5 mm; fore wing ♂ 28.0 mm, ♀ 29.0 mm.

Family : MANTIDAE
Subfamily : LITURGUSINAE
Genus : ***Humbertiella*** Saussure

3. ***Humbertiella indica*** Saussure

Material examined: 1 ♂, 28 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh (Sirmour district), Gujarat, Karnataka, Maharashtra, Orissa, Tamil Nadu, Uttar Pradesh.

Elsewhere: Sri Lanka.

Remarks: 1 ♂: Body length 26.5 mm; pronotum 4.9 mm; fore wing 24.0 mm.

Subfamily : IRIDOPTERYGINAE
Genus : ***Nanomantis*** Saussure

4. ***Nanomantis lactea*** Mukherjee

Material examined: 3 ♂♂, 18 Sep 1992, R. Paliwal; 5 ♂♂, 22, 27 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Sirmour district), Tamil Nadu.

Remarks: ♂ : Body length 24.0 mm; pronotum 8.0 mm; fore wing 14.5 mm. This species is a new record from Himachal Pradesh.

Subfamily : MANTINAE
Genus : ***Mantis*** Linnaeus

5. ***Mantis indica*** Mukherjee

Distribution: India: Himachal Pradesh.

Remarks: Recorded from Renuka lake and Chail by Mukherjee *et al.* (1995).

6. ***Mantis nobilis*** Brunner

Distribution: India: Himachal Pradesh (Renuka lake) Manipur, West Bengal.

Elsewhere: Myanmar.

Genus : ***Statiella*** Stal

7. ***Statiella nemoralis*** (Saussure)

Material examined: 4 ♂♂, 24, 28 Sep 1992, J.M. Julka; 1 ♀, 29 Sep 1992, R. Paliwal.

Distribution: India: Arunachal Pradesh, Himachal Pradesh (Renuka sanctuary), Tamil Nadu, West Bengal.

Elsewhere: Eastern Asia.

Remarks: Body length ♂ 48.5-49.5 mm, ♀ 60.0 mm; pronotum ♂ 16.0-17.0 mm, ♀ 19.5 mm (prozona 5.5 mm, metazona 14.0 mm); head width ♂ 5.5 mm, ♀ 7.7 mm; coxa ♂ 11.0 mm, ♀ 14.5 mm; femur ♂ 14.0 mm, ♀ 17.5 mm; tibia ♂ 5.7 mm, ♀ 7.0 mm; fore wing ♂ 38.0-39.0 mm, ♀ 43.0 mm. The body colour, shape of frontal sclerite, excess number of spines on anterior coxae and presence of black spots at ends of stigma are noteworthy in the specimens studied here. These specimens have some characters of *S. apicalis*, and some of *S. maculata* and rest of *S. nemoralis*. This species is a new record from Himachal Pradesh.

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Zool. Surv. India
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DERMAPTERA

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INTRODUCTION

Altogether 7 species belonging to 5 genera are represented, out of which 4 were already reported from the area by Srivastava and Lal (1992). These mostly occur under stones on the edge of streams, rivers and other water bodies, except *Proreus simulans abdominalis* Ramamurti which is generally found in leaf axils of various plants, scales of bamboo, rotten banana stems and decaying logs.

All the above species are terrestrial except *Forcipula trispinosa* (Dohrn) and *Forcipula quadrispinosa* (Dohrn) which are semiaquatic and capable of swimming short distance but close to the water edge. These two species alongwith *Nala nepalensis* (Burr) breed in the vicinity of water, spending almost their whole life there.

All species from the wetland are common in the Oriental Region, of which three, namely, *Euborellia annulipes*(Lucas), *Nala lividipes* (Dufour) and *Labidura riparia*(Pallas) are distributed all over the globe but more abundant in tropical parts. *Nala nepalensis* and *Forcipula trispinosa*have comparatively less extensive distribution, occurring in the montane and submontane habitats of South Asian countries.

My thanks are due to the Director, Zoological Survey of India, Calcutta for providing necessary facilities during the preparation of the paper.

KEY TO THE SPECIES OF DERMAPTERA OF RENUKA WETLAND

1. Genitalia with two functional distal lobes, often one reduced or atrophied.....2

   Genitalia with one median functional lobe.....(CHELISOCHIDAE) *Proreus abdominalis*

2. Genitalia with or without virga, if present, usually not wider at base and without sinuous inner tube; denticulated, chitinous pads present.....(ANISOLABIDIDAE) *Euborellia annulipes*

   Genitalia with a distinct virga, dilated at base with a distinct inner sinuous tube.....
   .....(LABIDURIDAE) 3

3. Elytra along the coastal margin with a ridge; legs relatively shorter.....(NALINAE) 4

   Elytra along the coastal margin without a ridge (occasionally with a faint convexity); legs longer...

.....(LABIDURINAE) 5

4. Forceps in basal half dilated internally.....*Nala nepalensis*

Forceps long and cylindrical, not dilated in basal half.....*Nala lividipes*

5. Sides of abdominal segments without spines; parameres with a short epimerite apically..... .....*Labidura riparia*

Sides of abdominal segments, in normal male specimens, with spines; parameres with a long epimerite apically.....6

6. Elytra tuberculated, with a faint convexity along the coastal margin.....*Forcipula quadrispinosa*

Elytra smooth or punctulated, without any convexity along the coastal margin..... .....*Forcipula trispinosa*

SYSTEMATIC LIST

Family : ANISOLABIDIDAE
Subfamily : ANISOLABIDINAE
IGenus : ***Euborellia*** Burr

1. *Euborellia annulipes* (Lucas)

Material examined: 2 ♀♀, 21 Apr 1992, 1 ♀, 23 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: World wide.

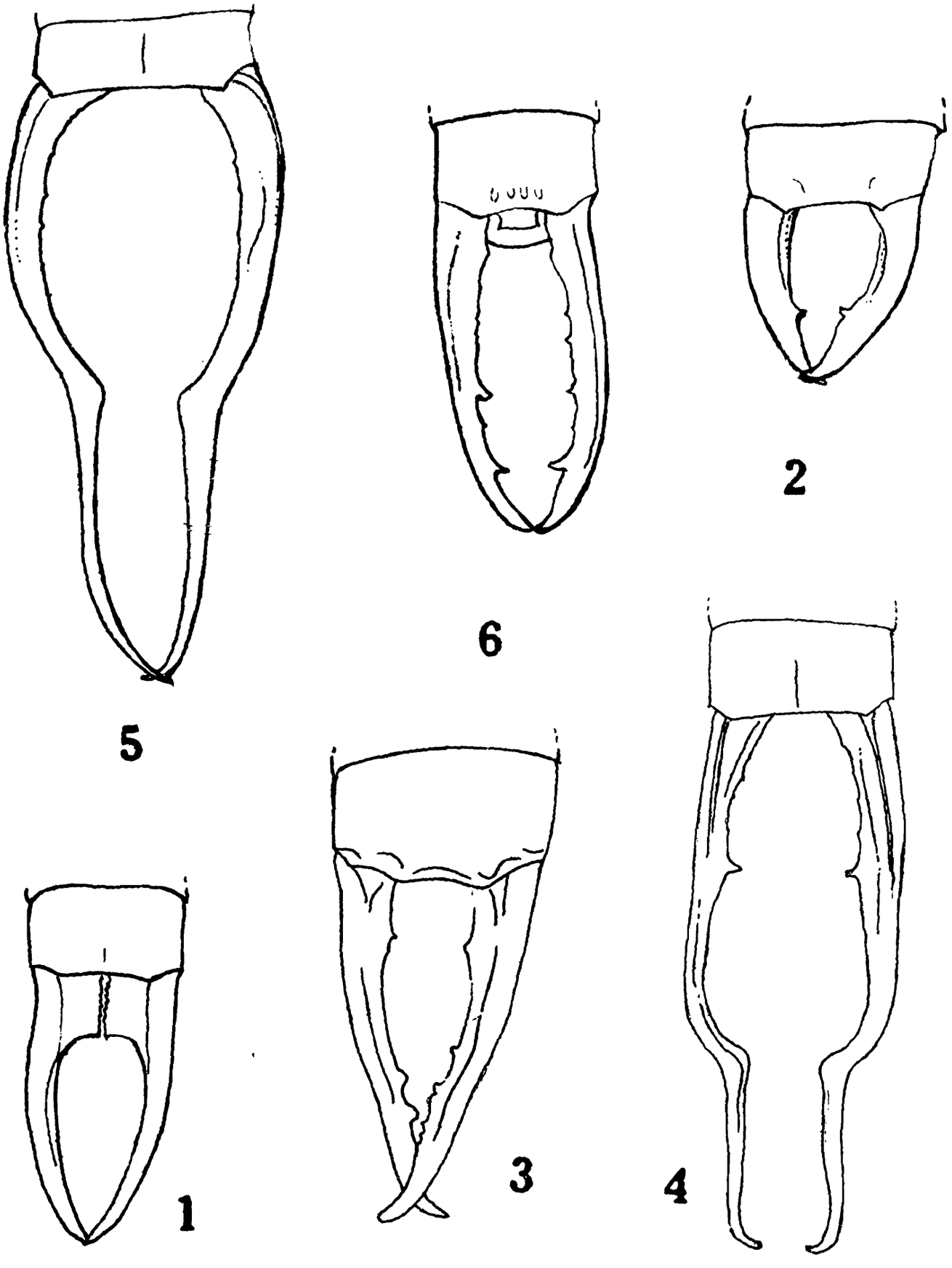
Family : LABIDURIDAE
Subfamily : NALINAE
Genus : *Nala* Zacher

2. *Nala nepalensis* (Burr) (Fig. 1)

Material examined: 1 ♂, 3 ♀♀, 24 Apr 1992, 1 ♂, 3 ♀♀, 1 nymph, 22 Apr 1992, 1 ♂, 1 ♀, 1 nymph, 23 Apr 1992, 3 ♂♂, 1 ♀, 27 Apr 1992, A.S. Mahabal; 2 ♀♀, at light, 29 Sep 1992, J.M. Julka.

Distribution: India: Occurring all along the Himalaya and other mountains of northeast India.

Elsewhere: In the mountains of Afghanistan, Bhutan, Nepal, Malaya, southern China, Laos, Vietnam and Siam.



Figs. 1-6. Male, ultimate tergite : 1. *Nala nepalensis*; 2. *Nala lividipes*; 3. *Labidura riparia*; 4. *Forcipula trispinosa*; 5. *Forcipula quadrispinosa*; 6. *Proreus abdominalis*.

3. *Nala lividipes* (Dufour)
(Fig. 2)

Material examined: 1 ♂, 3 ♀♀, 24 Sep 1973, H.P. Agrawal.

Distribution: India: All over India except semialpine region in extreme north.

Elsewhere: Widely distributed throughout tropical Asia, southern Europe, Africa, Australia.

Genus : ***Labidura*** Leach

4. ***Labidura riparia*** (Pallas)
(Fig. 3)

Material examined: 2 ♂♂, 2 ♀♀, 22 Apr 1992, A.S. Mahabal.

Distribution: India: Throughout.

Elsewhere : Almost world wide but more abundant in tropical and subtropical parts.

Genus : ***Forcipula*** Bolivar

5. ***Forcipula trispinosa*** (Dohrn)
(Fig. 4)

Material examined: 4 ♂♂, 5 ♀♀, 3 nymphs, 23 Apr 1992, 3 ♂♂, 3 ♀♀, 3 nymphs, 22 Apr 1992, 2 ♂♂, 3 ♀♀, 4 nymphs, 24 Apr 1992, 1 ♂, 1 ♀, 5 nymphs, 26 Apr 1992, A.S. Mahabal; 1 ♀, at light, 1 nymph, 2 Sep 1992, R. Paliwal; 2 ♂♂, 2 ♀♀, at light, 2 Sep 1992, J.M. Julka.

Distribution: India: In Himalaya and other mountains of northeast along streams and rivers. Elsewhere: Bhutan, Nepal, Afghanistan.

6. ***Forcipula quadrispinosa*** (Dohrn)
(Fig. 5)

Material examined: 1 ♂, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Throughout.

Elsewhere: Various countries in the Oriental Region, and Reunion and Mauritius.

Family : CHELISOCHIDAE
Subfamily : CHELISOCHINAE
Genus : ***Proreus*** Burr

7. ***Proreus abdominalis*** Ramamurthi
(Fig. 6.)

Material examined: 1 ♂, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Throughout.

Remarks: It commonly occurs in leaf axil, bamboo scales, banana stem and under bark of dead decaying logs.

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ORTHOPTERA

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INTRODUCTION

Grasshoppers, crickets, bush-crickets, mole-crickets and related insects are included in the Order Orthoptera. These insects are small to large in size (about 5 mm to 115 mm). They are distributed worldwide, but most of them occur in warmer regions and well represented in the temperate zone. They are found in all terrestrial habitats from subterranean burrows and caves to tree-tops, and from dense forest to savanna and desert; but subaquatic forms are less. Most of them are phytophagous but some are omnivorous. Some species are polyphagous but none is parasitic. These insects are of much economic importance as many species are serious pests of crops, forests and pastures. None is of medical or veterinary importance.

Julka *et al.* (1982), Bhowmik and Rui (1982), Bhowmik and Halder (1983) and Bhowmik (1985a) have worked on the orthopteran fauna of Himachal Pradesh. They recorded only three species of grasshoppers and crickets from Renuka lake area which are marked with single asterisk (*) in this paper. A total of 50 species of Orthoptera distributed under 9 families have been studied. In addition, Bhowmik (1985 b) has also reported *Turanogryllus histrio* (Saussure) from Giri river and a new species *Velarifictorus lambai* from Paonta. Both the localities are in Sirmour district. However, these two species are not included in the text. The species marked with double asterisks (**) are recorded for the first time not only from Renuka wetland but also from Himachal Pradesh.

Authors are grateful to the Director, Zoological Survey of India, Calcutta, for the laboratory facilities and the Officer-in-Charge, High Altitude Zoology Field Station, Zoological Survey of India, Solan, who has handed over the material of Orthoptera for study.

KEY TO THE IDENTIFICATION OF ORTHOPTERA OF RENUKA WETLAND AND SANCTUARY

1. Antennae about as long or longer than body, many segmented; tympanal organ, when present, on fore tibiae.....2

   Antennae shorter, with less than 30 segments; tympanal organ, when present, at base of abdomen.....25

2. Tarsi 4-segmented, at least on middle and hind legs.....3
   Tarsi 3-segmented.....8

3. Head globose, usually not slanted or frontally flattened; dorsal surface of tibiae flat or slightly concave; proximal tarsomere cylindrical, not laterally sulcate; ovipositor usually short, upturned, margins usually crenulated; prosternum unarmed.....4

   Without above combination of characters.....6

4. Front coxa unarmed or with oval, minute, hardly visible spine; tympanic membrane slit formed with light curved lid; subcosta and radius of tegmina near to each other but certainly at base, distinctly separated from each other.....*Elimaea securigera*

   Front coxa with one distinct, straight or curved sharp pointed spine; tympanic membrane open outside; subcosta and radius of tegmina in front of bases almost entirely longitudinal, separated from each other.....5

5. Hind wings of female distinctly more than twice the length of tegmina; subgenital plate of female contiguous from base, not curved; cerci acuminate; ovipositor distinctly shorter and acute..... .....*Himertula kinnaeri*

   Hind wings of female surpassing tegmina for less than twice the length of pronotum; subgenital plate of female triangular and obtuse; cerci conical; ovipositor not so short and acute..... .....*Letana despecta*

6. Antennal sockets strongly margined, produced specially on internal dorsal margins; thoracic auditory spiracle small, inconspicuous, not hidden by pronotum .....*Onomarchus* sp.

   Antennal sockets not strongly margined and specially not on internal margins; thoracic auditory spiracle large, conspicuous, elongate, often wholly or partially concealed by pronotum.....7

7. Tibial auditory structure typically open, if closed on one or both sides then slit laterally directed, opening broad and its margins undulant; prosternum armed with a pair of prominent spike-like processes.....*Mecopoda elongata*

   Tibial auditory structure with foramina (either open or closed) directed distinctly dorsally in relation to position on tibia); if open, opening of nearly uniform width; prosternum with a pair of spines.....*Conocephalus maculatus*

8. Second segment of tarsi compressed, minute.....9

   Second segment of tarsi depressed.....24

9. Spines of posterior tibiae immovable, without hairs.....10

   Spines of posterior tibiae movable, pubescent.....21

10. Both sexes with convex face; frontal rostrum never with prolongation or process.....11

    Face more or less flattened in male; frontal rostrum with or without process.....17

11. Head with narrow frontal rostrum.....*Gryllodes sigillatus*

Head with wide frontal rostrum.....12

12. Epiphallus with styli on posterior lateral corners .....*Turanogryllus rufoniger*

Epiphallus without styli.....13

13. Median line of bridge of epiphallus entire.....14

Median line of bridge of epiphallus with a small V-shaped emargination.....15

14. Head with a very faint yellow band along internal margin of eyes; lateral field of tegmina without widely separated veins; genitalia short and trilobate .....*Modicogryllus facialis*

Head without any markings; lateral field of tegmina with widely separated veins; genitalia short, deeply notched at apex with a small median process.....*Modicogryllus blennus*

15. Anterior projection of ectoparamere approximately equal to external projection.....*Gryllus bimaculatus*

Anterior projection of ectoparamere much longer than external projection.....16

16. Mesal lobes with their apices between bases of ectoparameres; endoparameres J-shaped.....*Plebeiogryllus guttiventris*

Mesal lobes with their apices between apices of ectoparameres; endoparameres C-shaped.....*Teleogryllus occipitalis*

17. Male with flattened or somewhat concave face; mandibles of male often very strong and lengthened .....*Velarifictorus dehradunensis*

Face of male strongly flattened, oblique in front; mandibles not so strong and lengthened.....18

18. First joint of antennae with external angle produced in a process.....*Loxoblemmus taicoun*

First joint of antennae without any process.:.....19

19. Frontal rostrum very broad, almost 4 times as broad as first antennal joint.....*Loxoblemmus macrocephalus*

Frontal rostrum not so wide.....20

20. Size small (11-12mm); first joint of antennae with a short dentiform projection.....*Loxoblemmus equestris*

Size large (14-18mm); first joint of antennae plain .....*Loxoblemmus detectus*

21. Posterior femora adorned with blackish bands.....22

Posterior femora unicolorous.....23

22. Maxillary palpi very dark at base, with 4th and 5th joints nearly white; lateral lobes of pronotum blackish.....*Pteronemobius fascipes*

Maxillary palpi testaceus, a little darkened at apex; lateral lobes of pronotum rufo-testaceous.....*Pteronemobius csikii*

23. Lateral lobes of pronotum and lateral field of tegmina blackish, contrasting with testaceous upper part .....*Pteronemobius taprobanensis*

Lateral lobes of pronotum and lateral field of tegmina of same colour as upper part.....
.....*Pteronemobius pantelchopardorum*

24. Tegminal venation similar in both sexes.....*Trigonidium cicindeloides*

Tegminal venation different in both sexes, showing always in male a very neat anal field and mirror.....*Anaxipha longipennis*

25. Tarsi usually 3-segmented; antennae usually long.....26

Tarsi 1 or 2-segmented; antennae short with 12 or fewer segments.....49

26. Pronotum normal or if, rarely, extended behind, then empodium present or antennae shorter than fore femur.....27

Pronotum extended backwards to cover abdomen; empodium absent; antennae longer than fore femur.....43

27. Foveolae of vertex lateral or inferior, never forming tip of fastigium; stridulatory mechanism present.....28

Foveolae of vertex contiguous, superior and forming extremity of fastigium; stridulatory mechanism absent.....41

28. Radial area of tegmina with a series of regular parallel stridulatory veinlets.....
.....*Spathosternum pr. prasiniferum*

Stridulatory veinlets of radial area of tegmina absent.....29

29. Prosternal process or tubercle present.....35

Prosternal process or tubercle absent.....30

30. Head with acute angle of frons.....31

Head with rounded fastigium.....34

31. Head conically ascending; hind femora with a spine on dorso-external and dorso-internal genicular lobes ..... *Acrida exaltata*

Head not ascending; hind femora with rounded dorso-internal genicular lobes..... 32

32. Lateral carinae of pronotum straight, continuous..... *Phlaeoba panteli*

Lateral carinae of pronotum diverging poseriorly..... 33

33. Antennae filiform..... *Ceracris striata*

Antennae ensiform, with basal third compressed and widened segments..... *Holopercna* sp.

34. Carina of pronotum complete, median sulcus visible on sides before middle; pronotum with incomplete white cruciform marks..... *Oedaleus abruptus*

Carina of pronotum cut by median sulcus much before middle; pronotum without cruciform marks ..... *Sphingonotus longipennis*

35. Last abdominal tergite in male with well developed furcula; supra-anal plate with strongly attenuate apical part; subgenital plate with transverse fold ..... *Eucoptacra saturata*

Last abdominal tergite in male without well developed furcula; supra-anal plate variable; subgenital plate without transverse fold..... 36

36. Dorsum of pronotum flat or weakly tectiform, with median and lateral carinae linear; male cercus with strongly compressed, lobiform or subacute downcurved apex..... 37

Dorsum of prnotum of variable shape; lateral carinae, if present, not linear; male cercus otherwise..... 38

37. Male cercus narrow, weakly compressed, with acute apex..... *Eyprepocnemis rosea*

Male cercus widened and strongly compressed in apical half..... *Choroedocus illustris*

38. Tegmina lateral, lobiform, extending beyond first abdominal segment..... *Paraconophyma scabra*

Tegmina and wings well developed, reaching upto or shorter than abdomen..... 39

39. Pronotum not constricted in middle; prosternal tubercle cylindrical and widened frontally with rounded apex..... *Diabolocatantops innotabilis*

Pronotum at least slightly constricted in middle; prosternal tubercle neither cylindrical nor with rounded apex..... 40

40. Male cercus not bifurcated apically..... *Xenocatantops humilis*

Male cercus clearly bifurcate apically..... *Xenocatantops karnyi*

41. Anterior margin of prosternum strongly reflexed and dilated..... ..... *Chrotogonus (Ch.) tr. trachypterus*

Anterior margin of prosternum neither reflexed nor dilated.....42

42. Tegmina long and narrow, body moderately slender .....*Atractomorpha cr. crenulata*

Tegmina moderately broad, body stout.....*Aularches miliaris*

43. Posterior angles of lateral lobes of pronotum acutely produced outwards and spined..... .....*Eucriotettix grandis*

Posterior angles of lateral lobes of pronotum not spined, but turned downwards and more or less rounded.....44

44. Eyes approximate anteriorly, vertex triangular.....*Teredorus frontalis*

Eyes not approximate anteriorly.....45

45. Vertex and eyes obviously raised above level of pronotum; antennae inserted between lower border of eyes.....46

Vertex and eyes very little or not at all raised above level of pronotum; antennae scarcely placed below middle of eyes.....48

46. Median carina of pronotum undulate; posterior femora with distinct nodosities on external surface.....47

Median carina of pronotum not undulate; posterior femora with less conspicuous nodosities on external surface.....*Euparatettix tenuis*

47. Median carina of pronotum distinctly undulate; lateral carinae with small dilated lobes on hind process of pronotum; median femora sufficiently flattened, margins lobate; hind femora tuberculate on external surface.....*Ergatettix guentheri*

Median carina of pronotum indistinctly undulate; lateral carinae without dilated lobes on hind process of pronotum; median femora less flattened, margins little lobate; hind femora with less protuberant tubercles on external surface.....*Ergatettix dorsifera*

48. Frontal costa widely sulcate, rami more or less abruptly widened between antennae..... .....*Hedotettix gracilis*

Frontal costa not widely sulcate, rami not widened between antennae.....*Hedotettix attenuatus*

49. Hind tarsi rudimantary, much shorter than subapical spur, without terminal tooth.....*Xya* sp.

Hind tarsi well developed, at least nearly as long as subapical spurs, mostly much longer and often with a terminal tooth.....*Tridactylus thoracicus*

SYSTEMATIC LIST

Suborder : ENSIFERA
Family : GRYLLIDAE
Genus : ***Gryllus*** Linne

1. ***Gryllus bimaculatus*** De Geer

Material examined: 2 ♂♂, 25 Jul 1992, Mahesh Chandra.

Distribution: India: Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Bihar, Gujarat, Himachal Pradesh (Bhakra Nagal Dam, Bilaspur, Renuka), Jammu and Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Africa, Malay, Myanmar, Mediterranean region, Pakistan, Singapore, Sri Lanka.

Genus : ***Teleogryllus*** Chopard

2. ***Teleogryllus occipitalis*** (Serville)

Material examined: 1 ♂, 23 Sep 1992, N.K. Sinha; 1 ♀, 27 Sep 1992, M.S. Verma.

Distribution: India: Andaman Islands, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh (Renuka, Lal Khud, Dadahu, Sirmour Distt; Pandoh, Mandi Distt.; Shalaghat, Bilaspur Distt.), Karnataka, Madhya Pradesh, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Borneo, Indonesia (Java), Japan, Nepal, the Philippines, Sri Lanka, Sulawesi, Sumatra, Thailand, Tibet, Veitnam.

Genus : ***Plebeiogryllus*** Randell

3. ***Plebeioqryllus guttiventris* (Walker)

Material examined: 1 ♂, 21 Apr 1992, A.S. Mahabal; 1 ♀, 28 Jul 1992, Jagdish Chand.

Distribution: India: Himachal Pradesh (Renuka), Bihar, Goa, Haryana, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Pondicherry, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Myanmar, Sri Lanka.

Genus : ***Modicogryllus*** Chopard

4 ***Modicogryllus blennus* (Saussure)

Material examined: 1 ♂, 1 ♀, at light, 27, 30 Sep 1992, M.S. Verma; 1 ♀, at light 1 Oct 1992. R. Paliwal.

Distribution: India: Himachal Pradesh (Renuka), Assam, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Australia, Malaysia, Solomon Island, Sri Lanka, Myanmar.

*5. ***Modicogryllus facialis*** (Walker)

Distribution: India: Himachal Pradesh (Renuka lake), Himalayas (without exact locality), Maharashtra, Tamil Nadu.

Remarks: Bhowmik (1985) recorded this species from Renuka lake.

Genus : ***Turanogryllus*** Tarbinskii

6. ***Turanoqryllus rufoniger*** (Chopard)

Material examined: 2 ♀♀, 18 Jul 1992, Jagdish Chand.

Distribution: India: Assam, Karnataka, Manipur, Meghalaya, Himachal Pradesh (Renuka), Punjab, Uttar Pradesh, West Bengal.

Elsewhere: French Indo-China, Laos, Myanmar.

Genus : ***Gryllodes*** Saussure

7. ***Gryllodes sigillatus*** (Walker)

Material examined: 1 ♂, 22 Jul 1992, Mahesh Chandra; 1 ♂, 25 Jul 1992. Mahesh Chandra; 2 ♂♂, 26 Apr 1993, A.S. Mahabal.

Distribution: India: Andaman Islands, Andhra Pradesh, Assam, Bihar, Himachal Pradesh (Renuka, Kandror, Bilaspur), Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Malaysia, Pakistan, Sri Lanka.

Genus : ***Velarifictorus*** Randell

8. ***Velarifictorus dehradunensis* Tandon & Shishodia

Material examined: 1 ♂, 16 Jul 1992, Jagdish Chand.

Distribution: India: Himachal Pradesh (Renuka), Uttar Pradesh.

Genus : ***Loxoblemmus*** Saussure

9. ***Loxoblemmus equestris* Saussure

Material examined: 4 ♀♀, at light, 22 Sep 1992, R. Paliwal and M.S. Verma; 2 ♀♀, 25 Sep 1992, J.M. Julka.

Distribution: India: Andaman Islands, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh (Renuka), Jammu and Kashmir, Karnataka, Madhya Pradesh, Manipur, Meghalaya, Punjab, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Celebes, Indonesia (Java), Japan, Malaysia, Myanmar, Sri Lanka, Thailand.

10. ***Loxoblemmus detectus*** (Serville)

Material examined: 1 ♂, 1 ♀, at light, 27 Sep 1992, M.S. Verma.

Distribution: India: Andaman Islands, Andhra Pradesh, Arunachal Pradesh, Bihar, Himachal Pradesh (Lal Khud, Renuka, Dadahu, Sirmour Distt.), Mizoram, Sikkim, Uttar Pradesh, West Bengal.

Elsewhere: China, Java, Malaysia, Singapore, Sri Lanka, Taiwan.

11. ***Loxoblemmus taicoun* Saussure

Material examined: 1 ♂, 3 ♀♀, 23 Sep 1992, J.M. Julka; 2 ♂♂, at light, 27 Sep 1992, M.S. Verma.

Distribution: India: Arunachal Pradesh, Himachal Pradesh (Renuka), Uttar Pradesh.

Elsewhere: China, Japan, Taiwan.

*12. ***Loxoblemmus macrocephalus*** Chopard

Distribution: India: Arunachal Pradesh, Assam, Jammu and Kashmir, Himachal Pradesh (Renuka lake).

Remarks: Bhowmik (1985) recorded this species from Renuka lake.

Genus : ***Pteronemobius*** Jacobson & Bianchi

13. ***Pteronemobius csikii* (Bolivar)

Material examined: 1 ♂, 28 Sep 1992, M.S. Verma.

Distribution: India: Arunachal Pradesh, Assam, Bihar, Himachal Pradesh (Renuka), Haryana, Karnataka, Rajasthan, Tamil Nadu, Uttar Pradesh.

Elsewhere: China, Myanmar, Sri Lanka.

14. ***Pteronemobius fascipes*** (Walker)

Material examined: 1 ♀, 23 Apr 1992, A.S. Mahabal; 1 ♂, 2 Jul 1992, Mahesh Chandra; 1 ♀ (nymph), 22 Jul 1992, Mahesh Chandra; 4 ♂♂, 2 ♀♀, 23 Sep 1992, R. Paliwal; 6 ♂♂, 4 ♀♀, at light, 27, 28, 29 Sep 1992, M.S. Verma; 1 ♂, 3 ♀♀, 2 Oct 1992, J.M. Julka.

Distribution: India: Arunachal Pradesh, Assam, Bihar, Goa, Haryana, Himachal Pradesh (Renuka, Dharamsala, Mandi-Kullu Road, Guglikhud, Jagindranagar, Gaura), Jammu and Kashmir, Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Meghalya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: China, Malaysia, Myanmar, the Philippines, Singapore, Sri Lanka, Taiwan.

15. ***Pteronemobius taprobanensis* (Walker)

Material examined: 1 ♂, 28 Sep 1992, M.S. Verma.

Distribution: India: Andaman Islands, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh (Renuka), Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, China, Indonesia, Malacca, Malaysia, Myanmar, Perak, Sri Lanka, Vietnam.

16. ***Pteronemobius pantelchopardorum* Shishodia & Varshney

Material examined: 4 ♂♂, 4 ♀♀, 2 Jul 1992, Mahesh Chandra.

Distribution: India: Himachal Pradesh (Renuka), Kerala, West Bengal.

Family : TRIGONIDIIDAE
Genus : ***Anaxipha*** Saussure

17. ***Anaxipha longipennis* (Serville)

Material examined: 1 ♂, at light, 23 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh (Renuka), Andaman Islands, Assam, Karnataka, Manipur, Meghalaya, Orissa, Tamil Nadu, West Bengal.

Elsewhere: East Africa, Tropical Asia, Madagascar, Malay, Sri Lanka, Myanmar, Mauritius, the Philippines, Queensland.

Genus : ***Trigonidium*** Rambur

18. ***Trigonidium cicindeloides* Rambur

Material examined: 2 ♂♂, 2 Jul, 1992, Mahesh Chandra; 1 ♀, 19 Jul 1992, Jagdish Chand.

Distribution: India: Andaman Islands, Arunachal Pradesh, Assam, Bihar, Himachal Pradesh (Renuka), Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Africa, Comoroon, Madagascar, Malaysia, Mauritius, Mediterranean region, Myanmar, Nepal, Sri Lanka.

Family : PHANEROPTERIDAE
Genus : ***Elimaea*** Stal

19. ***Elimaea securigera* (Brunner)

Material examined: 1 ♂, 22 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh, Assam, Tamil Nadu, West Bengal.

Elsewhere: Tropical regions from Africa to Australia, Nepal, Sri Lanka.

Genus : ***Letana*** Walker

20. ***Letana despecta* (Brunner)

Material examined: 1 ♂, 23 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh.

Remarks: Female not known.

Genus : ***Himertula*** Uvarov

21. ***Himertula kinnaeri* (Uvarov)

Material examined: 1 ♀, at light, 27 Sep 1992, M.S. Verma.

Distribution: India: Western India.

Elsewhere: Persia, Baluchistan.

Family : CONOCEPHALIDAE
Genus : ***Conocephalus*** Thunberg

22. ***Conocephalus maculatus* (Le Guillou)

Material examined: 1 ♂, 23 Sep 1992, M.S. Verma.

Distribution: India: Widely.

Elsewhere: Throughout tropical regions of old world, range extending eastwards to Australia and New Guinea.

Family : MECOPODIDAE
Genus : ***Mecopoda*** Serville

23. ***Mecopoda elongata* (Linnaeus)

Material examined: 1 ♂, 29 Sep 1992, M.S. Verma; 1 ♂, 1 ♀, 30 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh, Arunachal Pradesh, Andaman Islands, Sikkim, Tamil Nadu, West Bengal

Elsewhere: S. Africa, Borneo, Celebes, China, Japan, Moluccas, Penang Island, the Philippines, New Guinea, Sunda Island, Singapore, Sri Lanka, Taiwan, Tonkin.

Family : PSEUDOPHYLLIDAE
Genus : ***Onomarchus*** Stal

24. ***Onomarchus* sp.

Material examined: 1 ex, 28 Sep 1992, M.S. Verma.

Distribution: India: Assam, West Bengal, Himachal Pradesh.

Elsewhere: Tropical eastern Asia.

Suborder : CAELIFERA
Family : ACRIDIDAE
Genus : ***Acrida*** Linne

25. ***Acrida exaltata*** (Walker)

Material examined: 1 ex, 29 Sep 1992, M.S. Verma.

Distribution: India: Arunachal Pradesh, Andhra Pradesh, Bihar, Goa, Himachal Pradesh, (Kandaghat, Ghuma, Solan, Renuka, Pandoh, Chakkar, Mandi, Bilaspur), Jammu and Kashmir, Kerala, Maharashtra, Meghalaya, Madhya Pradesh, Orissa, Rajasthan, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: West Aden, Afghanistan, Saudi Arabia, Bangladesh, Iran, Pakistan, Sri Lanka, S.E. Tibet, Sri Lanka.

Genus : ***Ceracris*** Walker

26. ***Ceracris striata* Uvarov

Material examined: 1 ♂, 2 ♀♀, Jul 1992, Mahesh Chandra; 1 ♂, 3 ♀♀, 25 Sep 1992, J.M. Julka; 1 ♀, 29 Sep 1992, M.S. Verma.

Distribution: India: **Himachal Pradesh (Renuka).**

Elsewhere: Pakistan.

Remarks: Uvarov (1925) established this species on the basis of specimens obtained from Pusa collection (now I.A.R.I., New Delhi). These specimens were collected from Abbottabad, N.W.Frontier Province 4120 feet (now in Pakistan). So, at present, it is a new record not only from Himachal Pradesh but also from India.

Genus : ***Holopercna*** Karsch

27. ***Holopercna*** sp.

Material examined: 1 ♂ (nymph), 18 Jul 1992, Jagdish Chand.

Remarks: Due to nymphal stage, this specimen could not be identified upto specific level.

Genus : ***Phlaeoba*** Stal

*28. ***Phlaeoba panteli*** Bolivar

Material examined: 1 ♀, 23 Apr 1992, A.S. Mahabal; 1 ♀, 25 Sep 1992, J.M. Julka.

Distribution: India: Andhra Pradesh, Bihar, Himachal Pradesh (Chakkar, Drang, Pandoh, Mandi Distt; Bilaspur, Bilaspur Distt.; Renuka lake, Sirmour Distt.), Madhya Pradesh, Meghalaya, Tamil Nadu, West Bengal.

Elsewhere: Afghanistan.

Genus : ***Oedaleus*** Fieber

29. *Oedaleus abruptus* (Thunberg)

Material examined: 1 ♂, 25 Sep 1992, J.M. Julka.

Distribution: India: Widely.

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

Genus : ***Sphingonotus*** Fieber

30. ***Sphingonotus longipennis*** Saussure

Material examined: 1 ♂, 2 ♀♀, 18 Jul 1992, Jagdish Chand; 1 ♀, 23 Jul 1992, Jagdish Chand; 1 ♂, 22 Sep 1992, R. Paliwal; 3 ♂♂, 3 ♀♀, 26 Sep 1992, J.M. Julka.

Distribution: India: Arunachal Pradesh, Assam, Himachal Pradesh (Mandi, Drang, Pandoh, Mandi District; Renuka, Sirmour District), Jammu and Kashmir, Punjab, Rajasthan, Uttar Pradesh.

Genus : ***Spathosternum*** Krauss

31. ***Spathosternum prasiniferum prasiniferum*** (Walker)

Material examined: 2 ♂♂, 25 Jul 1992, Kailash Chandra; 1 ♂, 2 ♀♀, 25, 26 Sep 1992, J.M. Julka; 1 ♂, at light, 27 Sep 1992, M.S. Verma.

Distribution: India: Widely.

Elsewhere: S.E. China, Myanmar, Thailand, Veitnam.

Genus : ***Eucoptacra*** Bolivar

32. ***Eucoptacra saturata* (Walker)

Material examined: 1 ♂, 19 Jul 1992, Jagdish Chand.

Distribution: India: Assam, Madhya Pradesh, Orissa, Tripura, Himachal Pradesh (Renuka), Uttar Pradesh.

Genus : ***Paraconophyma*** Uvarov

33. ***Paraconophyma scabra*** (Walker)

Material examined: 1 ♀, 18 Jul 1992, Jagdish Chand; 1 ♀, 25 Jul 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Mandi, Simla, Renuka, Solan), Jammu and Kashmir, Karnataka, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal.

Genus : ***Diabolocatantops*** Jago

34. ***Diabolocatantops innotabilis*** (Walker)

Material examined: 1 ♀, 26 Sep 1992, J.M. Julka.

Distribution: India: Arunachal Pradesh, Assam, Himachal Pradesh (Renuka, Sirmour Distt.; Pandoh, Drang, Mandi Distt.; Dhungri, Manali, Kulu Distt.), Kerala, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Indo-China, Java, Malay, Myanmar, New Guinea, the Philippines, Sri Lanka, Sumatra, South Tibet, Thailand, Yunan.

Genus : ***Xenocatantops*** Dirsh & Uvarov

35. ***Xenocatantops h. humilis*** (Serville)

Material examined: 1 ♂, 28 Sep 1992, M.S. Verma.

Distribution: India: Arunachal Pradesh, Assam, Kerala, Himachal Pradesh (Mandi, Renuka, Arki, Solan), Madhya Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Borneo, Indo-China, Java, Malay, Myanmar, Nepal, New Guinea, the Philippines, Sri Lanka, Sumatra, Thailand, Tibet, Yunan.

36. ***Xenocatantops karnyi*** (Kirby)

Material examined: 2 ♂♂, 18, 23 Jul 1992, Jagdish Chand.

Distribution: India: Andhra Pradesh, Delhi, Himachal Pradesh (Kunihar, Solan, Renuka, Bilaspur, Mandi), Tamil Nadu, Uttar Pradesh.

Genus : ***Eyprepocnemis*** Fieber

37. ***Eyprepocnemis rosea*** Uvarov

Material examined: 1 ♀, 19 Jul 1992, Jagdish Chand.

Distribution: India: Assam, Himachal Pradesh (Chakkar, Mandi, Drang, Pandoh, Mandi Distt.; Deoghat, Saproon, Solan Distt.; Renuka, Sirmour Distt.), Jammu and Kashmir, Madhya Pradesh, Meghalaya, Uttar Pradesh, West Bengal.

Genus : ***Choroedocus*** Bolivar

38. ***Choroedocus illustris*** (Walker)

Material examined: 1 ♀ 23 Sep 1992, J.M. Julka; 1 ♀, 1 Oct 1992, R. Paliwal.

Distribution: India: Bihar, Himachal Pradesh (Mandi, Pandoh, Drang, Mandi Distt.; Solan, Solan Distt.; Renuka, Sirmour Distt.), Karnataka, Tamil Nadu.

Elsewhere: Pakistan, Thailand.

Family : PYRGOMORPHIDAE
Genus : ***Atractomorpha*** Saussure

39. ***Atractomorpha cr. crenulata* (Fabricius)

Material examined: 1 ♀, 26 Apr 1992, A.S. Mahabal; 2 ♀ ♀, 18 Jul 1992, Jagdish Chand.

Distribution: India: Andaman & Nicobar Islands, Andhra Pradesh, Bihar, Goa, Jammu and Kashmir, Karnataka, Madhya Pradesh, Tamil Nadu, Himachal Pradesh (Renuka), Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Myanmar, Pakistan, Sri Lanka, NW Sumatra, South Veitnam.

Genus : ***Chrotogonus*** Serville

40. ***Chrotogonus (Chrotogonus) tr. trachypterus* (Blanchard)

Material examined: 1 ♀, 27 Apr 1992, A.S. Mahabal; 1 ♂, 1 ♀, 23 Jul 1992, Jagdish Chand.

Distribution: India: Himachal Pradesh (Renuka), Bihar, Madhya Pradesh, Meghalaya, Orissa, Rajasthan, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Nepal, Pakistan.

Genus : ***Aularches*** Stal

41. ***Aularches miliaris*** (Linnaeus)

Material examined: 3 ♂♂, 3 ♀♀, 25, 26, 27 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka, Shalaghat, Bilaspur, Mandi), Jammu and Kashmir, Meghalaya, Orissa, Sikkim, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Indonesia, Java, Kampuchea, West Malaysia, Myanmar, Nepal, Pakistan, Sri Lanka, Thailand, Tibet, South Veitnam.

Family : TETRIGIDAE
Genus : ***Eucriotettix*** Hebard

42. ***Eucriotettix grandis* (Hancock)

Material examined: 2 ♂♂, 1 ♀, 29 Sep 1992, M.S. Verma.

Distribution: India : Himachal Pradesh (Renuka), Arunachal Pradesh, Assam, Meghalaya, Sikkim, West Bengal.

Elsewhere: Nepal, S.E. China.

Genus : ***Euparatettix*** Hancock

43. ***Euparatettix tenuis* Hancock

Material examined: 3 ♂♂, 20 Jul 1992, Mahesh Chandra; 3 ♂♂, at light, 22, 23 Jul 1992. Jagdish Chand.

Distribution: India: Himachal Pradesh (Renuka), Arunachal Pradesh, Assam, Bihar, Manipur, Meghalaya, Sikkim, Tripura, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Myanmar.

Genus : ***Hedotettix*** Bolivar

44. ***Hedotettix attenuatus* Hancock

Material examined: 1 ♂, at light, 22 Jul 1992, Jagdish Chand; 2 ♂♂, at light, 23 Jul 1992, Mahesh Chandra; 3 ♂♂, 2 ♀♀, at light, 23, 28, 30 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh (Renuka), Arunachal Pradesh, Assam, Manipur, Meghalaya, Orissa, West Bengal.

Elsewhere : Sri Lanka.

45. ***Hedotettix gracilis* (De Haan)

Material examined: 1 ♀, 25 Apr 1992, A.S. Mahabal; 1 ♀, 19 Jul 1992, Jagdish Chand; 1 ♂, 1 ♀, 25 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka), Arunachal Pradesh, Assam, Maharashtra, Manipur, Meghalaya, Orissa, Tripura, West Bengal.

Elsewhere: Bangladesh, Celebes, Java, Myanmar, Sri Lanka, Sulawesi, Sunda Island, Sumatra, Taiwan, Thailand, Veitnam.

Genus : ***Ergatettix*** Kirby

46. ***Ergatettix dorsiferus* (Walker)

Material examined: 2 ♂♂, 25, 27 Apr 1992, A.S. Mahabal; 1 ♂, 26 Apr 1992, A.S. Mahabal; 2 ♂♂, 25 Jul 1992, Mahesh Chandra; 3 ♂♂, at light, 23 Sep 1992, R. Paliwal.

Distribution: India: Widely.

Elsewhere: Afghanistan, Central Asia, Bangladesh, S. China, Greater Sunda Island, Iran, Java, Myanmar, Nepal, Sri Lanka, Sumatra, Sumba, Taiwan.

47. ***Erqatettix guentheri* Steinmann

Material examined: 1 ♀, at light, 30 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh (Renuka), Arunachal Pradesh, Assam, Bihar, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Tripura, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Nepal, Sri Lanka.

Genus : ***Teredorus*** Hancock

48. ***Teredorus frontalis*** Hancock

Material examined: 2 ♀♀, 23 Apr 1992, A.S. Mahabal.

Distribution: India: Arunachal Pradesh, Assam, Himachal Pradesh (Dharampur, Simla Hills, Renuka lake), Manipur, Meghalaya, Sikkim, West Bengal.

Family : TRIDACTYLIDAE
Genus : ***Tridactylus*** Oliver

49. ***Tridactylus thoracicus* Guerin

Material examined: 2 ex, 24 Sep 1992, J.M. Julka; 3 ex, at light, 28 Sep 1992, M.S. Verma; 1 ex, at light, 1 Oct 1992, R. Paliwal.

Distribution: India: Himachal Pradesh (Renuka), Bihar, Goa, Madhya Pradesh, Orissa, West Bengal.

Elsewhere: Borneo, Java, Malaysia, Myanmar, Sri Lanka, Sumatra, Thailand.

Genus : *Xya* Latreille

**50. *Xya* sp.

Material examined: 1 ex, 25 Jul 1992, Mahesh Chandra.

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AQUATIC AND SEMI-AQUATIC HEMIPTERA

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INTRODUCTION

True aquatic hemipteran insects mainly inhabit fresh waters, some even live in brackish water, and only a few are marine. Semi-aquatic bugs live on surface of waterbodies or among aquatic weeds. Water bugs are effectively predaceous on zooplanktons and other aquatic microfauna, fish fry, tadpoles and other aquatic insects. Indian aquatic and semi-aquatic bugs belong to 13 families: Nepidae, Notonectidae, Pleidae, Belostomatidae, Naucoridae, Corixidae, Gelastocoridae, Ochteridae, Hydrometridae, Veliidae, Mesoveliidae, Gerridae and Hebridae. Of these, first 6 families are truly aquatic and the remaining are semi-aquatic. This paper deals with 10 species under 9 genera and 6 families.

Distant (1902, 1906, 1910) carried out comprehensive faunal studies on Indian water bugs, recording about 150 species in the Indian subcontinent. Paiva (1919), Hafiz and Mathai (1938), Hafiz and Ribeiro (1939), Hutchinson (1940), Hafiz and Pradhan (1947), Pradhan (1950), Brooks (1951), Hungerford and Matsuda (1965), Bal and Basu (1992, 1994a, 1994b) and Thirumalai (1986) contributed on different groups of water bugs from different parts of India.

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KEY TO THE IDENTIFICATION OF AQUATIC AND SEMI-AQUATIC HEMIPTERA OF RENUKA WETLAND

1. Antennae shorter than head, usually hidden in cavities beneath eyes and not visible from above.....2

   Antennae longer than head, inserted in front of eyes and clearly visible from above.....5

2. Rostrum very short and broad without distinct segmentation; front tarsi spatulated, developed into comblike palae; base of head overlapping anterior margin of pronotum, pala of male with 29 uniform pegs in an oblique row .....*Corixa (Tropocorixa) choprai*

   Rostrum cylindrical or cone shaped, distinctly 3-4 segmented; front tarsi normal and not modified into palae; base of head inserted into pronotum, pala absent 3

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3. Abdomen with a pair of long, slender, non-retractile posterior appendages; hind coxae short, free and rotatory, prosternum with a strongly acute tubercle .....*Laccotrephes griseus*

   Abdomen without or with a pair of short posterior appendages; hind coxae broadly jointed to thoracic pleura, prosternum otherwise.....4

4. Membrane of hemelytra with reticulate veins; abdomen with a pair of short, flat, retractile posterior appendages; head nearly triangular at anterior margin, body length of adult 13.5-17.5 mm ....*Diplonychus molestus*

   Membrane of hemelytra without veins; abdomen without any flat retractile posterior appendages; head strongly curved posteriorly at anterior margin, body length of adult 9-10 mm ....*Heleocoris vicinus*

5. Claws apical; head as long as thorax; body long and remarkably cylindrical, legs filamentous ....*Hydrometra greeni*

   Claws of at least the front tarsi pre-apical; head shorter than pronotum; body neither long nor cylindrical, legs otherwise.....6

6. Body long, nearly 13-15 mm in length; middle femora of male provided with ventral fringe of thick hairs; parameres very prominent and bent laterally outwards; 7th abdominal segment of female with very prominent connexival spines with dorso-lateral lobe on each side..... .....*Ptilomera (Ptilomera) laticaudata*

   Body short, not reaching 13 mm in length; middle femora without ventral fringe of hairs; parameres otherwise; connexival spines when present in females otherwise.....7

7. Anterior part of pronotum with a large median light coloured spot; in apterous forms pronotal lobe more or less shortended.....*Neoqerris parvula*

   Anterior part of pronotum with either a pair of elongate yellowish lines or a single broad median whitish stripe; in apterous forms pronotal lobe may be greatly reduced or not reduced at all.....8

8. Anterior part of pronotum with a single median whitish stripe; pronotal lobe greatly reduced in apterous forms, first antennal segment robust and longest, other segments thin; male with pygophore forked into a pair of prominent, vertically raised, antler shaped processes; parameres very large and apices crossing beneath pygophore.....*Chimarrhometra orientalis*

   Anterior part of pronotum with a pair of yellowish lines; first antennal segment not robust, other segments otherwise; pronotal lobe not reduced in apterous forms; male with pygophore and parameres otherwise.....9

9. Connexivum terminating into a fairly prominent spine; pronotal lobe without any yellow median line..... .....*Limnogonus (Limnogonus) nitidus*

   Connexivum not terminating into prominent spine; pronotal lobe with a median yellow line extending its entire length.....*Limnogonus (Limnogonus) fossarum*

SYSTEMATIC LIST

Family : CORIXIDAE
Subfamily : CORIXINAE
Genus : ***Corixa*** Geoffroy

1. ***Corixa (Tropocorixa) choprai*** Hutchinson

Material examined: 1 ♂, 23 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Shimla Hills, Renuka lake).

Elsewhere: Pakistan.

Family : NEPIDAE
Subfamily : NEPINAE
Genus : ***Laccotrephes*** Stal

2. ***Laccotrephes griseus*** (Guerin)

Material examined: 1 ♂, 27 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka lake), Andhra Pradesh, Bihar, Kerala, Maharashtra, Orissa, Pondicherry, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Myanmar, Malacca, Seychelles, Thailand, Sri Lanka.

Family : BELOSTOMATIDAE
Subfamily : BELOSTOMATINAE
Genus : ***Diplonychus*** Laporte

3. ***Diplonychus molestus*** (Dufour)

Material examined: 1 ♂, 10 Jul 1994, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka lake), Jammu and Kashmir, Orissa, West Bengal.

Elsewhere: Malacca, Sumatra.

Family : NAUCORIDAE
Subfamily : LACCOCORINAE
Genus : ***Heleocoris*** Stal

4. ***Heleocoris vicinus*** Montandon

Material examined: 1 ex, 23 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka lake), Bihar, Kerala.

Family : HYDROMETRIDAE
Genus : ***Hydrometra*** Latreille

5. ***Hydrometra greeni*** Kirkaldy

Material examined: 1 ♀, 23 Sep 1992, J.M. Julka; 1 ♀, 25 Sep 1992, R. Paliwal; 1 ♂, 2 ♀♀, 26 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh (Renuka lake), Orissa, Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Myanmar, Japan, Malay, the Philippines, Sri Lanka.

Family : GERRIDAE
Subfamily : PTILPMERINAE
Genus : ***Ptilomera*** Amyot & Serville

6. ***Ptilomera (Ptilomera) laticaudata*** (Hardwicke)

Material examined: 2 ♀♀ apterous forms, 10 Jul 1994, J.M. Julka; 3 ♂♂, 5 ♀♀ apterous forms, 22 Apr 1992, A.S. Mahabal.

Distribution: India: Himachal Pradesh (Renuka lake), Meghalaya, Sikkim, Tamil Nadu, West Bengal.

Elsewhere: Myanmar, Malay Peninsula, Sri Lanka, Thailand.

Subfamily : EOTRECHINAE
Genus : ***Chimarrhometra*** Bianchi

7. ***Chimarrhometra orientalis*** (Distant)

Material examined: 3 ♂♂, 4 ♀♀ apterous forms, 1 ♀ macropterous form, 27 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka lake, Kangra, Shimla Hills), Meghalaya, Punjab, Uttar Pradesh, West Bengal.

Elsewhere: Pakistan.

Subfamily : GERRINAE
Genus : ***Neogerris*** Matsumura

8. ***Neogerris parvula*** (Stal)

Material examined: 2 ♂♂, 7 ♀♀ macropterous forms, 23 Sep 1992, J.M. Julka; 1 ♀ macropterous form, 28 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka lake), Assam, Bihar, Kerala, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Bangladesh, Myanmar, China, Iran, Java, Malay Peninsula, Muscat, New Guinea, Oman, Pakistan, the Philippines, Solomon Island, Sri Lanka, Taiwan, Thailand, Timor, Vietnam.

Genus : ***Limnogonus*** Stal

9. ***Limnogonus (Limnogonus) nitidus*** (Myar)

Material examined: 1 ♀ macropterous form, 28 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh (Renuka lake), Assam, Bihar, Kerala, Meghalaya, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Borneo, Myanmar, Celebes, Combodia, China, Java, Maldive, Malay, Nepal, Sri Lanka, Sumatra, Thailand, Vietnam.

10. ***Limnogonus (Limnogonus) fossarum*** (Fabricius)

Material examined: 1 ♀ macropterous form, 27 Sep 1992, J.M.Julka.

Distribution: India: Throughout.

Elsewhere: Australia, Myanmar, China, Formosa, Java, Malacca Islands, the Philippines, Sumatra, Taiwan, Thailand, Vietnam.

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AQUATIC COLEOPTERA

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INTRODUCTION

More than 5,000 species of water beetles are known in the world. Of these, about 1,000 species have been recorded from India and its adjacent countries. Earlier studies on the aquatic beetles of Himachal Pradesh are sparse (Zaitev, 1910; Knische, 1924; d'Orchymont; 1928). Recently, Vazirani (1977, 1984) has contributed significantly to the knowledge on dytiscid and gyrinid beetles of this state.

The present studies on aquatic beetles from Renuka wetland deal with 20 species referrable to 16 genera and 6 families. Information so gathered on their occurrence is very interesting as 17 species are recorded for the first time from Himachal Pradesh. These belong to the Dytiscidae (7 spp.), Hydrophilidae (7 spp.), Georyssidae (1 sp.), Byrrhidae (1 sp.) and Elmidae (1 sp.).

The author is grateful to the Director, Zoological Survey of India, for providing necessary facilities. He is also indebted to Dr. J.M. Julka, Officer-in-Charge of High Altitude Zoology Field Station, Z.S.I., Solan for making the material available for study.

KEY TO THE SPECIES OF AQUATIC BEETLES OF RENUKA WETLAND

1. Hind coxae immovably fused to metasternum, completely dividing first abdominal sternite.....2

   Hind coxae rarely fused to metasternum, if so, then not dividing first abdominal sternite.....11

2. Antennae short, thick, second segment with a process; eyes completely divided into dorsal and ventral parts; mid- and hind legs forming short and broad paddles.....3

   Antennae filiform; eyes not completely divided; mid- and hind legs neither very short nor broad.....4

3. Upper surface of body entirely covered with hairs .....*Orectochilus murinus*

   Upper surface of body partly glabrous.....*Orectochilus neglectus*

4. Scutellum visible.....5

   Scutellum not visible.....7

5. Suture between metepisternum and metasternal wing straight; apical spurs of hind tibiae simple, pointed..... .....*Hydaticus fabriici*

Suture between metepisternum and metasternal wing curved; apical spurs of hind tibiae blunt, more or less bifid.....6

6. Small species with length 11.5-13 mm and breadth 7-7.5 mm; transverse black band near elytral apex touching lateral margin.....*Sandracottus dejeani*

Large species with length 13-15.5 mm and breadth 8-9 mm; transverse black band near elytral apex not touching lateral margin.....*Sandracottus festivus*

7. Prosternal process straight, occasionally a little depressed; fourth segment of pro- and mesotarsi not reduced, subequal to third segment.....8

Prosternal process arched and oblique; fourth segment of pro- and mesotarsi much reduced and hardly visible 10

8. Elytral markings flexuous.....*Laccophilus flexuosus*

Elytral markings of zig-zag double lines.....9

9. Pronotum with transverse black marking in middle as well as along anterior and posterior margins; elytral zig-zag markings coalescent.....*Laccophilus sharpi*

Pronotum without any transverse black marking along anterior and posterior margins; elytral zig-zag markings distinct, never coalescent.....*Laccophilus parvulus*

10. Prosternal process broadened at apex.....*Hydrovatus* sp.

Prosternal process not broadened at apex.....*Hydrophorus elevatus*

11. Antennae with 3-5 proximal segments glabrous, next segment cup-like, distal ones forming a strong pubescent club; maxillary palpi nearly always longer than antennae.....12

Antennae and maxillary palpi otherwise.....19

12. Fore tarsi 4-segmented; metacoxae widely separated; intercoxal process broadly truncate.... .....*Georyssus* sp.

Fore tarsi 5-segmented; metacoxae nearly contiguous; intercoxal process narrow.....13

13. Body contour uniformly curved, body regularly convex; prothorax neither narrower than hind body nor conspicuously separated from it.....14

Body contour not uniformly curved, body not regularly convex; prothorax narrower than hind body, conspicuously separated from it.....*Hydrochus* sp.

14. Antennae normally longer than maxillary palpi, apical glabrous antennal segment fitted more or less lightly against first segment of pubescent club .....*Coelostoma* sp.

Antennae as long as or often shorter than maxillary palpi, apical glabrous antennal segment more or less asymmetrical, cup-like, embracing first segment of pubescent club.....15

15. Antennae 9-segmented; scutellum not longer than its width at base.....16

Antennae 8-segmented; scutellum a long triangle.....18

16. Meso- and metasternal carinae united intimately .....*Sternolophus rufipes*

Meso- and metasternal carinae not united intimately.....17

17. Maxillary palpi robust, shorter or nearly as long as antennae, last joint as long as or longer than penultimate.....*Laccobius* sp.

Maxillary palpi more or less slender, longer than antennae, last joint shorter than penultimate .....*Helochares crenatus*

18. Eyes divided by a conspicuous, complete canthus reaching vertex behind; posterior legs without swimming hairs.....*Amphiops pedestris*

Eyes very convex, prominent, without complete canthus; posterior legs with long swimming hairs .....*Berosus indicus*

19. Form short, oval, very convex; head without distinct fronto-clypeal suture.....*Byrrhus* sp.

Form usually elongate, not very convex; head with fronto-clypeal suture usually distinct.....*Stenelmis* sp.

SYSTEMATIC LIST

(Genera/species marked with asterisks (*) are new records from Himachal Pradesh)

Family : GYRINIDAE
Genus : ***Orectochilus*** Eschscholtz

1. ***Orectochilus murinus*** Regimbart

Material examined: 3 ex, 23 Apr 1992, A.S. Mahabal.

Distribution: India: Himachal Pradesh, Uttar Pradesh, West Bengal, Assam, Meghalaya, Sikkim.

Elsewhere: Bhutan, Indo-china.

2. ***Orectochilus neglectus*** Ochs

Material examined: 2 ex, 23 Apr 1992, A.S. Mahabal; 3 ex, 29 Sep 1992, J.M. Julka.

Distribution: India: Punjab, Himachal Pradesh, Haryana, Uttar Pradesh.

Family : DYTISCIDAE
Genus : ***Laccophilus*** Leach

3. ***Laccophilus flexuosus*** Aube

Material examined: 1 ex, 26 Sep 1992, J.M. Julka.

Distribution: India: Widely.

Elsewhere: Myanmar, Sri Lanka, Nepal, Pakistan, Iraq, Iran, Japan, Indonesia.

*4. ***Laccophilus parvulus*** Aube

Material examined: 1 ex, 30 Sep 1992, J.M. Julka.

Distribution: India: Widely.

Elsewhere: Myanmar, Sri Lanka, Pakistan, Malayasia, Indonesia, the Philippines.

*5. ***Laccophilus sharpi*** Regimbart

Material examined: 1 ex, 26 Sep 1992, J.M. Julka.

Distribution: India: Widely.

Elsewhere: Myanmar, Sri Lanka, Pakistan, Nepal, Iraq, Japan, Formosa.

Genus : *Hydrovatus* Motschulsky

6. ***Hydrovatus*** sp.

Material examined: 1 ex, 26 Sep 1992, J.M. Julka.

Genus : ***Hyphoporus*** Sharp

*7. ***Hyphoporus elevatus*** Sharp

Material examined: 1 ex, 23 Sep 1992, M.S. Verma; 1 ex, 24 Sep 1992, R. Paliwal; 13 ex, 26 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Madhya Pradesh, Punjab, Uttar Pradesh, Bihar, Rajasthan.

Elsewhere: Pakistan.

Genus : ***Hydaticus*** Leach

8. *Hydaticus fabriici Macleay

Material examined: **3 ex, 25 Sep 1992, R. Paliwal**; 1 ex, 1 Oct 1992, M.S. Verma; 9 ex, 23 Sep 1992, J.M. Julka.

Distribution: **India: Widely.**

Elsewhere: **Myanmar, Pakistan, Nepal, Vietnam,** the Philippines, Indonesia.

Genus : ***Sandracottus*** Sharp

9. *Sandracottus dejeani Aube

Material examined: **1 ex, 25 Sep 1992, R. Paliwal.**

Distribution: **India: Himachal Pradesh, Rajasthan,** Orissa, Madhya Pradesh, Bihar, Andhra Pradesh.

Elsewehre: **Pakistan.**

*10. ***Sandracottus festivus*** (Illiger)

Material examined: 1 ex, 23 Sep 1992, N.K. Sinha.

Distribution: India: Himachal Pradesh, Punjab, Bihar, Orissa, Andhra Pradesh, Tamil Nadu.

Elsewhere: Pakistan, Sri Lanka, China.

Family : GEORYSSIDAE
Genus : ****Georyssus*** Latreille

11. ***Georyssus*** sp.

Material examined: 1 ex, 23 Sep 1992, J.M. Julka.

Family : HYDROPHILIDAE
Genus : ****Coelostoma*** Brulle

12. ***Coelostoma*** sp.

Material examined: 10 ex, 26 Sep 1992, J.M. Julka; 6 ex, 23 Sep 1992, M.S. Verma.

Genus : **Hydrochus* Leach

13. ***Hydrochus*** sp.

Material examined: 2 ex, 23 Sep 1992, J.M. Julka.

Genus : **Laccobius* Errichson

14. ***Laccobius*** sp.

Material examined: 1 ex, 23 Sep 1992, J.M. Julka.

Genus : ***Helochares*** Mulsant

*15. ***Helochares crenatus*** Regimbart

Material examined: 3 ex, 22, 26, 30 Sep 1992, J.M. Julka; 1 ex, 23 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh, Bihar, West Bengal.

Elsewhere: Indo-China, Sunda Islands.

Genus : ***Sternolophus*** Solier

*16. ***Sternolophus rufipes*** (Fabricius)

Material examined: 8 ex, 23 Sep 1992, N.K. Sinha; 14 ex, 22 Sep 1992, J.M. Julka; 18 ex, 25 Sep 1992, R. Paliwal.

Distribution: India: Himachal Pradesh, West Bengal.

Elsewhere: Tropical Asia, East Asia, Sunda Islands.

Genus : ***Berosus*** Leach

*17. ***Berosus indicus*** Motschulsky

Material examined: 23 ex, 26 Sep 1992, J.M. Julka; 3 ex, 23 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh, West Bengal.

Elsewhere: South Asia, Sunda Islands.

Genus : ***Amphiops*** Errichson

*18. ***Amphiops pedestris*** Sharp

Material examined: 1 ex, 26 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, West Bengal, Pondicherry, Tamil Nadu.

Elsewhere: Sri Lanka, Indo-China, Sumatra.

Family : ELMIDAE
Genus : ***Stenelmis*** Linnaeus

19. ***Stenelmis*** sp.

Material examined: 50 ex, 23 Sep 1992, J.M. Julka.

Family : BYRRHIDAE
Genus : ***Byrrhus*** Linnaeus

20. ***Byrrhus*** sp.

Material examined: 1 ex, 26 Sep 1992, J.M. Julka.

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LEPIDOPTERA : BUTTERFLIES

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INTRODUCTION

The present account of butterflies from Renuka is based on a collection of 144 examples referable to 37 species. Kumar and Juneja (1977) have recorded eleven species from this wetland, of which two namely, *Pieris brassicae* (Linn.) and *Pontia daplidice moorei* (Roeber) are not represented in the material under study. Total number of species from Renuka thus, comes to thirty-nine.

While the general distribution for each species/subspecies is as given by Talbot (1939, 1947), Wynter-Blyth (1957) and Smith (1989) within India and neighbouring countries like Bhutan, Myanmar, Nepal and Sri Lanka, that in Himachal Pradesh is given on the basis of past records and the material studied at HAZFS, Solan. Significant contributions on the butterflies of Himachal Pradesh are those of D' Abrera (1982-1985), Hancock (1983) Philipe de Rhe (1931), Evans (1932), Wynter-Blyth (1940-1947), Singh and Gupta (1956) and Varshney (1993, 1994).

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SYSTEMATIC LIST

Family : PAPILIONIDAE
Genus : ***Papilio*** Linn.

Key to the identification of species of *Papilio* Linn. of Renuka Wetland

1. Hindwings not tailed 2

   Hindwings tailed.....3

2. Wings upper- and undersides black. Hindwings, in male above, with white costal stripe of specialised scales; tornal area with black-centred red spots in both sexes; undersides with submarginal black-centred red lunules.....*protenor* Cramer

Wings upperside brown black to black; undersides yellowish. Forewings upperside dotted with yellow at base; large irregular yellow spots and patch which diminish in size anteriorly toward apex. Hindwings upperside with a broad irregular yellow band; with a tornal red spot and an apical blue spot. Submarginal and terminal rows of yellow spots on upper and undersides of both wings.. .....*demoleus* Linn.

3. Sexes nearly alike. Hindwings upperside with a prominent green or blue-green patch, broader between areas 4 and 7 but narrowed posteriorly between areas 1 and 3, then continued as diffused spots; tornus with prominent red lunules; submarginal red crescent spots present. Underside both wings chocolate brown and without the conspicuous patch as on upperside; tornal red spots and submarginal red crescent spots more prominent than on upperside..... .....*polyctor* Boisduval

Sexes dissimilar: female polymorphic; female form *cyrus* like male, female forms *romulus* and *stichius* different from *cyrus*. Male and female form *cyrus* black above, with a series of terminal spots,in forewing, decreasing towards apex. Hindwings with a complete series of discal band of white spots. Female forms *romulus* and *stichius* mimic Crimson Rose and Common Rose , res - pectively; terminal series and discal band of white spots, as in normal male female, absent, but with discal spots being red in *romulus* female and white in *stichius* female..... .....*polytes romulus* Cramer

1. ***Papilio protenor protenor*** Cramer
(The Spangle)

Material examined: 1 ex, 29 Sep 1992, J.M. Julka.

Distribution: India: Kashmir to Kumaon. In Himachal Pradesh: Mandi, Shimla, Sirmour and Solan districts.

Remarks: The subspecies is very common in its range as given above and not recorded west of Mussoorie. In Himachal Pradesh, it is common between March and July, rarely till August, but never after the rains (Wynter-Blyth, 1940).

2. ***Papilio polyctor polyctor*** Boisdual
(The Common Peacock)

Material examined: 1 ex, 30 Sep 1992, 1 ex, 20 Oct 1992, R. Paliwal.

Distribution: India: Chitral to Kumaon. In Himachal Pradesh: Kullu, Mandi, Shimla, Sirmour and Solan districts.

Remarks: This is one of the most beautiful Swallowtail butterflies and is common and ascending from low elevation to about 7000 feet in Himalayas. Kumar & Juneja (1977) have recorded *Papilio arcturus arius* Rothschild from Renuka as well as Bilaspur for the first time. Philipe de Rhe (1931) and Wynter-Blyth (1940, 1957), however, state that the subspecies occurs above 7500 feet in N.W. Himala- yas. During the course of present studies, the author did not come across any material from these areas

referable to *P. arcturus arius*, as the blue green patch does not enter the cell as is characteristic of *P. polyctor polyctor* (VS entering in cell in *arcturus arius*). It seems to be a misidentity for *arcturus arius*.

3. *Papilio polytes romulus* Cramer
(The Common Mormon)

Material examined: 1 ex, 6 Apr 1974, R.K. Sharma; 2 ex, 18, 20 Jul 1992, Jagdish Chand; 9 ex, 23, 26, 30 Sep 1992 (including one female form each of *cyrus, romulus & stichius*), J.M. Julka; 5 ex, 24 Sep 1992, R. Paliwal; 3ex, 27, 30 Sep 1992 (including one female form *cyrus*), M.S. Verma.

Distribution: India: Throughout. In Himachal Pradesh: Kangra, Mandi, Shimla, Sirmour and Solan districts. Also Malay Peninsula, Myanmar, Nepal and Sri Lanka.

Remarks: It is a polymorphic species with three different female forms, all of which have been collected from this area. While the female form *cyrus* is like male, other two female forms mimic Crimson Rose (*Pachliopta hector*) and Common Rose (*Pachliopta aristolochiae*).

4. *Papilio demoleus demoleus* Linn.
(The Lime Butterfly)

Material examined: 1 ex, 26 Apr 1992, A.S. Mahabal; 1 ex, 25 Jul 1992, M. Chandra; 4 ex, 23, 26 Sep 1992, 1 ex, 1 Oct 1992, J.M. Julka; 3 ex, 1, 2 Oct 1992, R. Paliwal.

Distribution: India: Common throughout. In Himachal Pradesh: Bilaspur, Mandi, Shimla, Sirmour and Solan districts.

Remarks: It is one of the most common species in India, from plains to about 7000 feet in Himalayas, causing extensive damage to leaves of bael, orange and lime trees, and hence of economic importance.

Genus : *Graphium Scopoli*

5. *Graphium sarpedon luctatius* Fruhstorfer
(The Common Bluebottle)

Material examined: 3 ex, 23, 26 Sep, 1 Oct 1992, J. M. Julka

Distribution: India: Kashmir to Assam. In Himachal Pradesh: Mandi, Shimla and Sirmour districts. Also Myanmar, Nepal and Sri Lanka.

Remarks: The subspecies is often found settled on road-side puddles or damp patches for a drink, either alone or in the company of other papilionids, like *P. polytes*, and pierid species.

Family : PIERIDAE
Subfamily : PIERINAE
Genus : ***Delias*** Huebner

6. ***Delias belladonna horsfieldi*** (Gray)
(The Common Jezebel)

Material examined: 1 ex, 6 Apr 1974, Arun Kumar.

Distribution: India: Kullu to Kumaon. In Himachal Pradesh: Kullu, Shimla, Sirmour and Solan districts. Also Nepal.

Remarks: The species is reported to congregate near water (Smith, 1989). It occurs between 2000 and 10000 feet in Himalayas from May to July and later in September and October.

Genus : ***Pieris*** Schrank

7. ***Pieris canidia indica*** Evans
(The Indian Cabbage White)

Material examined: 1 ex, 20 Jul 1992, Jagdish Chand; 1 ex, 24 Sep 1992, R. Paliwal; 1 ex, 28 Sep 1992, M.S. Verma.

Distribution: India: Kashmir to Arunachal Pradesh, extending to Pakistan and Myanmar. In Himachal Pradesh: Bilaspur, Hamirpur, Shimla, Sirmour and Solan districts.

Remarks: One of the most common pierid butterfly found throughout its range of its distribution from about 1200 feet to 11000 feet in Himalayas. The species is very close to the Large Cabbage White, *Pieris brassicae*, in its general appearance. They, however, differ from each other by the inner edge of black apex on forewings being dentate in this species unlike smooth in ***brassicae***.

Subfamily : COLIADINAE
Genus : ***Catopsilia*** Huebner

Key to the identification of species of *Catopsilia* Huebner of Renuka Wetland

1. Underside both wings not marked with any transverse reddish brown strigae.....
.....***crocale*** **(Cramer)**

Underside both wings marked with transverse reddish brown strigae.....***pyranthe*** **(Linn.)**

8. ***Catopsilia crocale crocale*** (Cramer)
(The Common Emigrant)

Material examined: 1 ex, 20 July 1992, Jagdish Chand; 1 ex, 24 Sep 1992, R.Paliwal, 2 ex, 30 Sep, 1 Oct 1992, M.S. Verma.

8-B-44/ZSI/Cal/2K

Distribution: India: Throughout. In Himachal Pradesh: Bilaspur, Kullu, Mandi, Shimla, Sirmour and Solan districts. Also Myanmar, Nepal and Sri Lanka.

Remarks: The species is characterized by the complete absence of transverse strigae on underside of both wings unlike in a closely related species, *C. pyranthe* (Linn.) where these are reddish brown and present in all seasons.

9. ***Catopsilia pyranthe pyranthe*** (Linn.)
(The Mottled Emigrant)

Material examined: 2 ex, 23 Sep 1992, J.M. Julka; 2 ex, 25 Sep 1992, N.K. Sinha; 1 ex, 30 Sep 1992, M.S. Verma; 2 ex, 1, 2 Oct. 1992, R. Paliwal.

Distribution: India: Throughout. In Himachal Pradesh: Bilaspur, Shimla and Sirmour districts. Also Myanmar, Nepal and Sri Lanka.

Remarks: As for preceding species.

Genus : ***Eurema*** Huebner

Key to the species of *Eurema* Huebner of Renuka Wetland

1. Underside both wings without discocellular spots. Upperside forewings with the black border not continued along vein 1a.....*laeta* Boisduval

   Underside both wings with large discocellular ring spots. Upperside forewings with the black border continued along vein 1a.....*hecabe* Linn.

10. ***Eurema laeta laeta*** (Boisduval)
(The Spotless Grass Yellow)

Material examined: 1 ex, 24 Sep 1992, J.M. Julka.

Distribution: Peninsular India to Western Himalayas. In Himachal Pradesh: Mandi, Shimla, Sirmour and Solan districts. Also Sri Lanka.

Remarks: The species shows marked seasonal variations. Both the wings, in wet season, have well developed black borders but not much indented, unlike in dry season where the black border, in forewings, does not reach the tornus and, in hindwings, the border is absent or reduced to apical spots.

11. ***Eurema hecabe fimbriata*** (Wallace)
(The Common Grass Yellow)

Material examined: 5 ex, 22, 30 Sep 1992, M.S. Verma; 4 ex, 23, 26 Sep 1992, J.M. Julka.

Distribution: India: Panjab and Chitral to Kumaon. In Himachal Pradesh: Kangra, Mandi, Shmila, Sirmour and Solan districts.

Remarks: The species is very common throughout its range of distribution. The material available for study does not differ substantially from *E. hecabe contubernalis* (Moore), the distribution of which was, hitherto, reported from Bangal to Sikkim, Myanmar and Malaya Peninsula (Talbot, 1939), and Kumaon (India) to Myanmar and on to Australia (Smith, 1989). It seems that two subspecies overlap each other's range at some places. Kumar and Juneja (1977) have also recorded this species from Renuka as well as other localities of Himachal Pradesh. The species also shows marked seasonal variations.

Family : DANAIDAE
Genus : ***Danaus*** Kluk

12. ***Danaus chrysippus chrysippus*** (Linn.)
(The Plain Tiger)

Material examined: 2 ex, 20 Apr 1992, A.S. Mahabal; 2 ex, 22 Apr 1992, 1 ex, 19 Jul 1992, Jagdish Chand.

Distribution: India: Throughout. In Himachal Pradesh: Kullu, Mandi, Shimla, Sirmour and Solan districts. Also Myanmar, Nepal and Sri Lanka.

Remarks: It is one of the most common species throughout the year in the plains where its food plant "Ak" *calotropis* flourishes extending up to about 9000 feet in Himalayas. Predominantly tawny the male possesses a scent pouch on upperside of hindwings looks like an additional spot compared to that of hindwings of female. It is very unpalatable to preying birds and is mimicked by several butterfly species, viz. , *Cethosia nietneri*, *Hypolimnas misippus*, *Argyreus hyperbius* (all Nymphalidae) and *Elymnias hypermnestra* (Satyridae).

Genus : ***Tirumala*** Moore

Key to the species of *Tirumla* Moore of Renuka Wetland

1. Wings with the stripes and spots broader; those in area 1b forewings broader and often coalescent..... .....*limniace* (Cramer)

   Wings with the stripes and spots narrow; those in area 1b forewings narrower and never coalescent.....*hamata* (McLeay)

13. ***Tirumala limniace leopardus*** (Butler)
(The Blue Tiger)

Material examined: 1ex, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Chitral to Kumaon, Assam, Andaman and Nicobar Islands, Orissa, West Bengal, Sikkim, extending to SriLanka, Myanmar and other neighbouring countries. In Himachal Pradesh: Bilaspur, Shimla, Sirmour and Solan districts.

Remarks: Mainly a common butterfly in plains of India to several districts of Himachal Pradesh.Kumarand Juneja (1977) have recored this species as *T. limniace mutina* Fruh. Talbot (1947)

has recorded this along with the following species under the genus *Danaus* Kluk.

14. ***Trimula hamata septentrionis*** (Butler)
(The Dark Blue Tiger)

Material examined: 1 ex, 2 Oct 1992, J.M. Julka.

Distribution: The Himalayas from Kullu to Sikkim, Assam and Naga Hills. Also Bhutan, extending to Myanmar. In Himachal Pradesh: Kangra, Kullu, Shimla and Sirmour districts.

Remarks: Like preceding species, it is common throughout plains of India to Himalayas.

Genus : ***Parantica*** Moore

15. ***Parantica aglea melanoides*** (Moore)
(The Glassy Tiger)

Material examined: 1ex, 5Apr 1974, Arun Kumar; 1 ex, 20 Jul 1992, Jagdish Chand; 1 ex, 23 Sep 1992, J.M. Julka; 2 ex, 24, 29 Sep 1992, R. Paliwal; 1 ex, 25 Sep 1992, N.K. Sinha; 2 ex, 1, 2, Oct 1992, M.S,Verma.

Distribution: India: Kashmir to Arunachal Pradesh, Assam, Khasi and Naga Hills. In Himachal Pradesh: Kangra, Kullu, Mandi and Solan districts. Also Nepal and Myanmar.

Remarks: The species like preceding one is unpalatable to the preying birds and is mimicked by *Chilasa epicydes*, *Graphium macareus* (both papilionids), and *Elymnias nesaea* (Satyridae). It is characterised by the presence of two scent patches on upperside of hindwing, unlike one pouch on upperside of hindwing in preceding species. In Himalayas, it keeps to the warmer valleys but is reported to occur up to about 8900 feet in Kufri in June (Wynter- Blyth, 1940).

Genus : ***Euploea*** Fabricius

16. ***Euploea core core*** (Cramer)
(The Common Crow)

Material examined: 2 ex, 6 Apr 1974, Arun Kumar; 1 ex, 23 Apr 1992, A.S. Mahabal; 2 ex, 16 Jul 1992, M. Chander; 1 ex, 20 Jul 1992, Jagdish Chand; 2 ex, 22, 23 Sep 1992, J.M. Julka; 2 ex, 24, 30 Sep 1992, R. Paliwal; 2 ex, 25 Sep 1992, N.K. Sinha.

Distribution: India: Throughout, upto 5000 feet in Himalaya. In Himachal Pradesh: Mandi, Shimla, Sirmour and Solan districts. Also Myanmar, Nepal and Pakistan.

Remarks: The species, like other danaids, is unpalatable and mimicked by *Chilasa* sp. (Papilionidae), the female of *Hypolimnas bolina* (Nymphalidae) and *Elymnias singala* (Satyridae). Smith (1989) has recorded this species at 6200 feet with a solitary record at 12800 feet in Nepal.

Family : SATYRIDAE
Genus : ***Mycalesis*** Huebner

17. ***Mycalesis mineus mineus*** (Linn.)
(The Dark Brand Bushbrown)

Material examined: 1 ex, 30 Sep 1992, R.Paliwal.
Distribution: India: Himachal Pradesh (Kullu) to Kumaon, Assam, Andamans, In Himachal Pradesh: Kangra, Kullu, shimla and Sirmour districts. Also Myanmar, Nepal and sri Lanka.

Remarks: The species shows well marked seasonal variation and both the forms, i.e. wet and dry season forms are available in Himachal Pradesh and confined to low elevations but its occurrence up to 6000 feet in Himalayas is not uncommon.

Genus : **Lethe** Huebner

18. **Lethe rohria dytra** (Felder)
(The common Treebrown)

Material examined : 1 ex, 26 Sep 1992, J.M.Julka.

Distribution: India: Kashmir to Sikkim, assam. In Himachal Pradesh: Mandi, Shimla, Sirmour and Solan districts. Also Nepal and Myanmar.

Remarks: The species is characterised by the ocelli in area 3-4, sometimes in area 5, on underside of hindwings. elongated and distorted, that in area 2 large. Fairly common between 6000-9000 feet from May to October.

Genus: **Ypthima** Huebner

19. **Ypthima nareda nareda** (Kollar)
(The Large Threering)
Material examined: 5 ex, 27,30 sep 1992, J.M. Julka.

Distribution: India: Kashmir to Kumaon and Punjab. In Himachal Pradesh: Kullu, Shimla, Sirmour and Solan Districts.

Remarks: The species is fairly common between 2000 and 8000 feet in its range of distribution from May to October.

Family: **NYMPHALIDAE**
Genus : ***Polyura*** Billberg

20.***Polyura athamas*** (Drury)
(The Common Nawab)

Material examined : 1 ex,30 Sep 1992,R.Paliwal

Distribution: Peninsular India to Kullu (H.P.), Assam. In Himachal Pradesh: Kullu, Mandi, Shimla and Sirmour districts. Also Myanmar.

Remarks: The species is fairly common from Kullu eastwards in the Himalayas to about 9000 feet.

Genus : ***Neptis*** Fabricius

Key to the species of *Neptis* Fabricius of Renuka Wetland

1. Underside markings black-edged, particularly the inner discal band on hindwings; forewings with the basal streak separate from cell-end- spot. Hindwing discal band does not widen to costa..... .....*hylas* Linn.

   Underside markings not black-edged on hindwings; forewings with the basal streak and spot beyond cell often conjoined. Hindwing discal band widens to costa.....*yerburyi* Butler

21.***Neptis hylas astola*** Moore
(The Common Sailer)

Material examined: 1 ex, 2 Oct 1992, R. Paliwal.

Distribution: Throughout hilly regions of India In Himachal Pradesh: Kangra, Kullu, Shimla, Sirmour and Solan districts.

Remarks: *Neptis hylas* Linn. is quite common, with the subspecies *varmona* Moore distributed over plains to the lower elevations in India, while *astola* is distributed from low elevations to higher altitude in Himalayas.

22. ***Neptis yerburyi yerburyi*** Butler
(The Yerburyi's Sailer)

Material examined: 2 ex, 25 Sep 1992, N. K. Sinha.

Distribution: India: Kashmir to Kumaon. In Himachal Pradesh: Shimla, Sirmour and Solan districts.

Remarks: The species is fairly common in its range It is easily separable from *hylas astola* by the characters as given in the key.

Genus : ***Cyrestis*** Boisduval

23. ***Cyrestis thyodamas ganescha*** Kollar
(The Common Map)

Material examined: 1 ex , 2 Oct 1992, J.M. Julka.

Distribution: India: Himalayas, from Kashmir to Kumoan. In Himachal Pradesh: Mandi, Shimla and Sirmour districts.

Remarks: The species is common in the Himalayas between May and February up to and altitude of about 8000 feet. The species visits damp patches and flowers, especially of *Buddlela* and Horse-chestnut blossoms, and is found near streams. Their larvae feed on foliage of Banyan and Pipal trees in the Himalayas but never on plains, although these plants are quite common in plains.

Genus : ***Hypolimnas*** Huebner

24. ***Hypoiimnas bolina*** (Linn.)
(The Great Eggfly)

Material examined: 2 ex, 30 Sep, 2 Oct 1992, J.M. Julka.

Distribution: India: Throughout. In Himachal Pradesh: Shimla and Sirmour districts.

Remarks: Fairly common throughout India to about 7000 feet in Himalayas, the species is very beautiful and has characteristic sexual dimorphism. While the male is black and iridescent blue-white-centred ovel patch on each wing, the female is dull dark brown above, without oval patch as in male but with marginal and inner terminal row of pale markings more prominent in hindwings, and mimics a danaid, *Euploea core core* Cramer. Both these sexes have been recorded from Renuka (Distt Sirmour).

Genus : ***Kallima*** Westwood

25. ***Kallima inachus huegeli*** Kollar
(The Orange Oakleaf)

Material examined: 1 ex, 28 Sep 1992, J.M. Julka.

Distribution: India: N. W. Himalayas, from Kashmir to Kumaon. In Himachal Pradesh: Mandi, Shimla amd Sirmour districts.

Remarks: The species is one of the most colourful and beautiful butterflies, particularly on the upperside, and is the finest example of protective resemblance. While the upperside is dark violet-blue to deep steel-blue with orange discal band and the broad black apex in forewing, the underside is dead-leaflike and marked with spots and blotches exactly like those of fungus and mould found on dead leaves. So that, when the butterfly settles, the characteristic bright colour on upperside is not visible but only the underside is seen which camouflage with the surroundings.

Genus : ***Precis*** Huebner

Key to the identification of species *Precis* Huebner of Renuka Wetland

1. Wings ground colour black. Forewings with a broad medial yellow patch from base to disc, then bent and narrowed downwards towards tornus; apex with two short yellowish streaks. Hind-wings with a large medial broad subanal yellow patch and a large distinct subbasal blue spot.....
.....*hierta* (Fabr.)

Wings not as above.....2

2. Wings ground colour brownish ochreous. Forewing cell with a basal line across near base, two lines a little beyond middle and at about end of cell. Ocellated spots at tornal area in forewing and at subapical area in hindwing.....*lemonias* (Linn.)

Wings ground colour ferruginous brown. Both wings with obscure transverse fasciae. Hindwing with obscure ocellated spots.....*iphita* (Cramer)

26. *Precis hierta* (Fabr.)
(The Yellow Pansy)

Material examined: 2 ex, 22, 23 Apr 1992, A.S. Mahabal; 2 ex, 24, 28 Sep 1992, R. Paliwal; 1ex, 30 Sep 1992, M.S. Verma.

Distribution: India: Throughout. In Himachal Pradesh: Kullu, Mandi, Shimla and Sirmour districts. Also Myanmar, Nepal and Sri Lanka.

Remarks: It is one of the prettiest among 'Pansy' butterflies, abundantly available at low altitude up to about 9000 feet on dry and sunny places in hilly regions. Wings with the major upper area yellowish, bordered with black on costa, termen, apex and dorsum; hindwing with a prominent oval blue patch; female differs from male only by the presence of ocelli in area 2 and 5.

27. *Precis lemonias persicaria* Fruhstorfer
(The Lemon Pansy)

Material examined: 2 ex, 17, 19 Jul 1992, Jagdish Chand; 2 ex, 17, 21 Jul 1992, M. Chandra; 5 ex, 26, 28, 30 Sep, 1 ex, 1 Oct 1992, J.M. Julka.

Distribution: India: Kashmir to Kumaon.In Himachal Pradesh: Shimla, Sirmour and Solan districts.

Remarks: Predominantly brown in colour, the species is less known compared to the preceding species and is confined to the jungle region and gardens up to about 8000 feet in hills.

28. *Precis iphita siccata* Stichel
(The Chocolate Pansy)

Material examined: 1 ex, 23 Apr 1992, A.S. Mahabal; 3 ex, 22, 27 Sep, 3 ex, 1, 2 Oct 1992, J.M. Julka; 3 ex, 24 Sep 1992, R. Paliwal; 1 ex, 25 Sep 1992, N.K. Sinha.

Distribution: India: Kashmir to Kumaon. In Himachal Pradesh: Mandi, Shimla, Sirmour and Solan districts.

Remarks: One of the most common subspecies throughout its range up to about 9000 feet in the Himalayas, and is fond of settling on damp patches and wet roads.

Genus : ***Phalanta*** Horsfield

29. ***Phalanta phalantha*** Drury
(The Leopard)

Material examined: 5 ex, 24, 29 Sep, 1 ex, 2 Oct 1992, R. Paliwal; 1 ex, 29 Sep 1992, J.M. Julka.

Distribution: India: Throughout. In Himachal Pradesh: Bilaspur, Shimla, Sirmour and Solan districts. Also Myanmar, Nepal and Sri Lanka.

Remarks: Predominantly tawny with rows of black spots on wings as in 'Fritillaries' but without silver marking on underside as in the latter. Interestingly, it is absent in wetter parts of India during monsoon peried, but visits damp patches and wet road in hot weather for the drink.

Genus : ***Ariadne*** Horsfield

30. ***Ariadne merione tapestrina*** Moore
(The Common Castor)

Material examined: 2 ex, 27 Sep 1992, J. M. Julka; 1 ex, 28 Sep 1992, A.S. Mahabal; 2 ex, 28, 29, Sep 1992, R. Paliwal.

Distribution: India: Kashmir to Kumaon, extending to Madhya Pradesh and Orissa. In Himachal Pradesh: Sirmour district. Also Myanmar, Nepal and Sri Lanka.

Remarks: Fairly common in peniusular India, particularly abundantly around neighbourhood of castor plants on which the larvae feed. The species is very weak in flight and does not penetrate deep into the hilly tracks.

Family : ERYCINIDAE
Genus : ***Libythea*** Fabricius

31. ***Libythea myrrha sanguinalis*** Fruh.
(The Club Beak)

Material examined: 1 ex, 27 Sep 1992, J.M. Julka; 2 ex, 2 Oct 1992, M.S. Verma.

Distribution: India: H.P. (Kullu) to Assam. In Himachal Pradesh: Kullu and Sirmour districts. Also Myanmar.

Remarks: Fairly common in the vicinity of streams up to an altitude of 5000 feet in the Himalayas but rare in higher altitude.

Family : HESPERIIDAE
Genus : ***Notocrypta*** de Niceville

32. ***Notocrypta curvifascia*** (Felder)
(The Restricted Demon)

Material examined: 1 ex, 30 Sep 1992, R. Paliwal.

Distribution: India: Throughout. In Himachal Pradesh: Sirmour district. Also Myanmar, Nepal and Sri Lanka.

Remarks: It is a first record for Himachal Pradesh.

Genus : ***Suastus*** Moore

33. ***Suastus gremius*** (Fabricius)
(The Indian Palm Bob)

Material examined: 1 ex, 30 Sep 1992, R. Paliwal.

Distribution: India: Throughout. In Himachal Pradesh: Shimla and Sirmour districts. Also Nepal and Sri Lanka.

Genus : ***Potanthus*** Scudder

34. ***Potanthus pallida*** Evans
(The Dart Dark Brown)

Material examined: 1ex, 29 Sep 1992, J.M. Julka.

Distribution: India: H.P. (Shimla) to Sikkim and Assam. Also Bhutan, Myanmar, Nepal and Sri Lanka.

Genus : ***Parnara*** Moore

35. ***Parnara guttatus*** (Bremer & Grey)
(The Straight Swift)

Material Examined: 1 ex, 29 Sep 1992, J. M. Julka.

Distribution: India: Kashmir to Kumaon, Sikkim and Assam. In Himachal Pradesh: Shimla and Sirmour districts. Also Myanmar and Nepal.

Genus : ***Pelopidas*** Walker

36. ***Pelopidas mathias*** Fabr.
(The Small Branded Swift)

Material examined: 1 ex, 29 Sep 1992, J.M. Julka.

Distribution: India: Kashmir to Sikkim and Assam. In Himachal Pradesh: Shimla and Sirmour districts. Also Myanmar, Nepal and Sri Lanka.

Genus : ***Polytremis*** Mabille

37. ***Polytremis ?eltola*** (Hewitson)
(The Yellow Spotswift)

Material examined: 1 ex, 22 Sep 1992, M. S. Verma; 1 ex, 26 Sep 1992, J.M. Julka.

Distribution: India: Kashmir to Kumaon, Sikkim, Assam. In Himachal Pradesh: Sirmour district. Also Myanmar, Nepal and Pakistan.

Remarks: Recorded between 1900 and 8600 feet from March to November in its range.

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LEPIDOPTERA : MOTHS

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INTRODUCTION

Many species of moths are known to occur in the northwest Himalaya at altitudinal range varying between 700 and 2500 m but their precise records for the Renuka wetland have not been published earlier. Accordingly, an attempt has been made to provide an annotated list of 29 species of moths from the Renuka wetland. Significant contributions on moths of India are by Hampson (1892-96, 1898-99, 1900-13), Prout (1912-15), Seitz (1933), Bell and Scott (1937), Klima (1939) and Inoue (1987), and these have been largely followed in this communication.

With the present exploration of the fauna, it may be noted that six species (vide systematic list) constitute new locality records for whole of northwest Himalaya. Three species, *viz.*, *Polyptychus t. trilineatus, Cyana gelida* and *Micronissa costata*, are endemic in the Himalaya and adjoining areas of its eastern sector, while a few like *Zadadra distorta* has a very narrow range of geographical distribution within India in constrast to cosmopolitan members like *Hippotion celerio, Chrysodeixis eriosoma,* etc.

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SYSTEMATIC LIST

(Double asterisks (**) denote new records for NW Himalaya)

Family : SPHINGIDAE
Genus : *Meganoton* Boisduval

1. ***Meganoton analis* (Felder)

Material examined: 2 ♀♀, 27 Sep 1992, R. Paliwal.

Distribution: India: Northwest and east Himalaya, Meghalaya.

Elsewhere: Nepal, China.

Remarks: Wing expanse : 130-135 mm. This moth has grey ground colour with fore wing markings, hind wing and abdomen walnut brown. It is hardly attracted to light. Flight is weak.

Genus : ***Psilogramma*** Rothschild & Jordan

2. ***Psilogramma menephron*** (Cramer)

Material examined: 2 ♂♂, 1 ♀, 22, 28 Sep 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: China, Soloman Islands.

Remarks: Wing expanse: ♂ 82-88 mm, ♀ 105 mm. It is locally common, flying rapidly in forests and open country up to about 2000 m.

Genus : ***Polyptychus*** Huebner

3. ***Polyptychus trilineatus*** Moore

Material examined: 3 ♂♂, 24 Sep 1992, J.M. Julka.

Distribution: India: Northwest and west Himalaya, Sikkim, Meghalaya, Karnataka, Andaman Islands.

Elsewhere : Sri Lanka, Myanmar.

Remarks: Wing expanse : 85-94 mm. The moth is highly polytypic with as many as five subspecies from the Indian subregion, of which the very rare nominate subspecies is confined to the northwest and west Himalaya. It differs from others by pale cinereous colour with a grey bloom and fore wing without dentate line between two outer ones.

Genus : ***Nephele*** Huebner

4. ***Nephele didyma*** (Fabricius)

Material examined: 1 ♂, 22 Sep 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: Pakistan, Nepal, Sri Lanka, Myanmar, Malaya.

Remarks: Wing expanse : 68 mm. The moth is olive brown with abdomen bearing lateral black segmental bands. The specimen belongs to the form *hespera* (Fabr.), which differs from the form *didyma* by the fore wing without silvery spots.

Genus : ***Hippotion*** Huebner

5. ***Hippotion celerio*** (Linnaeus)

Material examined: 1 ♂, 24 Jul 1992, H.S. Mehta.

Distribution: India: Throughout.

Elsewhere: Eastern Hemisphere except in far north and Papua, Europe.

Remarks: Wing expanse : 70 mm. It is a very common, widespread and highly polyphagous brown moth, found in forest country with heavy rainfall.

Genus : ***Theretra*** Huebner

Key to the species

1: Hind wing red.....*alecto*
Hind wing not red 2

2. Fore wing greenish.....*nessus*
Fore wing blackish brown.....*oldenlandiae*

6. *Theretra alecto* (Linnaeus)

Material examined: 1 ♂, 22 Sep 1992, J.M. Julka; 1 ♂, 22 Sep 1992, M.S. Verma.

Distribution: India: West and east Himalaya, and almost throughout the peninsula.

Elsewhere: Widespread in other parts of Oriental Region.

Remarks: Wing expanse 80-86 mm. The moth is brown in colour with fore wing having a clear red tone and hind wing bright red. It shows swarming flight in the evening on blossoms.

7. *Theretra nessus* (Drury)

Material examined: 2 ♂♂, 24, 25 Sep 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: Malay-Australia-Papua Region, Japan.

Remarks: Wing expanse : 114-118 mm. This is a very large olive-green moth with fore wing pale brown, hind wing dusky and abdomen laterally golden. It is locally common and very shy, prefering hills and forest areas with heavy rainfall to open dry country.

8. *Theretra oldenlandie* (Fabricius)

Material examined: 1 ♀, 22 Sep 1992, M.S. Verma.

Distribution: India: As per the preceding species.

Elsewhere: Sri Lanka, Japan, Papua.

Remarks: Wing expanse : 65 mm. This is a brown moth with fore wing discal band blackish-brown,

hind wing dusky and abdomen having ochraceous lateral stripe. It is common in the plains, feeding at flowers.

Family : ARCTIIDAE
Genus : ***Argina*** Huebner

9. ***Argina argus*** (Kollar)

Material examined: 1 ♂, 27 Sep 1992, J.M. Julka.

Elsewhere: Sri Lanka, Myanmar, as far as eastern Asia.

Remarks: Wing expanse : 56 mm. This is a bright red moth tinged with grey and its fore wing bearing black-centered rows of pale rings, hind wing purple-red and black-spotted. It is rather of diurnal nature and common in status.

Genus : ***Creatonotus*** Huebner

10. ***Creatonotus transiens* (Walker)

Material examined: 1 ♀, 23 Jul 1992, K.S. Bakshi; 1 ♀, 27 Sep 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: Sino-Malayan area.

Remarks: Wing expanse : 46mm. The moth is sexually dimorphic. The female differs from male by creamy-white fore wing and subhyaline hind wing with three black subterminal dots. It feigns death when disturbed. It is common in the hills. It is the first record from Himachal Pradesh.

Genus : ***Zadadra*** Moore

11. ***Zadadra distorta* (Moore)

Material examined: 1 ♀, 25 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh, Sikkim, Arunachal Pradesh, Nagaland, Meghalaya.

Elsewhere: Nepal, China.

Remarks: Wing expanse : 40 mm. This hilly grey moth, apparently rare and with limited extra-territorial range of distribution was hitherto confined to northeast India.

Genus : ***Strysopha*** Arora & Chaudhary

12. ***Strysopha torticoides* (Walker)

Material examined: 1 ♂, 25 Sep 1992, M.S. Verma.

9-B-44/ZSI/Cal/2K

Distribution: India: Himachal Pradesh, Sikkim, Meghalaya, Tamil Nadu, Arunachal Pradesh.

Elsewhere: Bhutan, Sino-Malayan area.

Remarks: Wing expanse : 32 mm.

Genus : ***Cyana*** Walker

13. ***Cyana gelida* (Walker)

Material examined: 1 ♂, 1 ♀, 25 Sep 1992, M.S. Verma.

Distribution: India: Northwest Himalaya, Sikkim, Assam, Meghalaya.

Remarks: Wing expanse: ♂ 32 mm, ♀ 40 mm. This moth, with restricted mountainous distribution in India, is white in colour with olive yellow lines, discal black fascia and terminal band on fore wing, hind wing purplish red and basal half of adbomen pinkish. The species is rare.

14. ***Cyana puella*** (Drury)

Material examined: 1 ♂, 29 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Haryana, Maharashtra, Tamil Nadu.

Elsewhere: Nepal, Sri Lanka.

Remarks: Wing expanse : 26 mm. This is a common moth with white ground colour, fore wing having black and scarlet markings and hind wing pale crimson. It comes readily at light and shows sexual variations; male differs from female by the fore wing with two black spots on discocellulars and terminal band running round apex to postmedial band.

Genus : ***Hypsa*** Huebner

15. ***Hypsa ficus*** (Fabricius)

Material examined: 1 ♂, 3 ♀♀, 29 Sep 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: Sri Lanka.

Remarks: Wing expanse: ♂ 64 mm, ♀ 78 mm. Habits and status are rather unknown, though from frequency of occurrence the species seems to be locally common.

Genus : ***Asota*** Huebner

16. ***Asota caricae*** (Fabricius)

Material examined: 1 ♂, 3 ♀♀, 25, 27 Sep 1992, J.M. Julka; 1 ♀, 28 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh, Sikkim, West Bengal, Assam, Tripura, Maharashtra, Andamans.

Elsewhere: Myanmar, Sri Lanka, Sundaland, the Philippines, South China, Vietnam.

Remarks: Wing expanse : ♂ 50 mm, ♀ 60-65 mm. This is a common weedy moth represented only by the nominate subspecies from India.

Family : NOCTUIDAE
Genus : ***Anua*** Walker

17. ***Anua tirhaca*** (Cramer)

Material examined: 1 ♀, 28 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Uttar Pradesh, Punjab, Madhya Pradesh, Maharashtra, Tamil Nadu, Orissa, West Bengal, Sikkim, Meghalaya.

Elsewhere: Sri Lanka, Ceram, the Philippines, Ethiopio-Malagasian and West Palaearctic Regions.

Remarks: Wing expanse : 67 mm. The species was earlier treated as *Ophiusa tirhaca* (Cramer) by Hampson (1894) and as *Thyas separans* (Walker) by Swinhoe (1900) and subsequently considered under the genus *Anua* by Hampson (1913).

Genus : ***Fodina*** Guenee

18. ***Fodina pallula*** Guenee

Material examined: 1 ♀, 25 Sep 1992, J.M. Julka.

Distribution: India: Northwest Himalaya, Assam, West Bengal.

Elsewhere: Sri Lanka.

Remarks: Wing expanse : 35 mm.

Genus : ***Ischyia*** Huebner

19. ***Ischyia manlia*** (Cramer)

Material examined: 1 ♀, 28 Sep 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: Wide spread in other parts of Oriental Region.

Remarks: Wing expanse : 100 mm.

Genus : ***Spirama*** Guenee

20. ***Spirama retorta*** (Linnaeus)

Material examined: 2 ♂♂, 22 Sep 1992, M.S. Verma.

Distribution: India: Throughout.

Elsewhere: Other parts of Oriental Region.

Remarks: Wing expanse : 60-65 mm. The moth, earlier confused as polyphenic by Hampson (1894) and later corrected as heterospecific by Swinhoe (1900), is sexually dimorphic, in which male differs from female by the ground-colour non-ochreous, fore wing stigma shorter and hind wing markings indistinct, with a fold on inner area containing an erectile ridge of very long hairs.

Genus : ***Chrysodeixis*** Huebner

21. ***Chrysodeixis eriosoma*** (Doubleday)

Material examined: 1 ♂, 24 Sep 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: Widespread in old world.

Remarks: Wing expanse : 40 mm. The species was earlier treated as *Phytometra chaleytes* (Esper) by Hampson (1913). The moth has grey black ground colour tinged with reddish, segment of 3rd palpus naked, fore wing infra-cellular'Y'-mark and end-abdominal tuft of hairs large and golden-brown in male.

Genus : ***Psimada*** Walker

22. ***Psimada quadripennis*** Walker

Material examined: 1 ♂, 28 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Karnataka, Maharashtra, Andaman & Nicobar Islands.

Elsewhere: North China, Myanmar, Sri Lanka.

Remarks: Wing expanse : 42 mm.

Family : GEOMETRIDAE
Genus : ***Micronissa*** Swinhoe

23. ***Micronissa costata*** (Butler)

Material examined: 1 ♂, 29 Sep 1992, J.M. Julka.

Distribution: India: Himachal Pradesh, Sikkim, Meghalaya.
by Hampson (1895), is endemic in the Himalayan region.

Genus : ***Boarmia*** Treitchke

24. ***Boarmia boarmiaria* (Guenee)

Material examined: 1 ♀, 28 Sep 1992, M.S. Verma.

Distribution: Himachal Pradesh, Sikkim, Meghalaya, Nagaland, Lakshadweep.

Elsewhere: Bangladesh, Sri Lanka, Taiwan.

Remarks: Wing expanse : 52 mm. This species, earlier treated under the genus *Ectropis* Huebner by Swinhoe (1900), has brownish ochreous ground colour with speckled fore wing, and hind wing having brown patch in middle.

Genus : ***Maxates*** Moore

25. ***Maxates sp.***

Material examined: 1 ♀, 25 Sep 1992, J.M. Julka.

Remarks: Wing expanse : 38 mm.

Family : PYRALIDAE
Genus : ***Botyodes*** Guenee

26. ***Botyodes asialis*** Guenee

Material examined: 1 ♂, 1 ♀, 28 Sep 1992, M.S. Verma.

Distribution: India: Throughout.

Elsewhere: Other parts of Oriental Region, Africa, Papua, Fiji, Hawai Is.

Remarks: Wing expanse : 45 mm.

Genus : ***Nausinoe*** Huebner

27. ***Nausinoe pueritia*** (Cramer)

Material examined: 1 ♀, 1 Oct 1992, J.M. Julka.

Distribution: India: Throughout.

Remarks: Wing expanse : 38 mm. The species was earlier treated under the genus *Lepyrodes* Guenee by Hampson (1898), subsequently changed to *Nausinoe neptis* (Cramer) by Swinhoe (1900).

Genus : ***Terastia*** Guenee

28. ***Terastia egialealis*** (Walker)

Material examined: 1 ♀, 25 Sep 1992, M.S. Verma.

Distribution: India: Himachal Pradesh, Sikkim.

Elsewhere: Java.

Remarks: Wing expanse : 48 mm. This montane species, is delimited by a rather narrow range of distribution. It has a bright ferrugineous ground colour with fore wing dorsum and apex suffused golden yellow, erect hyaline band, medial band as B-shaped, quadrate hyaline cell-patch, and hind wing costal lobe black.

Genus : ***Maruca*** Walker

29. ***Maruca testulalis*** (Geyer)

Material examined: 1 ♂, 1 Oct 1992, J.M. Julka.

Distribution: India: Throughout.

Elsewhere: Other parts of Oriental Region, Japan, Ethiopian, Neotropical and Australian Regions.

Remarks: Wing expanse : 26 mm. This is a common moth with fuscous brown ground colour.

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HYMENOPTERA : ACULEATA

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INTRODUCTION

This paper deals with a collection of Hymenoptera mainly bees (apidae), wasps (Vespidae), cuckoo-wasps (Chrysididae) and ants (Formicidae) from Renuka wetland (Himachal Pradesh) received from High Altitude Zoology Field Station, Zoological Survey of India, Solan.

A perusal of literature reveals that not much work has been carried out on the diversity of Hymenoptera from Himachal Pradesh, especially from Renuka wetland; though from India, 600 species of family Apidae, 135 species of family Vespidae, 65 species of family Chrysididae and 500 species of family Formicidae are known. Some important references relating to the species, dealt in this paper, are those of Bingham (1897, 1903), Chhotani and Ray (1975), Batra (1977), Das and Gupta (1983) and Tiwari *et al.* (1994).

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SYSTEMATIC LIST

Family : APIDAE
Genus : *Apis* Linnaeus

Key to the species of genus *Apis* Linnaeus (based on caste worker)

1. Body size larger, length 16-18 mm; head finely punctured with short pubescence; basal three segments of abdomen honey-yellow.....*A. dorsata*

   Body size smaller, length 11-12 mm; head smooth and shining; basal three abdominal segments testaceous-yellow.....*A. indica*

1. *Apis (Megapis) dorsata* Fabricius

Material examined: 2 ♂♂, 24 Apr 1992, 7 ♀♀, 26 Apr 1992, A.S. Mahabal.

Distribution: India: Throughout.

Elsewhere: Sri Lanka, Maynmar, China, Java, Malaysia.

2. ***Apis indica*** Fabricius

Material examined: 1 ♂, 1 ♀, 21 Apr 1992, A.S. Mahabal.

Distribution: India: Throughout.

Elsewhere: Sri Lanka, Myanmar, Malaysia, Madagascar.

Genus : ***Bombus*** Latreille

3. ***Bombus tunicatus*** Smith

Material examined: 1 ♀, 21 Jul 1992, M. Chandra.

Distribution: India: Himachal Pradesh, Uttar Pradesh.

Elsewhere: China.

Genus : ***Megachile*** Latreille

4. ***Megachile bicolor*** (Fabricius)

Material examined: 1 ♂, 1 ♀, 26 Apr 1992, A.S. Mahabal.

Distribution: India: Himachal Pradesh, Sikkim, Uttar Pradesh, Maharashtra, Karnataka.

Elsewhere: Myanmar, China.

Family : VESPIDAE
Subfamily : POLISTINAE
Genus : ***Polistes*** Latreille

5. ***Polistes (Megapolistes) olivaceous*** (De Geer)

Material examined: 2 ♀♀, 21, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Throughout.

Elsewhere: Myanmar, Arabia, Egypt, Iran, Isle of France. ***Remarks***: Its sting is painful.

Family : CHRYSIDIDAE
Genus : ***Stilbum*** Spinola

6. ***Stilbum cyanurum amethystinum*** (Fabricius)

Material examined: 1 ♀, 23 Apr 1992, A.S. Mahabal.

Distribution: India: Rajasthan, Himachal Pradesh.

Elsewhere: Cosmopolitan.

Family : FORMICIDAE
Subfamily : FORMICINAE
Genus : ***Camponotus*** Mayr

7. *Camponotus compressus* (Fabricius)

Material examined: 2 workers (minor), 21 Apr 1992, A.S. Mahabal; 1 worker (major), 19 Jul 1992, M. Chandra; 1 worker (major), 23 Jul 1992, H.S. Mehta.

Distribution: India: Himachal Pradesh, Assam.

Elsewhere: Myanmar, Sri Lanka, Malaysia, Russia, Arabia, Africa.

Subfamily : PONERINAE
Genus : ***Bothroponera*** Mayr

8. *Bothroponera rufipes* (Jerdon)

Material examined: 1 worker, 19 Feb 1992, M. Chandra.

Distribution: India: Western India, Himachal Pradesh, West Bengal, Assam, Kanara to Malabar.

Elsewhere: Sri Lanka, Myanmar, Bangladesh.

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DIPTERA

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INTRODUCTION

The dipteran insects are easily recognised by the presence of one pair of wings and one pair of halters, which are modified hind wings. They inhabit a wide range of terrestrial, semi-aquatic and aquatic niches. Their food comprises nectar, decaying organic matter and other insects, and some being blood-suckers transmit pathogens of diseases like malaria, elephantiasis, sleeping-sickness, yellow fever, Kala-azar, etc.

The members of this order have been divided into three suborders - Nematocera possessing more than 5-segmented antenna, and Brachycera and Cyclorrhapha bearing less than 5-segmented antenna with arista being apical or subapical in the former and dorsal in the latter.

Brunetti (1917) made a noteworthy contribution on the Diptera of Simla. Significant accounts dealing with dipteran fauna of India are those of Brunetti (1912, 1920, 1923), Senior-White (1940) and Emden (1965). The present study is based on the Diptera collections made by the scientists of the High Altitude Zoology Field Station, Solan from the Renuka wetland. A total of 14 species under 14 genera of 9 families have been studied.

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KEY TO THE INDENTIFICATION OF DIPTERA OF RENUKA WETLAND

1 Antenna more than 5-segmented.....2

Antenna less than 5-segmented.....3

2. Thorax with a conspicuous V-shaped suture, ocelli absent, fourth palpal joint as long as 2+3 together, anterior margin of wing with colour patterns .....*Conosia irrorata*

Thorax without such suture, ocelli present, third and fourth veins bifurcate some distance beyond the anterior cross vein, scutum wholly reddish-yellow .....*Plecia dispersa*

3. Antennal arista situated apically or subapically, head without ptilinum.....4

Antennal arista situated dorsally, head with a ptilinum 8

4. Vena spuria always present.....5

Vena spuria always absent.....6

5. Anterior cross-vein before middle of discal cell, hind femur without any projection..... .....*Episyrphus balteatus*

Anterior cross-vein at or after middle of discal cell, hind femur with a conspicuous tooth below subapically.....*Phytomia (Dolichomerus) crassa*

6. At least middle tibia spurred, costa entirely surrounding the wing, abdomen with a dorsal darkbrown and 2 sublateral stripes.....*Tabanus striatus*

Tibiae without spur, costa not entirely surrounding the wing, anterior veins crowded together in fore part of wing.....7

7. Posterior cross-vein present, femora and tibiae orange-yellow.....*Oplodontha rubrithorax*

Posterior cross-vein absent, femora and tibiae shining black.....*Adoxomyia heminopla*

8. Calyptra not well-developed or vestigeal, subcostal vein usually reduced.....*Sepedon plumbella*

Calyptra well-developed.....9

9. Hypopleuron without a row of bristles.....10

Hypopleuron with a row of bristles.....13

10. Body metallic blue, sternopleural bristles 1+3.....*Orthellia timorensis*

Body not metallic.....11

11. Arista plumose.....12

Arista bare, abdominal segments with roundish spots .....*Gymnodia tonitrui*

12. Arista plumose dorsally, setulae on vein r4+5 few .....*Stomoxys calcitrans*

Arista plumose both dorsally and ventrally, vein r4+5 without setulae.....*Musca (M.) domestica*

13. Body metallic blue or green, nearly always two notopleurals, arista plumose upto tip, in male upper two- thirds of eye facets large, rest with small facets .....*Chrysomya megacephala*

Body dull black or striped grey and black, notopleurals always three to four, arista plumose on basal two- thirds, in male genitalia horn on vasica strongly recurved .....*Parasarcophaga albiceps*

SYSTEMATIC LIST

Suborder : NEMATOCERA
Family : TIPULIDAE
Genus : ***Conosia*** Van der Wulp

1. ***Conosia irrorata*** (Wiedemann)

Material examined: 1 ex (abdomen lost), 22 Apr 1992, A.S. Mahabal.

Distribution: India: Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, West Bengal.

Elsewhere: Java, Kalimantan, Myanmar, Sri Lanka, Taiwan, Kotosho Island, Malaya, Nepal, Simeulue Island, Africa, Australia, Israel, Japan, New Guinea, China.

Remarks: It is recorded for the first time from Himachal Pradesh.

Family : BIBIONIDAE
Genus : ***Plecia*** Wiedemann

2. ***Plecia dispersa*** Hardy

Material examined: 2 ♂♂, 22 Apr 1992, A.S. Mahabal.

Distribution: India: Andaman Islands, Arunachal Pradesh, Assam, Himachal Pradesh, Karnataka, Madhya Pradesh, Tamil Nadu, Uttar Pradesh, West Bengal.

Elsewhere: Indonesia, Malaya, the Philippines, Sumatra, Sri Lanka, Java, Samarang, Batavia, Papua.

Suborder : BRACHYCERA
Family : STRATIOMYIDAE
Genus : ***Oplodontha*** Rondani

3. ***Oplodontha rubrithorax*** (Macquart)

Material examined: 1 ♀, 17 Jul 1992, M. Chandra.

Distribution: India: Himachal Pradesh, Uttar Pradesh, West Bengal.

Elsewhere: Java, the Philippines, Sri Lanka, Sumatra, Thailand.

Remarks: It is the first record from Himachal Pradesh.

Genus : ***Adoxomyia*** Bezzi

4. ***Adoxomyia heminopla*** (Wiedemann)

Material examined: 1 ♀, 26 Apr 1992, A.S. Mahabal.

Distribution: India: Bihar, Himachal Pradesh, Tamil Nadu, also in many other parts of India.

Elsewhere: Myanmar, Pakistan, Sri Lanka.

Remarks: It is the first record from Himachal Pradesh.

Family : TABANIDAE
Genus : ***Tabanus*** Linnaeus

5. ***Tabanus (Tabanus) striatus*** Fabricius

Material examined: 1 ♀, 22 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: Africa, China, Pakistan, Sri Lanka, Thailand, Vietnam.

Remarks: It is the first record from Himachal Pradesh.

Suborder : CYCLORRHAPHA
Family : SYRPHIDAE
Genus : ***Episyrphus*** Matsumura and Adachi

6. ***Episyrphus balteatus*** (De Geer)

Material examined: 7 ♀♀, 23 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: Entire Oriental region, Australia, Bonin Islands, Ethiopian and Palaearctic regions.

Genus : ***Phytomia*** Guerin-Meneville

7. ***Phytomia (Dolichomerus) crassa*** (Fabricius)

Material examined: 2 ♂♂, 1 ♀, 23 Apr 1992, A.S. Mahabal.

Distribution: India: Andhra Pradesh, Assam, Bihar, Goa, Himachal Pradesh, Karnataka, Kerala, Meghalaya, Sikkim, Tamil Nadu, Uttar Pradesh.

Elsewhere: Celebes, Laos, Malaya, Nepal, Sri Lanka, Thailand.

Remarks: It is the first record from Himachal Pradesh.

Family : SCIOMYZIDAE
Genus : ***Sepedon*** Latreille

8. ***Sepedon plumbella*** Wiedemann

Material examined: 1 ♀, 27 Apr 1992, A.S. Mahabal.

Distribution: India: Bihar, Himachal Pradesh, Tripura, West Bengal.

Elsewhere: China, Java and many parts of Oriental region, Australia, New Caledonia, New Guinea, Solomon Islands.

Family : MUSCIDAE
Genus : ***Musca*** Linnaeus

9. ***Musca (Musca) domestica*** Linnaeus

Material examined: 5 ♀♀, 24 Apr 1992, A.S. Mahabal; 1 ♀, 26 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: Nearly cosmopolitan.

Genus : ***Orthellia*** Robineau-Desvoidy

10. ***Orthellia timorensis*** (Robineau-Desvoidy)

Material examined: 3 ♂♂, 3 ♀♀, 24 Apr 1992, A.S. Mahabal; 1 ♂, 26 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: Widely distributed in other parts of Oriental region, Japan, Papuan subregion.

Genus : ***Gymnodia*** Robineau-Desvoidy

11. ***Gymnodia tonitrui*** (Wiedemann).

Material examined: 1 ♀, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Andhra Pradesh, Assam, Bihar, Himachal Pradesh, Madhya Pradesh, Maharashtra, Uttar Pradesh, West Bengal.

Elsewhere: China, Taiwan, Malaya, Nepal, Pakistan; Ethiopian and S. Palaearctic regions.

Genus : ***Stomoxys*** Geoffroy

12. ***Stomoxys calcitrans*** (Linnaeus)

Material examined: 3 ♀♀, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: Bali, Bangladesh, Kalimantan, Celebes, China, Myanmar, Sri Lanka, Java, Malaya, Nepal, Pakistan, the Philippines, Simeule Island, Sumatra, Sumbawa, Thailand, Vietnam.

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Family : CALLIPHORIDAE
Genus : ***Chrysomya*** Robineau-Desvoidy

13. ***Chrysomya megacephala*** (Fabricius)

Material examined: 1 ♂, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: Other parts of Oriental region; north China and Japan of the Palaearctic region; Australasian region, Malagasy subregion of the Ethiopian region.

Family:SARCOPHAGIDAE

Genus : ***Parasarcophaga*** Johnston & Tiegs

14. ***Parasarcophaga (Parasarcophaga) albiceps*** (Meigen)

Material examined: 1 ♂, 24 Apr 1992, A.S. Mahabal.

Distribution: India: Widely distributed.

Elsewhere: China, Kalimantan, Malaya, Nepal, the Philippines, Ryukyu Islands, Taiwan, Thailand, Bismarck, Europe, Hawaii, Israel, Japan, Korea, New Britain, New Guinea, Solomon Island, Turkey.

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INTRODUCTION

The Renuka wetland being a part of western Himalayan ecosystem derives its fish fauna from the drainages of lesser Himalayan ranges. It has been postulated that the river Giri had its flow through the present day Renuka lake which was cut off due to land slides (Singh *et al.*, 1987). The lake supports a high population of Mahasser and a variety of other hill stream and lacustrine fishes.

The fish fauna of Himachal Pradesh is rich because of a network of drainages of major rivers like Sutlej, Ravi, Chenab, Beas and Yamuna and their torrential tributaries. As a result, some species depict remarkable morphological modifications in commensurating with torrential way of life which in turn has generated immense interest amongst naturalists and ichthyologists. Notable amongst these are McCelland (1839, 1842), Steindachner (1867), Day (1878), Hora (1927, 1937, 1950), Menon (1951, 1954, 1966) and Sehgal (1973).

Of 79 species of fishes from Himachal Pradesh, Tilak and Hussain (1977) recorded only 3 species from Renuka lake. Further, Singh *et al.* (1987) raised this number to 9.
The present studies show the occurrence of 19 species from this wetland with distinct ecological zones (Fig. 1).

The author is grateful to Dr A.K. Ghosh, Director, Zoological Survey of India, Calcutta for laboratory facilities. Thanks are due to Dr J.M. Julka, Scientist-SF and Officer-in-Charge, High Altitude Zoology Field Station, Zoological Survey of India, Solan for going through the manuscript and suggestions for improvements.

KEY TO THE IDENTIFICATION OF FISHES OF RENUKA WETLAND

1. Body elongated, eel-shaped.....*Mastacembelus armatus*

   Body neither elongated nor eel-shaped 2

2. Head with scales; dorsal and anal fins long.....3

   Head without scales; dorsal and anal fins short.....4

3. Scales 15-16 between snout and origin of dorsal fin, dorsal fin rays 45-55; black ocellus present at base of caudal fin.....*Channa marulius*

Scales 12-13 between snout and origin of dorsal fin, dorsal fin rays 29-37; black ocellus absent at base of caudal fin 4

4. Dorsal fin rays 32-37; pectoral with alternating orange and blue bands; bands on body absent ..... .*Channa orientalis*

Dorsal fin rays 29-32; pectoral without transverse bands; body uniform of colour with several bands or patches.....*Channa punctatus*

5. Barbels 3-4 pairs; simple or bifid movable spine present in groove before or below eye; mouth subterminal; gill opening small or moderate; scales small or rudimentary; eyes covered with skin.....6

Barbels 1-2 pairs or absent; spine in groove or before eye absent; mouth terminal to inferior; gill opening wide; scales generally large; eyes not covered with skin 8

6. Dorsal fin inserted nearer snout than base of caudal fin; scales conspicuous, imbricate .....*Nemacheilus botia*

Dorsal fin inserted nearer base of caudal fin or equidistant to snout and base of caudal fin; scales minute, non-imbricate.....7

7. Dorsal fin inserted nearer base of caudal fin; scales minute.....*Nemacheilus montanus*

Dorsal fin inserted at equidistant to snout and base of caudal fin; scales small, indistinct..... .....*Nemacheilus rupecola*

8. Lower jaw without any symphysial process; dorsal fin inserted before origin of pelvic fin, generally with a spine; lateral line running along median line of caudal peduncle 9

Lower jaw with a symphysial process fitting in a notch of emargination of upper jaw; dorsal fin inserted behind base of pelvic fin, spine absent; lateral line incomplete, if complete running along lower part of caudal peduncle 15

9. Lower lip with a fleshy lobe below mandibular symphysis **10**

Lower lip without a fleshy lobe below mandibular symphysis 11

10. Head longer than depth of body, maxillary and rostral pair of barbels of equal length..... .....*Tor putitora*

Head shorter than depth of body, rostral pair of barbels shorter than maxillary pair.....*Tor tor*

11. Lower lip without an inner transverse fold; mouth terminal, no horny covering on inner side of lower lip 12

Lower lip with an inner transverse fold; mouth terminal to inferior; lower lip with horny covering 14

12. Barbels present; last ray of dorsal fin unserrated ..... *Puntius chola*

Barbels absent; last ray of dorsal fin serrated 13

13. Body deep and compressed, 2-2.4 times in standard length than its height; dorsal fin inserted equidistant from tip of snout and base of caudal fin ..... *Puntius conchonius*

Body elongate,2.6-3 times in standard length than its height; dorsal fin nearer base of caudal peduncle than that of snout ..... *Puntius ticto*

14. Lateral transverse scales 7-8 ..... *Labeo dero*

Lateral transverse scales 6-6.5 ..... *Labeo rohita*

15. Maxillary barbels very long, extending upto anal fin, rostral barbels short; anal fin with 5 branched rays 16

Maxillary barbels if present short to moderate; anal fin with 7 branched rays 17

16. Lateral line present but incomplete ..... *Esomus danricus*

Lateral line absent ..... *Brachydanio rerio*

17. Barbels absent ..... *Rasbora daniconius*

Barbels present 18

18. Predorsal scales 18-20; lateral line with 40-45 scales; 8-10 vertical bars ..... *Barilius bendelisis*

Predorsal scales 21-26; lateral line with 30-35 scales; 10 to 14 bluish verticular bars ..... *Barilius vagra*

SYSTEMATICAL LIST

Family : MASTACEMBELIDAE
Genus : ***Mastacembelus*** Scopli

1. ***Mastacembelus armatus*** Lacepede
(Groage, Godol, Bam)

Material examined: 2 ex, 23 Jul 1992, H.S. Mehta; 1 ex, 23 Apr 1992, A.S. Mahabal

Distribution: India: Assam, West Bengal, Bihar, Tamil Nadu, Kerala, Maharashtra, Punjab, Orissa.

Elsewhere: Pakistan, Sri Lanka, Nepal, Myanmar, Thailand, Malay, southern China.

Remarks: Inhabits fresh and brackish waters in plains and hills. It was collected from peripheral region of the lake. Being carnivorous, this species is considered an important component of lacustrine ecosystem. It probably helps in scavanging. Singh *et al.*, (1987) recorded *M. pancalus* from Renuka lake.

Family : CHANNIDAE
Genus : ***Channa*** Scopli

2. ***Channa marulius*** (Hamilton-Buchanan)
(Giant snake-head)

Material examined: 2 ex, 22 Jul 1992, H.S. Mehta; 3 ex, 28 Jul 1992, H.S. Mehta.

Distribution: India: Assam, West Bengal, Punjab, Orissa, Tamil Nadu, Karnataka, Kerala.

Elsewhere: Pakistan, Sri Lanka, Nepal, Myanmar, Thailand, China.

Remarks: Inhabits large lakes and rivers. It was observed in clear water in peripheral areas with submerged vegetation. Being carnivorous, it is a good scavanger. The fish is specially known for its parental care; fries are enclosed in a sheet which is guarded by the parents.

3. ***Channa orientalis*** Block and Schneider
(Snake-headed, Chenga-fish)

Material examined: 3 ex, 25 Apr 1992, A.S. Mahabal.

Distribution: India: Assam, West Bengal, Bihar, Punjab, Orissa, Andhra Pradesh, Karnataka.

Elsewhere: Afghanistan, Pakistan, Nepal, Sri Lanka, Bangladesh, Myanmar, East Indies.

Remarks: It inhabits mountain streams and low land waters. It leads more or less amphibious mode of life in the peripheral zone with vegetation.

4. ***Channa punctatus*** (Bloch)
(Spotted-Snakehead, Goresa, Daula)

Material examined: 1 ex, 2 Oct 1992, J.M. Julka.

Distribution: India: West Bengal, Bihar, Punjab, Jammu, Orissa, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka.

Elsewhere: Afghanistan, Pakistan, Sri Lanka, Nepal, Bangladesh, Myanmar, Yunan.

Remarks: It prefers stagnant waters in muddy streams.

Family : COBIITIDAE
Genus : ***Nemacheilus*** Hasselt

5. ***Nemacheilus botia*** (Hamilton-Buchanan)
(Bhareli)

Material examined: 4 ex, 28 Jul 1992, H.S. Mehta.

Distribution: India: Northern India, Brahmaputra and Ganga basins.

Elsewhere: Pakistan: Indus Basin.

Remarks: It inhabits submontane zones. It was recorded in streams by disturbing small stones during rainy season probably being flushed with rain water.

6. ***Nemacheilus montanus*** (McClelland)

Material examined: 2 ex, 28 Jul 1992, H.S. Mehta.

Distribution: India: Himachal Pradesh.

Remarks: The species was collected during rains in shallow eastern zone of the wetland.

7. ***Nemacheilus rupecola*** (McClelland)

Material examined: 4 ex, 30 Sep 1992, J.M. Julka.

Distribution: India: Western Himalaya: Kumaon through Garhwal Himalaya, Yamuna, Sutlej and Beas drainages of Himachal Pradesh.

Remarks: It was collected from the western zone by disturbing stones and small boulders at its outlet.

Family : CYPRINIDAE
Genus : ***Tor*** Gray

8. ***Tor putitora*** (Hamilton-Buchanan)
(Putitora-Mahaseer)

Material examined: 6 ex, 25 Jul 1992, H.S. Mehta.

Distribution: India: Assam, West Bengal, Punjab, Himachal Pradesh, Jammu and Kashmir.

Elsewhere: Afghanistan, Pakistan, Nepal, Bangladesh.

Remarks: It inhabits montane and submontane regions in streams and rivers. Its population is very dense particularly near the temple. It is a good scavanger.

9. ***Tor tor*** (Hamilton-Buchanan)
(Tor Mahaseer)

Material examined: 4 ex, 22 Jul 1992, H.S. Mehta.

Distribution: India: Sub-Himalayan range, Ganga and Narmada river systems, Assam, West Bengal, Uttar Pradesh.

Elsewhere: Pakistan, Bangladesh.

Remarks: It was collected from Parashuram Tal. It is a voracious feeder and feeds upon submerged plants, and can be used in biological control of aquatic weeds.

Genus : ***Puntius*** Hamilton-Buchanan

10. ***Puntius chola*** (Hamilton-Buchanan)
(Swamp-barb, Chola-barb)

Material examined: 3 ex, 22 Jul 1992, H.S. Mehta.

Distribution: India: West Bengal, Bihar, Uttar Pradesh, Punjab, Orissa, Tamil Nadu, Kerala, Karnataka.

Elsewhere: Pakistan, Nepal, Sri Lanka, Bangladesh, Myanmar.

Remarks: The species was collected from Parashuram Tal

11. ***Puntius conchonius*** (Himilton-Buchanan)
(Rosy-Barb, Red-Barb)

Material examined: 4 ex, 27 Jul 1992, H.S. Mehta; 2 ex, 27 Apr 1992, A.S. Mahabal.

Distribution: India: Ganga, Brahmputra, Mahanadi and Cauveri river systems.

Elsewhere: Afghanistan, Pakistan, Nepal, Bangladesh.

Remarks: Generally inhabits lakes and streams. The species was collected from the eastern zone wth drag net.

12. ***Puntius ticto*** (Hamilton-Buchanan)
(Ticto-Barb, Firebin-Barb, Two-spot Barb)

Material examined: 2 ex, 27 Apr 1992, A.S. Mahabal; 8 ex, 30 Jul 1992, H.S. Mehta.

Distribution: India: Assam, Bihar, Uttar Pradesh, Orissa, Kerala.

Elsewhere: Pakistan, Sri Lanka, Myanmar, Bangladesh, Thailand.

Remarks: It inhabits montane and submontane regions. It was found in small pools with vegetation along the lake.

Genus : ***Labeo*** Cuvier

13. ***Labeo dero*** (Hamilton-Buchanan)
(Gid, Bhanga)

Material examined: 1 ex, 25 Jul 1992, H.S. Mehta.

Distribution: India: Assam, West Bengal, Uttar Pradesh, Orissa, Punjab, Himachal Pradesh, Arunachal Pradesh.

Elsewhere: Pakistan, Sri Lanka, Bangladesh, Myanmar, China.

Remarks: The species was collected from the Parashuram Tal at its inlet from Renuka lake.

14. ***Labeo rohita*** (Hamilton-Buchanan)
(Rohu)

Material examined: 2 ex, 25 Apr 1992, A.S. Mahabal.

Distribution: India: Assam, West Bengal, Bihar, Uttar Pradesh, Punjab, Andhra Pradesh, Maharashtra.

Elsewhere: Pakistan, Bangladesh, Terai region of Nepal, Myanmar.

Remarks: It is a bottom feeder, and feeds on plants, decaying vegetation and algal slime.

Genus : ***Esomus*** Swainson

15. ***Esomus danricus*** (Hamilton-Buchanan)
(Flying-Barb)

Material examined: 2 ex, 24 Apr 1992, A.S. Mahabal; 3 ex, 28 Sep 1992, J.M. Julka.

Distribution: India: Assam, West Bengal, Uttar Pradesh, Punjab, Andhra Pradesh, Tamil Nadu, Kerala.

Elsewhere: Pakistan, Nepal, Sri Lanka, Myanmar.

Remarks: It dwells and jumps in small pools along the lake.

Genus : ***Brachydanio*** Weber & Beaufort

16. ***Brachydanio rerio*** (Hamilton-Buchanan)

Material examined: 1 ex, 26 Sep 1992, J.M. Julka.

Distribution: India: West Bengal to Krishna river system, Orissa, Andhra Pradesh, Tamil Nadu.

Elsewhere: Pakistan, Bangladesh, Nepal.

Remarks: It Inhabits slow moving to stagnant waters, particularly rice fields.

Genus : ***Rasbora*** Bleeker

17. ***Rasbora daniconius*** (Hamilton-Buchanan)
(Bhareli)

Material examined: 6 ex, 29 Jul 1992, H.S. Mehta; 2 ex, 25 Sep 1992, J.M. Julka.

Distribution: India: Gangetic provinces, Assam.

Elsewhere: Pakistan, Bangladesh, Myanmar, Thailand.

Remarks: It was observed along the peripheral zone with vegetation in small pools and puddles.

Genus : ***Barilius*** Hamilton-Buchanan

18. ***Barilius bendelisis*** (Hamilton-Buchanan)

Material examined: 6 ex, 22 Jul 1992, H.S. Mehta.

Distribution: India: Assam, West Bengal, Bihar, Punjab, Himachal Pradesh, Jammu, Orissa, Tamil Nadu, Maharashtra.

Elsewhere: Pakistan, Nepal, Sri Lanka, Bangladesh.

Remarks: It inhabits streams and rivers along the base of hills.

19. ***Barilius vagra*** (Hamilton-Buchanan)

Material examined: 2 ex, 29 Jul 1992, H.S. Mehta; 24 Apr 1992, A.S. Mahabal.

Distribution: India: Himalayan and sub-Himalayan rivers, Assam, West Bengal, Uttar Pradesh.

Elsewhere: Afghanistan, Pakistan, Nepal, Bangladesh, Sri Lanka.

Remarks: It is a hill-stream fish, dwelling in pools and puddles with slow running water.

ECOLOGICAL OBSERVATIONS

Fishes in general are basically of three types; column feeders, column dwellers and bottom feeders, The Renuka wetland can be categorized into four convenient ecological zones.

1. *Fishes of littoral zone (without vegetation)*: In this zone, fishes like *Tor putitora, Tor tor, Puntius chola, Labeo dero, Labeo rohita* swim freely and visit ashore for feeding. *Tor putitora* and *Tor tor* are mahaseer fishes typical of low mountain regions. All these species are with terminal mouths of varying degree. In mahaseer fishes, lower lip serves as an adhesive organ during feeding. In *Labeo,*

the blade-like lower jaw is meant for scrapping off algal slime. Species of *Puntius* are planktonic feeders where lower jaw is not produced into a blade-like structure. All species require fresh running water which is rich in dissolved oxygen. Oxygen content in this zone is more in upper layers than lower one.

2. *Fishes of littoral zone* (with vegetation): This zone is characterised by low dissolved oxygen and high carbon dioxide. The specis in this region belong to *Rasbora, Esomus, Brachydanio* and *Puntius*. Their characteristic feature is laterally compressed body. All species are with terminal mouth and planktonic feeders. They require low contents of dissloved oxygen. *Channa* species are perches, characterised by perching movemnets. Their mouth is terminal and they are carnivorous. They have accessory breathing organs and can store oxygen. Some *Namacheilus* species are also observed in this zone.

3. *Fishes of shoals and puddles*: There are some isolated pocekts in the lake from where *Barilius* specis were collected. These are typically hill-stream fishes which require high quantity of dissolved oxygen. The body is laterally compressed, suitable for lacustrine mode of life. *Namacheilus* species were collected from the bottom by disturbing the vegetation.

4. *Fishes of shallow outlets*: During low currents of water, *Namacheilus* fishes were collected by disturbing stones and gravels with the help of a hand net. These fishes are bottom feeders, feeding on benthic insect larvae.

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AMPHIBIA

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INTRODUCTION

The amphibians form an evolutionary important group of vertebrates holding a significant intermediate position between fishes and reptiles. They are the first land vertebrates but still possess organs suitable for aquatic life. They live both on land and in water. Three groups are recognised among amphibians: tailed salamandars and newts, limbless snake-like caecilians, tailless limbed frogs and toads. Approximately 3140 species of living amphibians are known in the world (Duellman, 1982), frogs and toads forming the largest group with about 2770 species. The Indian amphibian fauna comprises 204 species predominated by frogs and toads with 188 species (Chanda, 1991).

They are considered as excellent laboratory animals all over the world. Their importance as baits for pike angling has already been recognised long ago. They play a significant role in the ecosystem by consuming a large variety of insect pests. As a part of natural food chain, they are preyed upon by fishes, reptiles and birds. Frog legs are considered a table delicacy in some countries.

The amphibian fauna of Renuka wetland is not known. However, some information on the amphibians of neighbouring Shimla hills is available in the works of Annandale (1907), Boulenger (1920) Kripalani (1952) and Dubois (1975). Tilak and Mehta (1983) studied the amphibian fauna of district Sirmour. The present studies reveal the existence of two additional species of frogs and toads, *viz.*, *Rana (Paa) minica* Dubois and *Bufo andersonii* Boulenger. A field key to the identification of adults and tadpoles has been constructed. Morhological characters having bearings on taxonomy are discussed in the light of their functional aspects. Distribution of amphibians in diverse ecological niches of the wetland, *viz.*, littoral zone (without vegetation), littoral zone (with vegetation), pools near the lake, marshes, etc., is dealt with.

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KEY TO THE IDENTIFICATION OF ADULT AMPHIBIANS OF RENUKA WETLAND

1. Skin smooth and slimy; tongue small, oval or bifid; paratoid glands absent.....2

   Skin rough, tuberculated; paratoid glands present.....7

2. Tongue bifid.....3

   Tongue oval.....*Microhyla ornata*

3. Tympanum distinct.....4

   Tympanum indistinct.....*Rana(Paa)minica*

4. Toes with well developed web almost complete.....5

   Toes with reduced web.....6

5. Snout not projecting beyond jaws; subarticular tubercles on fingers and toes weakly developed; inner metatarsal tubercle small, digitiform.....*Rana cyanophylyctis*

   Snout projecting beyond jaws; subarticular tubercles on fingers and toes well developed; inner metatarsal tubercle long and shovel-like.....*Rana tigerina*

6. Nostrils near anterior end of snout; interorbital width equal to height of upper eyelid; inner metatarsal tubercle shorter than fifth toe.....*Rana limnocharis*

   Nostrils equidistant from eye and snout; interorbital width narrower than height of upper eyelid; inner metatarsal tubercle longer than fifth toe.....*Rana (Tomopterna) breviceps*

7. Head with distinct cranial ridges; snout pointed.....*Bufo melanostictus*

   Head without distinct cranial ridges; snout obtusely pointed.....8

8. Skin rough, tuberculated; interorbital space narrower than height of upper eyelid; tympanum circular; tarsometatarsal articulation absent.....*Bufo stomaticus*

   Skin smooth; interorbital space broader than height of upper eyelid; tarsometatarsal articulation present .....*Bufo andersonii*

KEY TO IDENTIFICATION OF TADPOLES OF RENUKA WETLAND

1. Tail rounded.....2

   Tail pointed.....3

2. Colour dark brown; nostrils nearer to eye than snout; mouth slightly aterminal; tail more than
3 times snout-vent length.....*Bufo melanostictus*

   Colour grey; nostrils equidistant from eye and snout, mouth terminal; tail less than 3 times snout-vent length.....*Bufo stomaticus*

3. Transparent with specific streak; nostrils at tips of laterally placed eyes, interorbital space wide.... .....*Microhyla ornata*

Opaque and grey; nostrils nearer to eyes than snout, eyes dorsal, interorbital space narrow..... 4

4. Dentitional rows 6 in upper jaw and 3 in lower jaw .....*Rana (Paa) minica*

Dentitional rowsone in upper jaw and 2 in lower jaw .....*Rana cyanophlyctis*

SYSTEMATIC LIST

Family : RANIDAE
Genus : ***Rana*** Linnaeus

1. ***Rana cyanophlyctis*** Schneider
(Skiping Frog)
(Figs. 1a, b, c)

Material examined: 18 ex, 20 Jul 1975, H.S. Mehta; 6 ex, 18 Jul 1995, H.S. Mehta; 2 ex, 16 Jul 1992, H.S. Mehta; 6 ex (tadpoles), 20 Jul 1992, H.S. Mehta; 1 ex, 23 Sep 1992, J.M. Julka, 5 ex, 27 Sep 1992, J.M. Julka.

Distribution: India: upto 1550 m in Himalaya; commonly found in other parts of country.

Elsewhere: South Arabia, Pakistan, Afghanistan, Sri Lanka.

Remarks: Its is dominantly aquatic as shown by well developed web of toes for active swimming. Inner metatarsal tubercle is digitiform with a web. In the evenings, it is observed under light poles foraging for food. The skin is dry and rough with hardened inner metatarsal tubercles which indicate their adaptations for terrestrial mode of life.

2. ***Rana limnocharis*** (Boie)
(Indian Cricket Frog)
(Figs. 2a, b, c)

Material examined: 4 ex, 16 Jul 1992, H.S. Mehta; 2 ex, 18 Jul 1992, H.S. Mehta; 3 ex, 27 Sep 1992, J.M. Julka.

Distribution: India: Western India, Rajasthan, Sikkim, West Bengal, Meghalaya, southern India, Punjab, Haryana, Jammu and Kashmir.

Elsewhere: East Asia, Japan, China, Sri Lanka, Malaya Peninsula, the Philippines, Borneo.

Remarks: This species is very well adapted for terrestrial mode of life as evidenced by well developed subarticular tubercles on its fingers and toes, reduced web and inner metatarsal tubercle well developed, which is for burrowing mode of life.

3. ***Rana tigerina*** Daudin
(Common Bull Frog)
(Figs. 3a, b, c)

Material examined : 2 ex, 28 Nov 1978, J.M. Julka; 3 ex, 20 Jul 1979.H. S. Mehta; 3 ex, 26 Jul 1992, H.S. Mehta; 2 ex, 26 Sep 1992, J.M. Julka; 2 ex, 6 Apr 1993, A.S. Mahabal.

Distribution: India: Widespread, cosmopolitan in plains and upto 600 m in hills.

Elsewhere: Sri Lanka, Thailand, Vietnam, Combodia, S. China, Formosa.

Remarks: In rainy and breeding seasons, this species inhabits shallow region of the lake. But during other seasons, it is invariably found in wet areas, commonly hiding in and camouflaging with colour of vegetation, escape from predators like snakes. Inner matatarsal tubercle is long for digging and burrowing. The folds of skin in palmer region and its web between toes are well developed.

4. ***Rana (Tomopterna) breviceps*** Schneider
(Burrowing Frog)
(Figs. 4a, b, c)

Material examined: 4 ex, 16 Jul 1976, H.S. Mehta; 3 ex, 18 Jul 1992, H.S. Mehta; 4 ex, 23 Jul 1992, H.S. Mehta; 1 ex, 1 Oct 1992, J.M. Julka; 2 ex, 5 Apr 1993, A.S. Mahabal.

Distribution: India: Restricted to plains of Uttar Pradesh, West Bengal, Punjab, southern India.

Elsewhere: Sri Lanka, upper Myanmar.

Remarks: This species is better adopted for terrestrial mode of life as shown by advancement of characters, ***viz.***, widening of head, better developed subarticular tubercles of fingers and toes for a firm grasp on land. A long shovel-shaped inner metatarsal tubercle helps in burowing. The reduced web between toes is correlated with the decreasing aquatic mode of life. These toad-like frogs are common in the marshy areas of the lake and temporary pools along the Parashuram Tal. The undersurface, vocal sacs and tubercles are pink in colour during breeding season.

5. ***Rana (Paa) minica*** Dubois
(Small Montane Frog)
(Figs. 5a, b, c)

Material examined: 11 ex (8 tadpoles), 30 May 1978, H.S. Mehta; 18 ex (12 tadpoles), 20 Jul 1992, H.S. Mehta; 2 ex, 23 Apr 1992, A.S. Mahabal; 22 ex (tadpoles), 25 Jul 1992, H.S. Mehta.

Distribution: India: Upto 2500 m in the Himalaya.

Elsewhere: Nepal.

Remarks: Next to *R. cyanophlyctis*, this species is quite common in the wetland. It usually lives under straw. Breeding calls, like whistling at low pitch, are heard from the end of April to July.

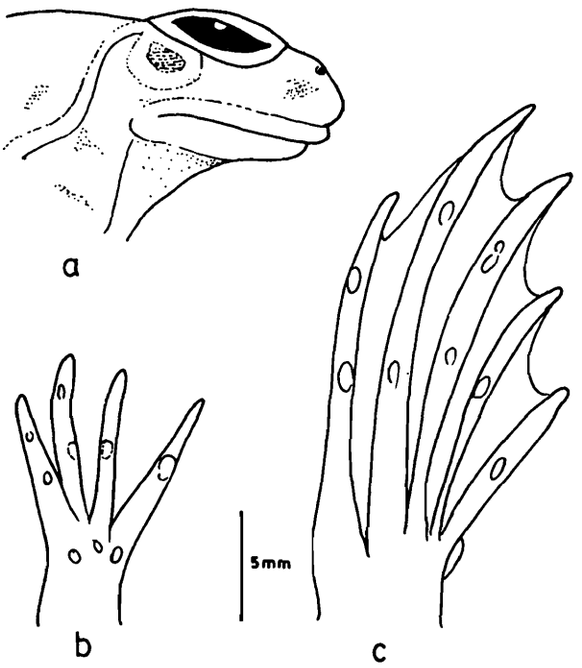

Fig. 1.*Rana cyanophlyctis* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

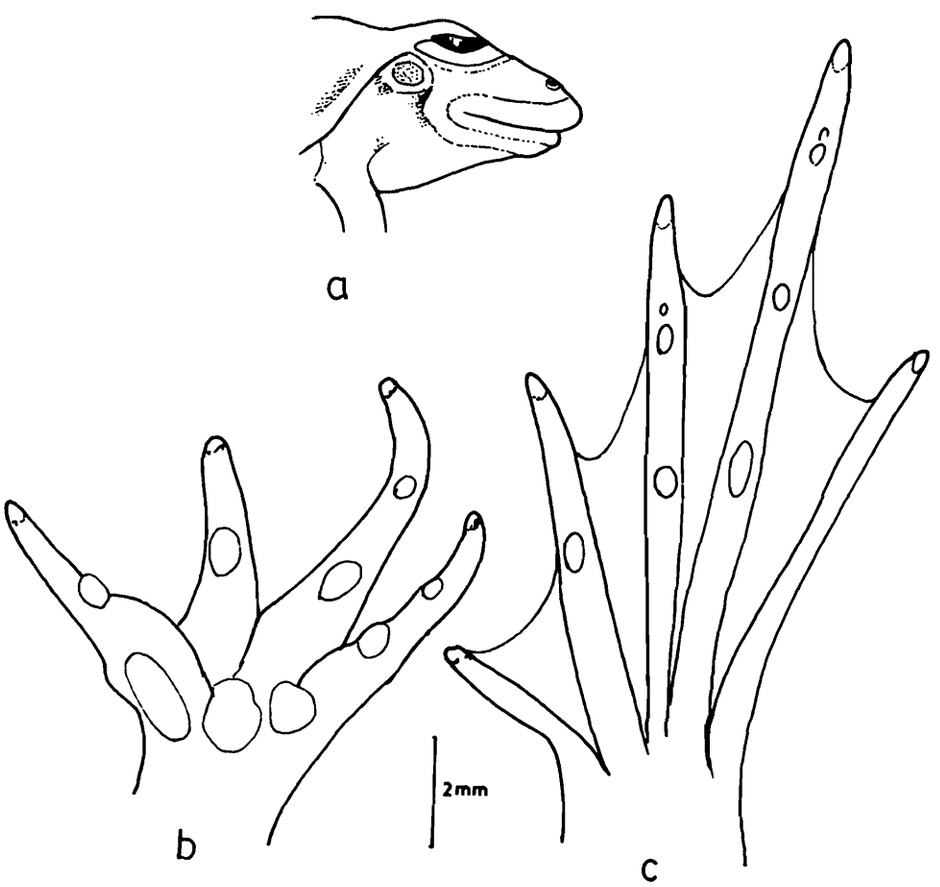

Fig. 2.*Rana limnocharis* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

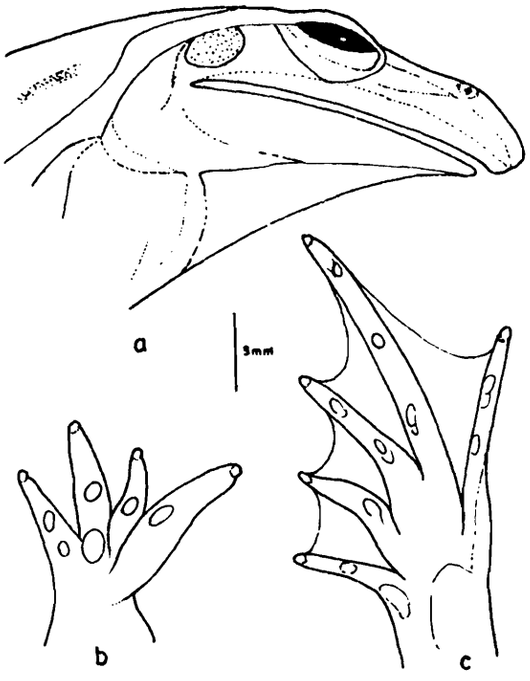

Fig. 3.*Rana tigerina* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

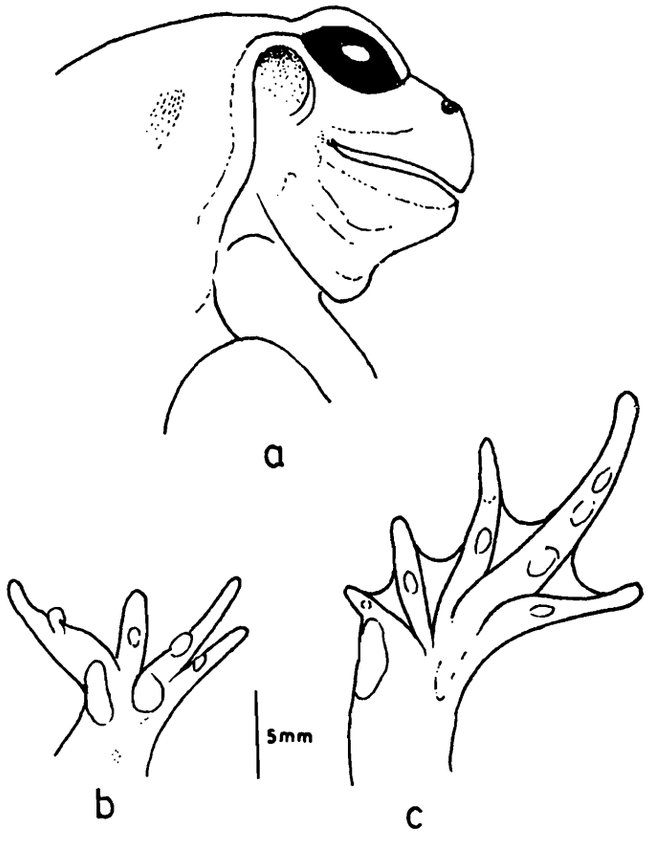

Fig. 4.*Rana (Tomopterna) breviceps* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

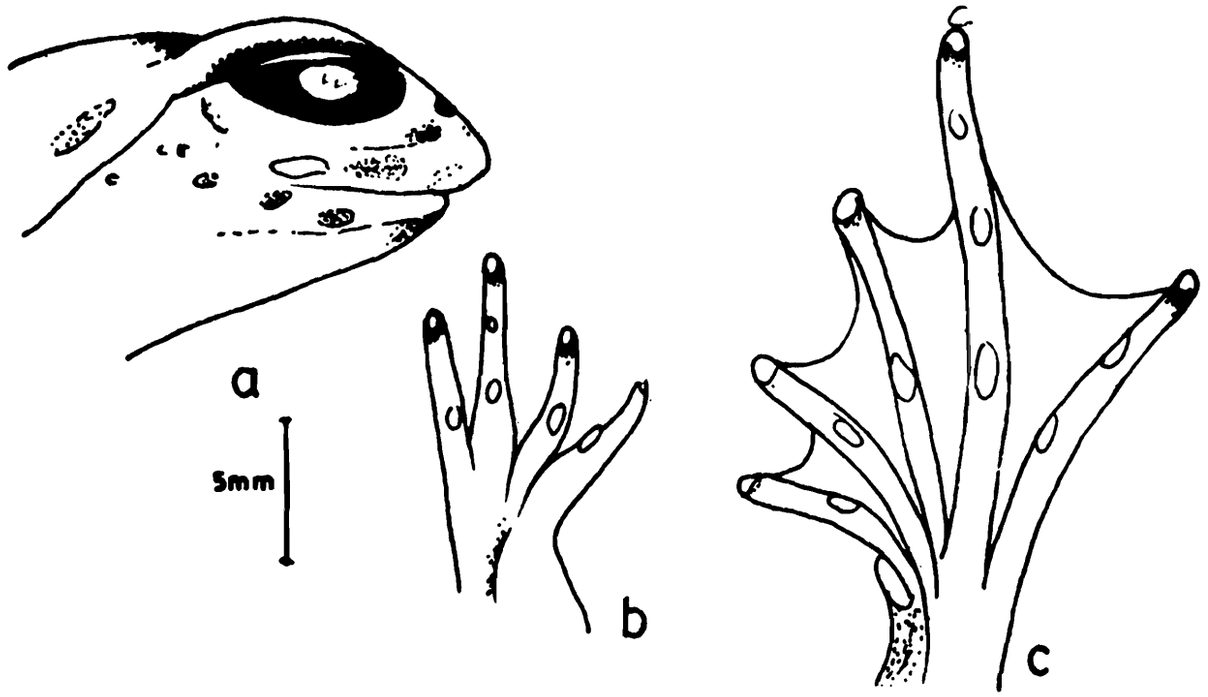

Fig. 5.*Rana (Paa) minica* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

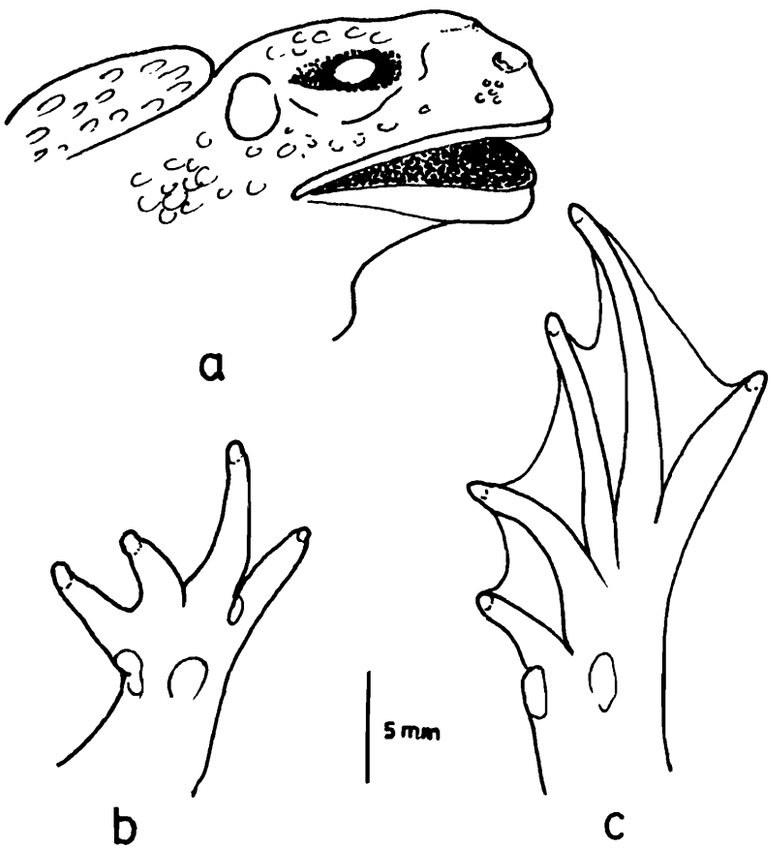

Fig. 6.*Bufo melanostictus* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

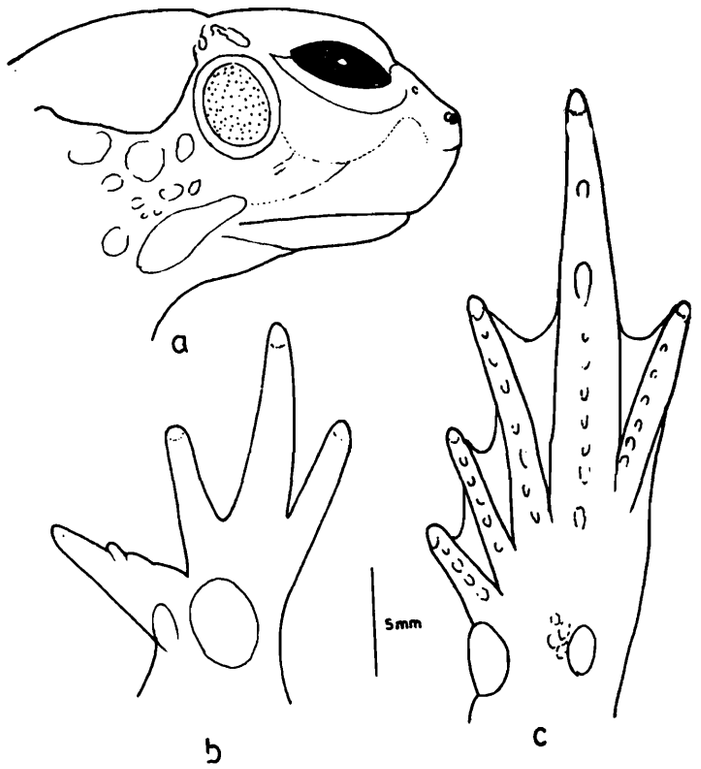

Fig. 7.*Bufo stomaticus* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

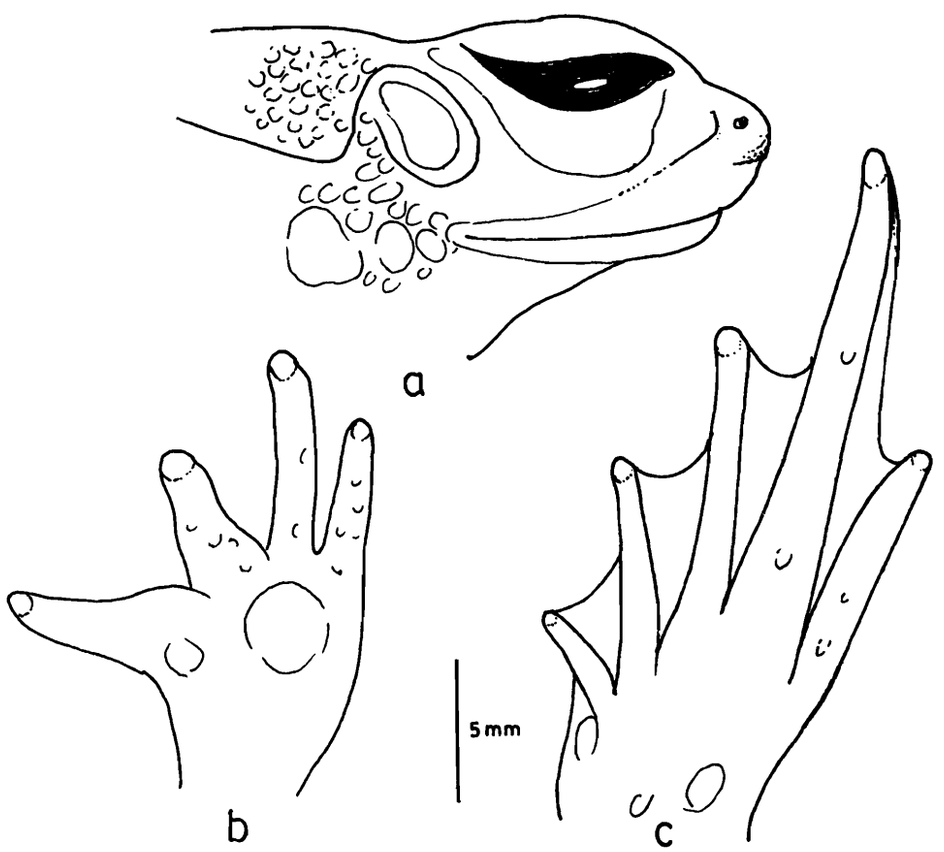

Fig. 8.*Bufo andersonii* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

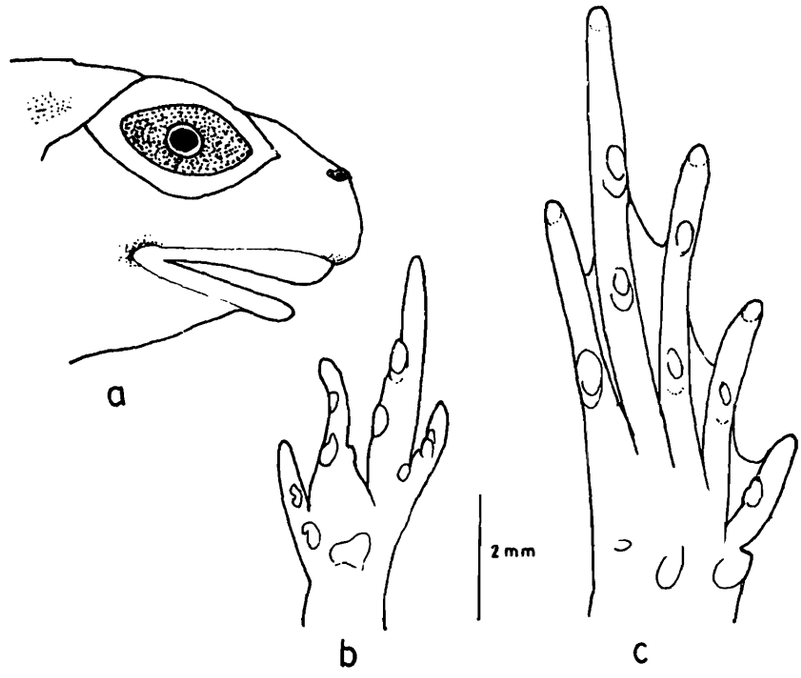

Fig. 9.*Microhyla ornata* : a. Lateral aspect of antetior part; b. Inner view of palm; c. Inner aspect of toe.

Family : BUFONIDAE
Genus : ***Bufo*** Laurenti

6. ***Bufo melanostictus*** Schneider
(Common Indian Toad)
(Figs. 6a, b, c)

Material examined: 18 ex (15 tadpoles), 25 Jul 1992, H.S. Mehta; 2 ex, 22 Apr 1992, A.S. Mahabal.

Distribution: India: Himalaya upto 1600 m, West Bengal Rajasthan, Punjab, Haryana, southern India, Andaman and Nicobar Islands, Sikkim.

Elsewhere: Nepal, southern China, Malaya Archipelago.

Remarks: It breeds in stagnant waters. Its colour varies from light yellow to dark grey and black. During breeding season, undersurface of throat, carpals and tarsal tubercles are slightly pink, and tips of fingers black.

7. ***Bufo stomaticus*** Lutken
(Marbled Toad)
(Figs. 7a, b, c)

Material examined: 4 ex, 29 Aug 1978, H.S. Mehta; 17 ex (15 tadpoles), 27 Jul 1992, H.S. Mehta; 3 ex, 26 Sep 1992, J.M. Julka.

Distribution: India: Upto 1500 m in the Himalaya, Punjab, Haryana, Rajasthan, western India.

Elsewhere: Sri Lanka, western Pakistan, Nepal.

Remarks: Next to *Bufo melanostictus*, this species is common in the plains. It breeds in puddles with slow running water. Its tadpoles are dark grey or black and can easily be distinguished from those of *B. melanostictus*, which are dark brown in colour.

8. ***Bufo andersonii*** Boulenger
(Figs. 8a, b, c)

Material examined: 6 ex, 28 Aug 1978, H.S. Mehta; 2 ex, 21 Jul 1992, H.S. Mehta.

Distribution: India : Himachal Pradesh, Rajasthan, Madhya Pradesh, Uttar Pradesh.

Elsewhere: Pakistan (Sind), Muscat.

Remarks: This species is usually confused with *Bufo stomaticus* but can be readily distinguished by the characters: dorsal surface less tuberculated, interorbital width more than height of upper eye-lid, tympanum oval or beak-like dorsaly and presence of tarsal fold.

Family : MICROHYLIDAE
Genus : ***Microhyla*** Tschudi

9. ***Microhyla ornata*** (Dummeril and Bibron)
(Black-throated Frog)
(Figs. 9a, b, c)

Material examined: 6 ex, 15 Jul 1976, H.S. Mehta; 4 ex, 30 Jul 1992, H.S. Mehta; 3 ex, 27 Sep 1992, J.M. Julka.

Distribution: India: Himalaya upto 1500 m, Haryana, western India, Assam, West Bengal.

Elsewhere: Sri Lanka, Pakistan, Bangladesh, Myanmar, southern China, Laos, Combodia, Vietnam.

Remarks: It can be located by its loud vocal calls during breeding season. This species breeds in temporary ponds and marshes. It is burrowing in nature, and for this purpose its subarticular tubercles of fingers and toes, and carpal and tarsal tubercles are well developed.

ECOLOGICAL OBSERVATIONS

A distinct pattern of distribution of amphibians in different ecological zones of Renuka wetland has been observed as follows:

i) *Littoral zone without macrophytes*: In this zone, only *Rana cyanophlyctis* is observed swimming from one corner to another. Usually it basks on margins of the lake, but actively swims in the lake water

for food and defence. Sometimes *Rana tigerina* also floats in this zone. Both species are characterised by an arrow-shaped head and fully webbed toes for aquatic mode of life.

ii) *Littoral zone with macrophytes*: This region harbours rich diversity of amphibians because of availability of plenty insect food and better chance of camouflaging with the habitat. *Rana limnocharis, R. tigerina* and *R.(Tomopterna) breviceps*, and sometimes *Rana (Paa) minica*, *Microhyla ornata*and *Bufo melanostictus* are found in this zone. These species, except *Rana (Paa) minica*, show modification of morphological characters like reduction of web between toes, and better developed subarticular tubercles on fingers and toes for terrestrial adaptation. They feed upon aquatic insects, worms and slugs.

iii) *Pools in wetland*: Some temporary pools are formed during rainy seasons which become good breeding grounds for *Bufo melanostictus, B. stomaticus, Rana cyanophlyctis, Rana (Tomopterna) breviceps, Rana (Paa) minica*. Breeding pairs and spawns of *Microhyla ornata* are also observed in these pools.

iv) *Marshy zone*: This part of the wetland is submerged during the floods. *R. tigerina, R. (Tomopterna) breviceps, R. limnocharis* and *B. melanostictus* inhabit this zone.

v) *Terrestrial zone*: Before the onset of monsoons, *B. stomaticus, B. melanostictus, B. andersonii, R. (Paa) minica*and *M. ornata* are observed on land around the wetland.

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REPTILIA

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INTRODUCTION

The present studies reveal the existence of 14 species of turtles, lizards, skinks and snakes in the Renuka wetland. Species of turtle and yellow monitor lizard have been identified with the help of a pair of field binoculars. Some information on reptiles of Himachal Pradesh is available in the works of Smith (1931, 1935, 1943) and Waltner (1974). Recently, Hussain and Ray (1995) have reported 70 species of reptiles from adjacent areas of western Himalaya in Uttar Pradesh.

The author is thankful to the Director, Zoological Survey of India Calcutta for the laboratory facilities. The author is also grateful to Dr. J.M. Julka, Officer-in-Charge, High Altitude Zoology Field Station, Zoological Survey of India, Solan for his help in the preparation of this paper.

KEY TO THE IDENTIFICATION OF REPTILES OF RENUKA WETLAND

1. Body covered with bony shell; jaws toothless.....*Kachuga kachuga*

   Body without bony shell; jaws with teeth.....2

2. Body not very much elongated; limbs present.....3

   Body very much elongated; limbs absent.....10

3. Tongue broad and short.....4

   Tongue long and slender.....8

4. Tongue with villose papillae.....5

   Tongue with imbricate scale-like papillae.....9

5. Symmetrical shields on the top of head present.....6

   Symmetrical shields on the top of head absent.....7

6. Femoral pores absent.....*Hemidactylus brooki*

   Femoral pores present.....*Hemidactylus flaviviridis*

7. Dorsal scales regular; a dorsal crest present.....*Calotes versicolor*

   Dorsal scales irregular; a dorsal crest absent.....*Agama tuberculata*

8. Nostrils oblique slits; snout convex.....*Varanus flavescens*

   Nostrils rounded, snout depressed.....*Varanus bengalensis*

9. Limbs well developed.....*Mabuya carinata*

   Limbs short or vestigial.....*Riopa punctata*

10. Small slender worm-like; head not distinct from neck.....*Typhlops porrectus*

    Long; head distinct from neck.....11

11. Head elongate, distinct from neck; normally 2-3 loreal shields; tail long.....*Ptyas mucosus*

    Head more or less triangular; distinct from neck; small imbricate scale or symmetrical shields, pre-ocular and loreal scales smooth or keeled; tail short.....12

12. Snout pointed; a deep pit inside of the face preocular and the loreal absent; 3 longitudinal brown spots presents.....*Vipera russelli*

    Snout not pointed; a deep pit inside of the face preoculars and the loreal present; 3 longitudinal brown spots absent.....13

13. Snout short rounded; nostrils small; scales on the top of head small; elengate imbricate ....Echis carinatus

    Snout not rounded; nostrils medium, scales strongly keeled.....*Agkistrodon himalayanus*

SYSTEMATIC LIST

Order : TESTUDINES
Family : EMYDIDAE
Genus : ***Kachuga*** Gray

1. ***Kachuga kachuga*** (Gray)
(Bengal Roofed Turtle)

Material examined: 6 ex, Jul 1992, author's field observations.

Distribution: India: West Bengal, Bihar, Uttar Pradesh.

Elsewhere: Bangladesh, Nepal.

Remarks: It was found during rainy season along the banks of Parashuram Tal. The females were observed with raised scutes.

Family : GEKKONIDAE
Genus : ***Hemidactylus*** Oken

2. *Hemidactylus brooki* Gray
(Common House Lizard)

Material examined: 5 ex, 20 Jul 1992, H.S. Mehta.

Distribution: India: Cosmopolitan.

Elsewhere: China, Malay Peninsula except Singapore, northern half of Africa.

Remarks: These were observed preying upon insects under light poles near the lake.

3. *Hemidactylus flaviviridus* Ruppell

Material examined: 2 ex, Apr 1993, A.S. Mahabal.

Distribution: India: Northern region, Maharashtra.

Elsewhere: Iran, from Arabia to shores of Red sea.

Family : AGAMIDAE
Genus : ***Agama*** Daudin

4. ***Agama tuberculata*** Hardwicke & Gray
(Rock Lizard)

Mateiral examined: 6 ex, 20 Jul 1992, author's field observations.

Distribution: India: Western Himalaya, Punjab, Uttar Pradesh.

Elsewhere: Afghanistan, Western Tibet, Pakistan.

Remarks: The lizards were observed on margins of the wetland.

Genus : ***Calotes*** Raffinesque

5. ***Calotes versicolor*** (Daudin)
(Indian Garden Lizard)

Material examined: 3 ex, Apr 1993, A.S. Mahabal.

Distribution: India: Throughout, including Andaman and Nicobar Islands.

Elsewhere: Afghanistan, Sri Lanka, China, Malay Peninsula.

Family : VARANIDAE
Genus : ***Varanus*** Gray

6. ***Varanus bengalensis*** (Daudin)
(Monitor Lizard)

Material examined: 5 ex, Jul 1992, author's field observations.

Distribution: India: Western Himalaya (upto 1800 m), West Bengal, Sikkim, Assam.

Elsewhere: Sri Lanka, Bangladesh, Myanmar, China.

7. ***Varanus flavescens*** (Hardwicke & Gray)
(Yellow Monitor)

Material examined: 2 ex, Jul 1992, author's field observations.

Distribution: India: Northern and northeastern regions from Punjab to Orissa, West Bengal, Assam.

Elsewhere: India: Pakistan, Nepal, Bangladesh.

Remarks: It was observed slipping into Renuka lake from nearby bushes.

Family : SCINCIDAE
Genus : ***Mabuya*** Raffinesque

8. ***Mabuya carinata*** (Schneider)
(Common Skink)

Material examined: 3 ex, Jul 1992, H.S. Mehta; 1 ex, Apr 1993, A.S. Mahabal.

Distribution: India: Northern plains, foothills of western Himalaya, Assam, Indian Peninsula, Meghalaya, West Bengal.

Elsewhere: Nepal, Sri Lanka, Bangladesh.

Remarks: It was found under stones on margins of the wetland.

Genus : ***Riopa*** Gray

9. ***Riopa punctata*** (Gmelin)
(Dotted Garden Skink)

Material examined: 2 ex, Jul 1992, H.S. Mehta.

Distribution: India: Widely distributed at low altitudes in hilly areas, Uttar Pradesh, Tamil Nadu.

Elsewhere : Sri Lanka.

Remarks: It was confined to understones near banks of Parashuram Tal.

Order : SERPENTES
Family : TYPHLOPIDAE
Genus : ***Typhlops*** Oppel

10. ***Typhlops porrectus*** Stoliczka
(Slender Blind Snake)

Material examined: 1 ex, Apr 1993, A. S. Mahabal.

Distribution: India: Foothills of Himalaya, Punjab, Bihar, West Bengal, Orissa, Karnataka, Maharashtra.

Elsewhere: Pakistan, Bangladesh, Myanmar, Sri Lanka.

Family : VIPERIDAE
Genus : ***Vipera*** Laurenti

11. *Vipera russelli* (Shaw)
(Russell's Viper)

Material examined: 1 ex, Jul 1976, D.P. Juneja; 1 ex, Jul 1992, H.S. Mehta.

Distribution: India: Sub-Himalayan region, Assam, West Bengal, soutern India.

Elsewhere: Bangladesh, Sri Lanka, Pakistan, Indo-Australian Archipelago.

Remarks: The specimens were collected near the banks of Renuka lake in thick vegetation during rainy season.

Genus : ***Echis*** Merrem

12. ***Echis carinatus*** (Schneider)
(Saw-scaled Viper)

Material examined: 2 ex, Jul 1976, D.P. Juneja; 1 ex, Jul 1992, H.S. Mehta.

Distribution: India: Common in north-western India.

Elsewhere: Pakistan, Africa, Sri Lanka.

Genus : ***Agkistrodon*** Beauvois

13. ***Agkistrodon himalayanus*** Guenther
(Himalayan Pit Viper)

Material examined: 1 ex, Jul 1992, H.S. Mehta.

Distribution: India: Eastern and western Himalaya, Khasi Hills.

Family : COLUBRIDAE
Genus : ***Ptyas*** Linnaeus

14. ***Ptyas mucosus*** (Linnaeus)
(Rat Snake)

Material examined: 1 ex, Sep 1978, J.M. Julka.

Distribution : India: Western Himalayan foothills, Andaman islands.

Elsewhere: Afghanistan, Malay Peninsula, Java, Sumartra.

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AVIFAUNA

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INTRODUCTION

Studies on the avifauna of Renuka wetland and fringes were undertaken during 1991-1992, covering winter, summer and rainy seasons. All observation were made by using a pair of field binoculars (8 x 50 with zoom focussing), and birds were identified with the help of Ali (1949), and Ali and Ripley (1983a, 1983b).

A systematic list of 103 species of birds belonging to 38 families and subfamilies alongwith their food habits, status and abundance is presented in Table 1. Relative percentage of status of these birds has been derived and plotted in Fig. 1. Table 1 indicates that Muscicapidae and Motacillidae are better represented. However, the distribution of different species in remaining families is uneven and poor, including the families comprising waterbirds.

Further, 66 species (64.1%) are resident and most of them show certain local or seasonal movements. Among these, Pariah Kite, Whitebacked Vulture, Blossomheaded Parakeet, House Swift, Crimsonbreasted Barbet, Indian Myna, Jungle Crow, Punjab Redvented Bulbul and Brownbacked Indian Robin are most common in the sanctuary area. However, resident birds like Pond Heron, European Kestrel, Brown Crake, Little Brown Dove, Crow-Pheasant, Grey Hornbill, White-eye and Indian Baya are noticed occasionally.

A large number of high altitude birds of the Himalayan ecosystem migrate towards lower elevations during winter because of heavy snowfall at higher ranges. Fourteen species (13.6%) confined to the Himalayan ecosystem show vertical movements during winter-summer. Of these, Himalayan Redbilled Blue Magpie, Whitecheeked Bulbul, Simla Streaked Laughing Thrush and Kashmir Tit are quite common as compared to others. Nineteen species (18.4%) are found to be wintering in the sanctuary area. Scarlet-Minivet, Kashmir Sooty Flycatcher, Brown Chiffchaff, Plain Leaf Warbler and wagtails are seen fairly in good numbers. Very few summer visiting bird species (3.9%) (mainly migrating for breeding during March-September) are observed in the area.

The food habits of different birds occurring in the area show that majority of species are insectivorous, followed by frugivorous, omnivorous, aquatic animal eaters and graminivorous species. Carnivores, scavengers and nectar feeders are comparatively less in numbers.

Two pairs of Redwattled Lapwing were seen nesting on the west bank of Parashuram Tal during April, 1992. Communal roosts of Jungle Myna, Punjab Redvented Bulbul and Whitecheeked Bulbul are

observed within the sanctuary area, and that of Little Egret is located just outside the sanctuary (in Dadahu vilage on the bank of Giri river).

In general, it is noticed that the densely forested area with negligible cultivation, less human inhabitation and its remoteness from the industrial belt have favourably supported the bird life in the wetland surrounding sanctuary. Further, the avifauna of this wetland and sanctuary resembles with that of the plains of neighbouring states of Haryana and Uttar Pradesh (Whisler, 1918a, 1918b; Jones, 1927).

Author is thankful to the Director, Zoological Survey of India, Calcutta and Dr. J.M. Julka, Officer-in-Charge, Zoological Survey of India, High Altitude Field Zoology Station, Solan for providing necessary facilities to carry out the work.

Table 1. Birds of Renuka wetland and sanctuary with their food habits, status and abundance. (Number in parenthesis against each family/ subfamily shows species known from Himachal Pradesh).

S. No.	Species name	Common name	Food habit	Status	Abund-ance
	1	2	3	4	5
	Order : CICONIIFORMES Family : ARDEIDAE (8)				
1.	*Ardeola grayii* Sykes	Indian Pond Heron	A,I	R/LM	+
2.	*Egretta intermedia* (Wagler)	Median Egret	A,I	R/LM	++
3.	*Egretta garzetta* (Linnaeus)	Little Egret	A,I	R/LM	++
	Order : FALCONIFORMES Family : ACCIPITRIDAE (34)				
4.	*Elanus caeruleus* (Desfontaines)	Blackwinged Kite	C	R/LM	+
5.	*Milvus migrans* (Boddaert)	Pariah Kite	O	R/LM	+++
6.	*Accipiter badius* (Gmelin)	Indian Shikra	C	R	++
7.	*Gyps bengalensis* (Gmelin)	Whitebacked Vulture	S	R	+++
8.	*Neophron perchopterus* (Linnaeus)	Scavenger Vulture	S	R/SM	+
	Family : FALCONIDAE (5)				
9.	*Falco tinnunculus* Linnaeus	European Kestrel	C	R/SM	+
	Family : PHASIANIDAE (12)				
10.	*Francolinus pondicerianus* (Gmelin)	North Indian Grey Partridge	V,G	R	++
11.	*Perdicula asiatica* (Latham) Punjab	Jungle Bush Quail	V,I	R	+
	Order : GRUIFORMES Family : RALLIDAE (5)				
12.	*Amaurornis akool* (Skyes)	Brown Crake	I,V	R/LM	+
13.	*Amaurornis phoenicurus* (Pennant)	Whitebreasted Waterhen	I,V	R	++

	1.	2	3	4	5
	Order : CHARADRIIFORMES Family : CHARADRIIDAE (13) Subfamily : CHARADRIINAE				
14.	*Vanellus indicus* (Boddaert)	Redwattled Lapwing	I,V	R	++
	Subfamily : SCOLOPACINAE				
15.	*Tringa nebularia* (Gunnerus)	Greenshank	A,I	WV	+
16.	*Tringa ochropus* Linnaeus	Green Sandpiper	A,I	WV	++
17.	*Tringa hypoleucos* Linnaeus	Common Sandpiper	A,I	WV	+
	Order : COLUMBIFORMES Family : COLUMBIDAE (14)				
18.	*Columba livia* Gmelin	Blue Rock Pigeon	G	R/SM	+++
19.	*Streptopelia decaocta* (Frivaldszky)	Indian Ring Dove	G	R/SM	++
20.	*Streptopelia chinensis* (Scopoli)	Indian Spotted Dove	G	R/SM	++
21.	*Streptopelia senegalensis* Linnaeus	Little Brown Dove	G	R/SM	+
	Order : PSITTACIFORMES Family : PSITTACIDAE (4)				
22.	*Psittacula cyanocephala* (Linnaeus)	Northern Blossomheaded Parakeet	F	R/LM	+++
23.	*Psittacula himalayana* (Lesson)*	Himalayan Slatyheaded Parakeet	F	VM	+
	Order : CUCULIFORMES Family : CUCULIDAE (12)				
24.	*Clamator jacobinus* (Boddaert)	Pied Crested Cuckoo	I,F	SV	+
25.	*Cuculus varius* Vahl	Common Hawk Cuckoo	I	R/LM	++
26.	*Eudynamys scolopacea* (Linnaeus)	Indian Koel	F	R/LM	++
27.	*Taccocua leschenaultii* Lesson	Western Sirkeer Cuckoo	I,F	R/LM	+
28.	*Centropus sinensis* (Stephens)	Crow Pheasant	I,C	R	+
	Order : STRIGIFORMES Family : STRIGIDAE (13) Subfamily : STRIGINAE				
29.	*Athene brama* (Temminck)	Northern Spotted Owlet	I,C	R	++
	Order : APODIFORMES Family : APODIDAE (4) Subfamily : APODINAE				
30.	*Apus affinis* (J.E.Gray)	House Swift	I	R	+++
	Order : CORACIIFORMES Family : ALCEDINIDAE (4)				

	1	2	3	4	5
31.	*Ceryle rudis* (Linnaeus)	Pied Kingfisher	A	R	+
32.	*Alcedo atthis* (Linnaeus)	Small Blue Kingfisher	A	R/LM	++
33.	*Halcyon smyrnensis* (Linnaeus)	Whitebreasted Kingfisher	A,I	R/LM	++
	Family : MEROPIDAE (3)				
34.	*Merops orientalis* Latham	Small Green Bee-eater	I	R/SM	++
	Family : CORACIIDAE (1)				
35.	*Coracias bengalensis* (Linnaeus)	Northern Roller	I	R/SM	++
	Family : UPUPIDAE (1)				
36.	*Upupa epops* Linnaeus	European Hoopoe	I	SV	++
	Family : BUCEROTIDAE (1)				
37.	*Tokus birostris* (Scopoli)	Grey Hornbill	F	R/LM	+
	Order : PICIFORMES Family : CAPITONIDAE (4)				
38.	*Megalaima zeylanica* (Gmelin)	Northern Green Barbet	F	R	++
39.	*Megalaima asiatica* (Latham)	Bluethroated Barbet	F	R/LM	+
40.	*Megalaima haemacephala* (Mueller)	Crimsonbreasted Barbet	F,I	R	+++
	Family : PICIDAE (13) Subfamily : PICINAE				
41.	*Picus chlorolophus* Vieillot*	West Himalayan Yellownaped Woodpecker	I	VM	+
42.	*Picoides mahrattensis* (Latham)	Yellowfronted Pied Woodpecker	I,F	R/LM	++
43.	*Picoides canicapillus* (Blyth)*	West Himalayan Greycrowned Pygmy Woodpecker	I,F	VM	+
	Order : PASSERIFORMES Family : ALAUDIDAE (8)				
44.	*Galerida cristata* (Linnaeus)	Indian Crested Lark	C,I	R/LM	++
	Family : HIRUNDINIDAE (7)				
45.	*Hirundo rustica* Linnaeus	Western Swallow	I	SV	+
46.	*Hirundo daurica* Linnaeus	Himalayan Striated Swallow	I	SV	++
47.	*Delichon urbica* (Linnaeus)	House Martin	I	R/LM	++

1.	2.	3.	4.	5.
	Family : LANIIDAE (1)			
48.	*Lanius schach* Linnaeus	Rufousbacked Shrike	I,C	R/SM +
	Family : ORIOLIDAE (3)			
49.	*Oriolus oriolus* (Linnaeus)	Golden Oriole	F,I	R/SM ++
	Family : DICRURIDAE (4)			
50.	*Dicrurus adsimilis* (Bechstein)	North Indian Black Drongo	O	R/LM +
	Family : STURNIDAE (8)			
51.	*Sturnus pagodarum* (Gmelin)	Brahminy Myna	O	R/SM +
52.	*Acridotheres tristis* (Linnaeus)	Indian Myna	O	R +++
53.	*Acridotheres ginginianus* (Latham)	Bank Myna	O	R/LM +
54.	*Acridotheres fuscus* (Wagler)	Northern Jungle Myna	O	R/LM ++
	Family : CORVIDAE (13)			
55.	*Cissa erythrorhyncha* (Boddaert)*	Himalayan Redbilled Blue Magpie	C,I	VM ++
56.	*Dendrocitta vagabunda* (Latham)	Northwestern Tree Pie	O	R/SM ++
57.	*Dendrocitta formosae* Swinhoe*	West Himalayan Tree Pie	O	VM +
58.	*Corvus splendens* Vieillot	House Crow	O	R/SM +
59.	*Corvus macrorhynchos* Wagler	Jungle Crow	O	R/SM +++
	Family : CAMPEPHAGIDAE (8)			
60.	*Tephrodornis pondicerianus* (Gmelin)	Sind Wood Shrike	I	R/LM +
61.	*Coracina melaschistos* (Hodgson)*	Dark-grey Cuckoo-Shrike	I	VM ++
62.	*Pericrocotus flammeus* (Forster)	North-Indian Scarlet Minivet	I	W ++
	Family : IRENIDAE (3)			
63.	*Aegithina tiphia* (Linnaeus)	Northwestern Iora	I	R ++
	Family : PYCNONOTIDAE (4)			
64.	*Pycnonotus leucogenys* (Gray)*	Whitecheeked Bulbul	F	VM ++
65.	*Pycnonotus cafer* (Linnaeus)	Punjab Redvented Bulbul	F	R +++
	Family : MUSCICAPIDAE Subfamily : TIMALIINAE (23)			
66.	*Pomatorhinus erythrogenys* Vigors*	West Himalayan Rustycheeked Scimitar Babbler	I,F	VM +
67.	*Chrysomma sinense* (Gmelin)	Western Yellow-eyed Babbler	I,F	R/LM +
68.	*Turdoides striatus* (Dumont)	Sind Jungle Babbler	I	R ++

	1	2	3	4	5
69.	*Garrulax lineatus* (Vigors)*	Simla Streaked Laughing Thrush	I,F	VM	++
	Subfamily : MUSCICAPINAE (16)				
70.	*Muscicapa sibirica* Gmelin	Kashmir Sooty Flycatcher	I	W	++
71.	*Culicicapa ceylonensis* (Swainson)	Northern Greyheaded Flycatcher	I	W	++
72.	*Rhipidura aureola* Lesson	Northern Whitebrowed Fantail Flycatcher	I	R/LM	++
73.	*Rhipidura albicollis* (Vieillot)	Western Whitethroated Fantail Flycatcher	I	W	+
	Subfamily : MONARCHINAE (1)				
74.	*Terpsiphone paradisi* Linnaeus	West Himalayan Paradise Flycatcher	I	W	+
	Subfamily : SYLVIINAE (29)				
75.	*Prinia hodgsonii* Blyth	Northern Ashy-grey Wren-Warbler	I	W	+
76.	*Prinia socialis* Sykes	Northern Ashy Wren-Warbler	I	R/LM	++
77.	*Orthotomus sutorius* (Pennant)	Tailor Bird	I	R	++
78.	*Phylloscopus collybita* (Vieillot)	Brown Chiffchaff	I	WV	++
79.	*Phylloscopus neglectus* Hume	Plain Leaf Warbler	I	WV	++
80.	*Phylloscopus proregulus* (Pallas)	Western Pallas's Leaf Warbler	I	WV	+
81.	*Seicercus xanthoschistos* (Gray)*	Western Greyheaded Flycatcher Warbler	I	VM	++
	Subfamily : TURDINAE (38)				
82.	*Copsychus saularis* (Linnaeus)	Indian Magpie Robin	I	R	++
83.	*Saxicola torquata* (Linnaeus)	Collared Bush Chat	I	W	++
84.	*Saxicola caprata* (Linnaeus)	Northern Pied Bush Chat	I	W	++
85.	*Saxicola ferrea* Gray	Dark-grey Bush Chat	I	W	+
86.	*Saxicoloides fulicata* (Linnaeus)	Brownbacked Indian Robin	I	R	+++
87.	*Myiophonus caeruleus* (Scopoli)*	Himalayan Whistling Thrush	A,I	VM	+
	Family : PARIDAE (10) Subfamily : PARINAE				
88.	*Parus major* Linnaeus*	Kashmir Grey Tit	I	W/VM	++
	Family : CERTHIIDAE (2)				
89.	*Certhia himalayana* Vigors*	Himalayan Tree Creeper	I	W/VM	+

1.	2.	3.	4.	5.
	Family : MOTACILLIDAE (12)			
90.	*Anthus novaeseelandiae* Gmelin	Northwestern Paddyfied Pipit	I	R/LM +
91.	*Motacilla citreola* Pallas	Northern Yellowheaded Wagtail	I	WV ++
92.	*Motacilla caspica* (Gmelin)	Grey Wagtail	I	W ++
93.	*Motacilla alba* Linnaeus	White Wagtail	I	WV +
94.	*Motacilla maderaspatensis* Gmelin	Large Pied Wagtail	I	R ++
	Family : DICAEIDAE (3)			
95.	*Dicaeum erythrorhynchos* (Latham)	Tickell's Flowerpecker	F	R +
	Family : NECTARINIIDAE (3)			
96.	*Nectarina asiatica* (Latham)	Indian Purple Sunbird	N	R/LM ++
97.	*Aethopyga siparaja* (Raffles)*	Indian Yellowbacked Sunbird	N	VM +
	Family : ZOSTEROPIDAE (1)			
98.	*Zosterops palpebrosa* (Temminck)	Indian White-eye	I,F	R/SM +
	Family : PLOCEIDAE (8) Subfamily : PASSERINAE			
99.	*Passer domesticus* (Linnaeus)	House Sparrow	O	R ++
	Subfamily : PLOCEINAE			
100.	*Ploceus philippinus* (Linnaeus)	Indian Baya	G,I	R/SM +
	Subfamily : ESTRILDINAE			
101.	*Lonchura punctulata* (Linnaeus)	Indian Spotted Munia	G,F	R ++
	Family : FRINGILLIDAE (25) Subfamily : CARDUELINAE			
102.	*Carpodacus erythrinus* (Pallas)	Common Rose Finch	G	WV +
	Family : EMBERIZIDAE (9)			
103.	*Melophus lathami* (Gray)	Crested Bunting	G,I	R/LM ++

(C)	: Carnivorous	(R)	: Resident	(+)	: Occasional
(F)	: Frugivorous	(LM)	: Local Movements	(++)	: Common
(I)	: Insectivorous	(SM)	: Seasonal Movements	(+++)	: Most Common
(G)	: Graminivorous	(W)	: Wintering		
(O)	: Omnivorous	(WV)	: Winter Visitor		
(S)	: Scavenger	(SV)	: Summer (Breeding) Visitor		
(V)	: Vegetable matter	(VM)	: Vertical Movements (Winter-Summer)		
(N)	: Nectar eater	(*)	: Bird confined to Himalayan ecosystem		
(A)	: Aquatic animals				

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MAMMALIA

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INTRODUCTION

The Renuka wetland and fringes of adjacent wildlife sanctuary, has been surveyed in September, 1992 to prepare a list of mammals present in the area. Due to abundance of food, shelter and water, a good number of wild animals have made their home in the sanctuary (Anon, 1984). Barking deer, chital, sambar, goral, langur and bandar are some of main species of mammals occurring in the sanctuary. Leopard, black bear, and wolf are occasional visitors.

The Renuka Wildlife Sanctuary is unique in maintaining a lion safari, a mini zoo and an aviary within its area. The lion safari is a fenced area of 07.0 ha. Despite alien environment, the lions have completely adapted to their new home. The mini zoo has a collection of eleven species of wild mammals, namely lion, black bear, nilgai, goral, black buck, chinkara, barking deer, hog deer, chital, sambar and mithun (Sinha, 1992).

The present paper records 23 wild species and one hybrid mammal from the Renuka Wildlife Sanctuary, mostly based on sight records by the author, as well as discussion with the authorities of forest and wildlife department. The classification is based on Simpson (1945), and distribution and other characters are after Blanford (1880), Pocock (1939), Ellerman and Morrison-Scott (1951), Walker (1968), Parter (1971) Anderson (1981) and ScLater (1981).

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SYSTEMATIC LIST

Order : INECTIVORA
Family : SORICIDAE
Genus : ***Suncus*** Ehrenberg

1. ***Suncus murinus*** (Linnaeus)
(House Shrew or Grey Musk Shrew)

Distribution: India: Throughout

Elsewhere: Widespread in temperate and tropical regions of Europe, Africa, north America and Asia.

Status: Very common. Seen moving in the camp at dusk every day.

Remarks: The long pointed snout projecting beyond the lower lip, two front curved teeth, depressed ears, small eyes, feet and tail sparsely clad with hairs make the species easily identifiable from rats. A very useful animal to mankind as it gets rid of cockroaches and other pests. Shrews are intolerant to rats and drive them away. Two to three youngones are born at a time which are very active after birth and follow their mother by holding her tail one after the other.

Order : CHIROPTERA
Family : PTEROPIDAE
Genus : ***Rousettus*** Gray

2. ***Rousettus leschenaulti*** (Desmarest)
(Fulvus Fruit Bat)

Distribution: India: Western Ghats, Rajasthan, Peninsula, West Bengal, Himalaya.

Elsewhere: Bhutan Duars, Myanmar, north Siam, Tonkin, Indo-China.

Status: A common species. Roosts have been seen in old temples, and in stage and green room of open air theatre inside the sanctuary.

Remarks: Their colonies comprise of 10 to 2000 individuals. They are distinguished from other insectivorous bats by their large brilliant eyes and a fermented fruit odour. Usually the roosts are made in caves and other man made structures like ancient tombs and temples, tunnels, wells and rock crevices.

Genus : ***Pteropus*** Brisson

3. ***Pteropus giganteus*** (Brunnich)
(Indian Flying Fox)

Distribution: India: From Peninsula upto Rajasthan, Kutch, Kathiawar, western Himalaya, Punjab, Sikkim, Assam, Manipur.

Elsewhere: Nepal, Bhutan Duars, Myanmar, Sri Lanka.

Status: Seen flying in evenings over the sanctuary area.

Remarks: The Indian flying fox roosts on trees usually in habitated areas. It flies on same route regularly in a single file for considerable distances in search of food. They are very destructive to orchards. Single youngone is born in February after a gestation period of 140-150 days. The flesh of Indian flying fox is eaten in many parts of the country.

Family : VESPERTILIONIDAE
Genus : ***Pipistrellus*** Kaup

4. ***Pipistrellus coromandra*** (Grey)
(Indian Pipistrelle)

Distribution: India: Western Himalaya, southern Peninsula.

Elsewhere: Southern China, Hainan, Indo-China, Myanmar, Bhutan Duars, Sri Lanka, Persia.

Status: Quite common. Recorded near Renuka Lake in early evenings.
Remarks: The roosting sites include caves, rock crevices, under loose rocks, trees, etc. No definite breeding season; youngones are seen in all months of the year.

Order : PRIMATES
Family : CERCOPITHECIDAE
Genus : ***Macaca*** Lacepede

5. ***Macaca mulatta*** (Zimmermann)
(Bandar or Rhesus Macaque)

Distribution: India: Himalaya (upto 2340 m altitude), Assam, northern and central regions upto river Tapti in west and Godavari in south.

Elsewhere: Afghanistan, Nepal, Myanmar and other adjoining countries.

Status: Very common specially in temple area of the sanctuary where they are fed by the pujaris and other pilgrims.

Remarks: The Rhesus macaque has a more liking for open country. Near human settlements, they get mingled with human beings freely. In forests, it lives habitually among rocks and cliffs. There is a definite breeding season and the mating is often recorded between October-December. Majority of youngones are born between March and June.

Genus : ***Presbytes*** Eschscholtz

6. ***Presbytes entellus*** (Duffresne)
(Hanuman Langur)

Distribution: India: Throughout. Elsewhere: Tibet, Sri Lanka.

Status: Common. Troops regularly observed near temples and near lion safari on forest road.

Remarks: Langurs are more arboreal but also live on rocks and cliffs. The proximity of water is essential to their habitat. Roosting places are fixed. It is vegetarian and lives in troops which are led by males. The marked period of breeding is between April and May in northern India.

Order : CARNIVORA
Family : CANIDAE
Genus : ***Canis*** Linnaeus

7. ***Canis lupus*** Linnaeus
(Wolf)

Distribution: India: Practically throughout.

Elsewhere: North America, Europe, Commonwealth of States (former USSR), northern Greece, Turkey.

Status: Occasionally recorded from the sanctuary area by the Forest Department (personal communication from the Range Officer, Renuka Wildlife Sanctuary).

Remarks: It lives in forests as well as in bare and open regions, holes, caves and cavities of rocks, thickets of reeds and shrubs, and burrows dug in sand dunes in deserts. The species hunts both during day and night and its main food comprises of cattle, but occasionally it kills human babies and lone adults. The mating takes place during the end of rainy season and youngones, numbering upto three, are born in middle of winter. The large size of body, skull and teeth with arching brows and elevated fore head, which give the wolf its noble profile, instantly distinguishes it from other carnivores. The body colour is sandy fawn stippled with black. The winter coat is variegated with long, black and white or black and buff hair.

8. ***Canis aureus*** Linnaeus
(Asiatic Jackal)

Distribution: India: Throughout.

Elsewhere: South-eastern Europe, south-Western Asia, Nepal, Sri Lanka, extending a little into Myanmar and south-eastern Thailand.

Status: Common. A lone animal was seen in the afternoon near the N.C.C. Camp site.

Remarks: The species is found from humid forests to dry-open plains or desert and upto 3660m in Himalaya. Sometimes packs are formed but mostly the jackal goes alone or in pair for hunting. Food comprises of cleaning carcases alongwith vultures, offal, poultry, goats and sheep and youngones of many wild animals. Wild fallen fruits, melon and sugar cane are also eaten. Jackal's call is eerie. There is no distinct breeding season.

Genus : ***Vulpes*** Oken

9. ***Vulpes vulpes*** (Linnaeus)
(Common Red Fox)

Distribution: India : Throughout.

Elsewhere: Throughout Palaearctic Region, south-eastern Asia upto Yunan, Fukien and northern Indo-China, and much of north America.

Status: Occasionally seen in the sanctuary.

Remarks: Brushwood and cultivated lands are its preferred habitats, living in dugged burrows having more than one opening among rocks, reeds and bushes. Food consists of small mammals, birds, fallen fruit, berries, comb and honey of wild bees, etc., but during winter when driven by hunger the red fox compromises with discarded scrap and offal of human dwellings.

Family : URSIDAE
Genus : ***Selenarctos*** Heude

10. ***Selenarctos thibetanus*** (G. Cuvier)
(Asiatic Black Bear or Himalayan Black Bear)

Distribution: India: Assam westward through the Himalaya upto Kashmir.

Elsewhere: Siberia, Japan, Manchuria, Formosa, most of China, Nepal, Baluchistan, Afghanistan, Indo-China, Siam, Myanmar.

Status: Visits the sanctuary during winter months.

Remarks: Steep forested hills are its favoured home, feeding on wild fruit, berries, honey, corn and maize. It also enjoys variety of insects and their larvae and even kills sheep, goat, etc. Mating takes place in early winter and youngones, numbering two or more, are born in late winter or spring. The association of youngones with their mother lasts for about a year.

Family : VIVERRIDAE
Genus : ***Viverricula*** Hodgson

11. ***Viverricula indica*** (Desmarest)
(Rasse, or Small Indian Civet)

Distribution: India: Throughout, except high Himalaya.

Elsewhere: Southern China, south-eastern Asia, Bhutan, Myanmar.

Status: One specimen was seen at dusk near the camp which was tentatively identified as Small Indian Civet. This needs further observation to establish its occurrence in the Renuka Wildlife Sanctuary.

Remarks: It prefers to live among long grass or shrub. Its food comprises of small mammals and birds, lizards, poultry, insects, etc. There is no marked breeding period and youngones numbering four to five are seen in every month.

Genus : ***Paradoxurus*** Cuvier

12. ***Paradoxurus hermaphroditus*** (Pallas)

Distribution: India: Himalaya from Kashmir to Assam, southwards whole of peninsula.

Status: Common. Seen near the N.C.C. Camp site at early night.

Remarks: It lives mostly on trees but quite a few have changed their arboreal habits and live in human settlements on roof top, out-house or in drain pits. Its food consists of small mammals, birds and fruits. Three to four youngones are born in one litter.

Genus : ***Herpestes*** Illiger

13. ***Herpestes auropunctatus*** (Hodgson)
(Indian Grey Mongoose)

Distribution: India: Kashmir to Assam, Orissa.

Elsewhere: Western Asia, Myanmar, Malay.

Status: Common. A pair seen in the bushes close to Lion Safari in mid-morning.

Remarks: It lives in holes in bushes, hedges and cultivated fields. Its food comprises of snakes, rats, mice, scorpions, centipedes, wasps, etc. Gestation period is of seven weeks recorded in semi wild female and two to three youngones are produced in one litter.

Family : FELIDAE
Genus : ***Felis*** Linnaeus

14. ***Felis chaus*** Guldenstaedt
(Jungle Cat)

Distribution: India: Throughout.

Elsewhere: Widely, from north Africa through south-eastern Asia, Indo-China, Myanmar, Sri Lanka.

Status: One specimen was seen near Parashuram Tal in late evening.

Remarks: It prefers grassland, shurb forests, reed bank and marshes. When found near human settlement it lives in rocks and old buildings. The jungle cat is diurnal. Its preferred food is small mammals, birds and poultry. It is generally believed that two litters are produced in a year.

Genus : ***Panthera*** Oken

15. ***Panthera pardus*** (Linnaeus)
(Leopard)

Distribution: India: Throughout.

Elsewhere: Widely in Commonwealth of States (former U.S.S.R.), Asia Minor, parts of African continent, western Asia, China, Tibet, Nepal, east to Vietnam, Malaysian States, Sri Lanka.

Status: Occasional visitor.

Remarks: Not restricted to forests only, but it also inhabits open country among rocks and shrubs. Being more tolerant to sun, the leopard also hunts during the day time. Its food comprises of cattle, artiodactyles, monkeys, small beasts of prey, rodents, birds, reptiles, crabs, etc. No marked breeding peak. Gestation period is 100 days and two to four cubs are born at a time.

Order : ARTIODACTYLA
Family : CERVIDAE
Genus : ***Muntiacus*** Rafinesque

16. ***Muntiacus muntjak*** (Zimmermann)
(Barking Dear)

Distribution: India: Himalaya, Assam, Uttar Pradesh, southern Peninsula.

Elsewhere: Nepal, Sri Lanka, southern China, Indo-China, Siam, Malay states, Sumatra, Java, Borneo and adjacent Islands.

Status: Seen single or in pair near the grassy patch on the bank of Renuka Lake near Lion Safari.

Remarks: Its calls resemble with the bark of a dog. It is usually found in thick forested areas in plains and upto 2600 m in Himalaya. It lives singly or in pairs but never forms large herds. Fairly diurnal in habit, and its food consists of grasses, leaves and wild fruits.

Genus : ***Axis*** Smith

17. ***Axis axis*** (Erxleben)
(Chital or Spotted Deer)

Distribution: India: Throughout upto about 1000 m elevation.

Elsewhere: Sri Lanka, Nepal,

Status: Common. Herds of 10-15 individuals have been seen in grassy patches on the bank of Renuka lake and in the peripheny of forests. The population of chital at Renuka seems to have been released from the zoo, where it was brought sometime past. They have well adapted to the environment and are thriving very well.

Remarks: Sometimes big herds of several hundred individuals are formed. It inhabits grassy forests and shaded streams, where its association with monkeys is a common sight. The species is prolific breeder and sometimes breeds twice in a year.

Genus : ***Cervus*** Linnaeus

18. ***Cervus unicolor*** (Kerr)
(Sambar)

Distribution: India: Throughout.

Elsewhere: Sri Lanka, Myanmar extending through Indo-China, Siam, Malaysia, eastward to Philippines and beyond.

Status: Common. A pair seen drinking water at Renuka lake in late evening.

Remarks: It is less gregarious, and only small herds upto 3-4 individuals are formed. Its preferred habitat is forested hill sides near cultivation. Its food consists of grass, leaves, a variety of wild fruits and green crops. Mating takes place in winter and single fawn is born in summer.

Family : BOVIDAE
Genus : *Nemorhaedus* Smith

19. ***Nemorhaedus goral*** (Hardwicke)
(Goral)

Distribution: India: Himalaya, Shivaliks.

Status: Not abundant. A small herd has been seen on eastern side of the Renuka Sanctuary in the mid-morning.

Remarks: Two distinct subspecies of goral are found within Indian limits. The designate subspecies *N. g. goral* (Hardwicke) is found in western Himalaya and the other *N. g. hodgsoni* Pocock in eastern Himalaya. The species is found at an elevation from 900 to 2750 m. The usual size of a goral herd is from 4 to 8 individuals, and can be seen feeding on rugged grassy hilly side or rocky ground in the forests. Fawns are born between May and June.

20. **'Mithun' or 'Methne' or 'Mithan'**

Distribution: India: Within hill ranges of north-east, particularly Arunachal Pradesh and Indo-Myanmar hill ranges.

Status: A few mithun were presented to the Renuka Wildlife Sanctuary by Mr. Rajiv Gandhi. Initially the mithun were kept in the zoo but subsequently two were released in the open forests and are well thriving.

Remarks: A cross breed between gaur and domestic cattle has given rise to a handsome breed of cattle, which is partially domesticated by the hill tribes in north-eastern India. These hybrid cattle are generally called 'Mithun', 'Mithan' or 'Methne', as massive as gaur with large head, deep massive body and sturdy limbs. The dorsal high ridge over the shoulders which slopes down in the middle of the back where it ends in an abrupt dip. A smaller variety is found in Chin hill region where they are less massive and smaller in stature with shorter limbs. This variety is having a well developed dewlap, which is absent in gaur. Being a hybrid animal it requires frequent interbreeding with the wild gaur for retention of massiveness of body structure. If interbreeding is not performed, the high dorsal ridge which lends so much to the imposing stature of the gaur disappears, the horns become cow-like and the domestic cow's varied colourings will begin to reappear. Unfortunately Renuka Wildlife Sanctuary does not have gaur population for interbreeding. Hence the continuance of mithun is jeopardised in this sanctuary.

Order : LAGOMORPHA
Family : LEPORIDAE
Genus : ***Lepus*** Linnaeus

21. ***Lepus nigricollis*** Cuvier
(Indian Black-naped Hare)

Distribution: India: Throughout.

Elsewhere: Pakistan, Nepal, Bhutan, Myanmar, Java, Sri Lanka.

Status: Rare. No animal was seen directly but its fresh feacal pellets were recorded from the wild track of the sanctuary.

Remarks: It occurs upto an elevation of 2400 m in the Himalaya. Its preferred habitat is neighbourhood of villages and cultivation. One or two youngones are born at a time between October and February. Eyes at birth are open and youngones are able to move about within twelve hours of birth.

Order : RODENTIA
Family : HYSTRICIDAE
Genus : ***Hystrix*** Linnaeus

22. ***Hystrix indica*** (Kerr)
(Indian Crested Porcupine)

Distribution: India: Widely in north-western, northern and peninsula regions.

Elsewhere: Western Asia, southern Arabia, parts of Turkistan, Transcaucasia, Sri Lanka, Nepal.

Status: Common. Its dropped quills were seen at two different places.

Remarks: In Himalaya, the species has been recorded upto 2,400 m. It is brave and good fighter when attacked by animals like tiger and leopard. It is nocturnal.

Family : MURIDAE
Genus : ***Rattus*** Fischer

23. ***Rattus rattus*** (Linnaeus)
(House Rat)

Distribution: Widely throughout world including India.

Status: Common. In the F.R.H. where we established our camp, the species has been seen moving in and out in the roof ceiling.

Remarks: Its habits, damage caused to human property and deadly role in the spread of diseases, are well known.

Genus : ***Mus*** Linnaeus

24. ***Mus musculus*** Linnaeus
(House Mouse)

Distribution: India: Throughout.

Elsewhere: Widespread.

Status: Common. Seen frequently in the kitchen during day time.

Remarks: It prefers to live in houses, gardens and nearby fields. It is a prolific breeder and gives birth to 4-5 youngones after every two to four months. The youngones attain maturity in about a month.

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Renuka lake, a subtropical wetland of national importance in Western Himalaya.

Parashuram Tal which receives water overflow from adjoining Renuka lake.

A bird's eye view of Renuka wetland with surrounding forested catchment area.

Marshy growth on eastern end of Renuka wetland.

High density of mahaseer fish, *Tor putitora,* in Renuka wetland.

Rhesus Macaque, *Macaca macullata,* commanly seen near temple area of the wetland.

1. *Neurobasis c. chinensis*; 2. *Ceriagrion coromandelianum*;
3. Freshwater medusa (*Limnocnida* sp.); 4. *Rana* (*Tomopterna*) *breviceps;*