CHANDRA
SIDHU
RAGHUNATHAN
KUBENDRAN

Faunal Diversity of Biogeographic Zones:
Indian Trans-Himalaya

Ministry of Environment, Forest and Climate Change

सत्यमेव जयते

ZOOLOGICAL SURVEY OF INDIA 1916

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Price
India : ₹ 2500/-
Foreign : $ 100; £ 75

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2019

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C. RAGHUNATHAN | T. KUBENDRAN*

Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053, West Bengal
**Zoological Survey of India, High Altitude Regional Centre, Solan, Himachal Pradesh*

ZOOLOGICAL SURVEY OF INDIA
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CITATION

Chandra, K., Sidhu, A.K., Raghunathan, C. and Kubendran, T. 2019. *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya* : 1-225. (Published by the Director, Zool. Surv. India, Kolkata).

Published : November, 2019

ISBN 978-81-8171-527-2

Price
India : ₹ 2500/-
Foreign : $ 100; £ 75

Published at the Publication Division by the Director, Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053 and printed at Calcutta Repro Graphics, Kolkata–700 006.

सी.के. मिश्रा
C.K. Mishra

सत्यमेव जयते

सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE

Foreword

The Indian Himalayas is recognized for its ecosystem services to the Asian region as well as world at large for maintaining slope stability, regulating hydrological integrity and vast biodiversity for human well-being. It is covering an area about 5.3 lakh square kilometers with 16.2% of India's total landmass stretching in an arc over 3000 km with an altitude of 8000 m. Most of the area is covered by snow-clad peaks, glaciers and dense forests. This region is providing water to a large part of the Indian subcontinent and harbours rich flora and fauna. The Indian Himalayas comprised of 9 States and 2 Union Territories covering 95 districts which occupies the strategic position of the nation with an international boundary for 7 countries. The Himalayas is a globally recognized Biodiversity Hotspot straddles the transition zone between the Palearctic and Indo-Malayan bio-geographic realms serve as an abode for about 25% of flora and 30% of fauna.

The Trans-Himalayas, an extension of Tibetan plateau in India is the northern most region of the country covering the State of Himachal Pradesh, Union Territories of Jammu & Kashmir and Ladakh and upper part of Sikkim which are the cold deserts of India harbouring unique biodiversity. Despite apparent extreme environment and inaccessibility, the Himalayas not have been spared anthropogenic mediated biodiversity loss. Due to man-made and natural habitat loss caused by mining, construction of roads, expansion of agricultural land and large dams, it is presumed that only 25% of the original vegetation is intact in Himalayas which needs higher level of protection to safeguard its precious biodiversity.

Considering the ecological significance and ecosystem services of this world largest mountains, the Zoological Survey of India conducted a series of studies on the assessment of faunal communities and brought out a book on *Faunal Diversity of Biogeographic Zones* : *Indian Trans-Himalaya* to understand their status and distribution for effective conservation and management in this ecologically fragile high altitude ecosystem.

I appreciate the authors of the book for earnest effort to make an inventory of the animals along with the details of endemism, distribution and status of rare, endangered and threatened categories in a precise manner for the benefit of researchers, academicians and students in general and the ecosystem managers and policymakers in particular. I am confident that, this publication will serve as a yardstick for the Trans-Himalayan faunal diversity not only in India but also the countries bordering the country in Himalayan region.

Date : 14th October, 2019

Place : New Delhi

(C.K. Mishra)

इंदिरा पर्यावरण भवन, जोर बाग रोड़, नई दिल्ली-110 003 फोन : (011) 24695262, 24695265, फैक्स : (011) 24695270
INDIRA PARYAVARAN BHAWAN, JOR BAGH ROAD, NEW DELHI-110 003 Ph. : (011) 24695262, 24695265, Fax : (011) 24695270
E-mail : secy-moef@nic.in, Website : moef.gov.in

डॉ कैलाश चन्द्र
निदेशक
Dr Kailash Chandra
Director

सत्यमेव जयते

भारत सरकार
भारतीय प्राणि सर्वेक्षण
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
Government of India
Zoological Survey of India
Ministry of Environment, Forest and Climate Change

Preface

The Trans-Himalayan landscape covers 1600 km long mountain range in India, Tibet and extending in a west-east direction parallel to the main Himalayan range. This cold desert lying on Himachal Pradesh, U.T. of Jammu and Kashmir and U.T. of Ladakh in India with an altitude ranging from about 2,900 m to 6,000 m peaks with average elevation of 4,000 m. This mountain range is characterized by extreme cold, low precipitation, low oxygen, low atmospheric pressure, high velocity winds and intense radiation which makes the areas inaccessible and hence the faunal diversity of these regions of Himalayas is poorly documented.

The biodiversity of Trans-Himalayan areas play an important role in maintaining its sustainability of the extreme cold climate and extending ecosystem services like clean water, air, pollination, food, fuel and medicine for human well-being especially for the inhabitants of this region. However, the excessive anthropogenic pressures causing habitat alteration and destructions coupled with climate change in recent time leads to loss of biodiversity in the fragile ecosystem.

The Trans-Himalayan region with its sparse vegetation has the richest wild sheep and goat community in the world. In addition, snow leopards, kiang, marbled cat, marmots and black-necked cranes are the unique faunal communities of this region.

In this given circumstances, in order to fulfill a gap to understand the faunal diversity of Trans-Himalayan Bio-geographic zone in a comprehensive manner, the Zoological Survey of India brought out the book on the *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya* by conducting field surveys in different periods and collating the existing information which covers 3324 species in 19 chapters and Annexure. It is pertinent to note that 10.94% of the total Indian Himalayan fauna recognized from the Trans-Himalayas and it represents 17 species of protozoa, 2734 species invertebrate and 573 species of vertebrate species to this account.

I appreciate the Scientists of ZSI including staff of High Altitude Regional Centre, Solan, for their relentless effort in bringing out this publication which attempted to document faunal groups from lower to higher phyla along with complete check-list of species. I am sure that the book serve as a baseline information on the fauna of Trans-Himalayas in general and cold desert in particular for conservation and management of this ecologically fragile mountain habitat from anthropogenic as well as natural factors.

Kolkata
17th, October, 2019

(Kailash Chandra)

ZOOLOGICAL SURVEY OF INDIA 1916

प्राणि विज्ञान भवन, 535, एम. ब्लॉक, न्यु अलीपुर, कोलकाता – 700 053, दूरभाष : +91 33 2400 6893, टेलीफैक्स : +91 33 2400 8595
Prani Vigyan Bhawan, 535, M-Block, New Alipore, Kolkata - 700 053, Phone : +91 33 2400 6893, Telefax : +91 33 2400 8595
E-mail : kailash611@rediffmail.com, Website : zsi.gov.in

Acknowledgements

We would like to thank all those scientists and experts who have contributed their chapters to this document, without their unreserved cooperation this task would not have been completed. Our sincere thanks are due to Shri. Sh. Devinder Chuahan, Range Officer, Kaza and Shri. Santosh Thakur, Himachal Pradesh Forest Department (Wildlife) (Snow Leopard and Bharal respectively), and S.K. Sajan, Research Scholar, Zoological Survey of India, Kolkata (Geographical maps) for providing the photographs, utilized in the book. Last but not the least, we are also thankful to Shri. Ratiram Verma, Publication & Production Officer, Zoological Survey of India, Kolkata for his strenuous efforts in layout, designing and printing of the book.

Kailash Chandra, Avtar Kaur Sidhu,
C. Raghunathan and T. Kubendran

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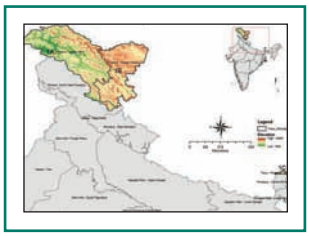
Chapter 1

Fauna of Indian Trans-Himalaya : An Overview

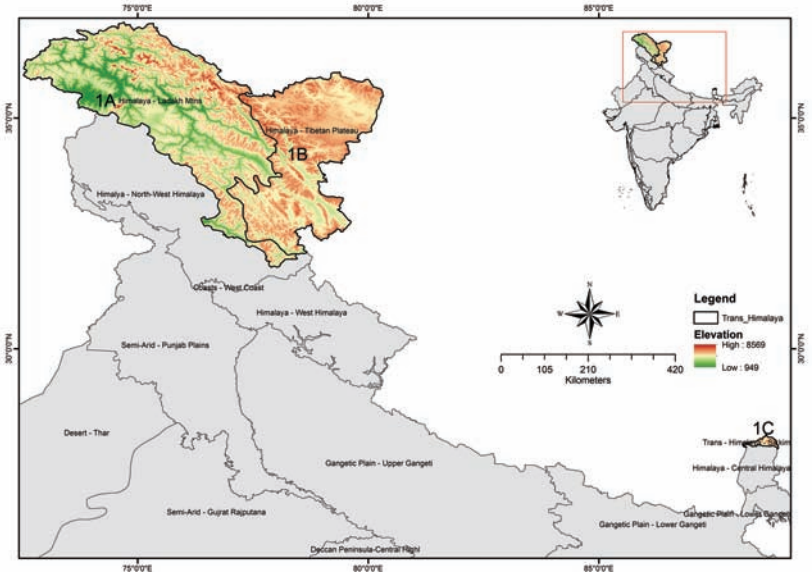


KAILASH CHANDRA**, AVTAR KAUR SIDHU, C. RAGHUNATHAN, INDU SHARMA* and T. KUBENDRAN

Indian Trans Himalaya is unique and distinct area of Himalaya which lies in the north crest line of the great Himalaya and transected by Zaskar and Ladakh ranges. Overall, 3324 species/subspecies of both Protozoa (17) and Animalia (3307) have been recorded from Trans Himalaya, representing about 10.94% of the total Indian Himalayan fauna (30377 species). Regarding taxonomic richness, phylum Arthropoda with about 2415 species/subspecies, represents approximately 9.15% of the total diversity of Trans Himalaya, further including 2311 species/subspecies of Hexapods, 82 species/subspecies of Arachnids. Trans Himalaya (Cold Deserts) has 100 species of mammals, 349 species of birds, 100 species of fishes, 16 species of reptiles, and 8 species of amphibians, accounting about 31.55% of the total vertebrate diversity of the Indian Himalaya. Though, the diversity is less but all the species are unique and endemic to this area.

Keywords: Indian Trans Himalaya, cold deserts, diversity, high altitude

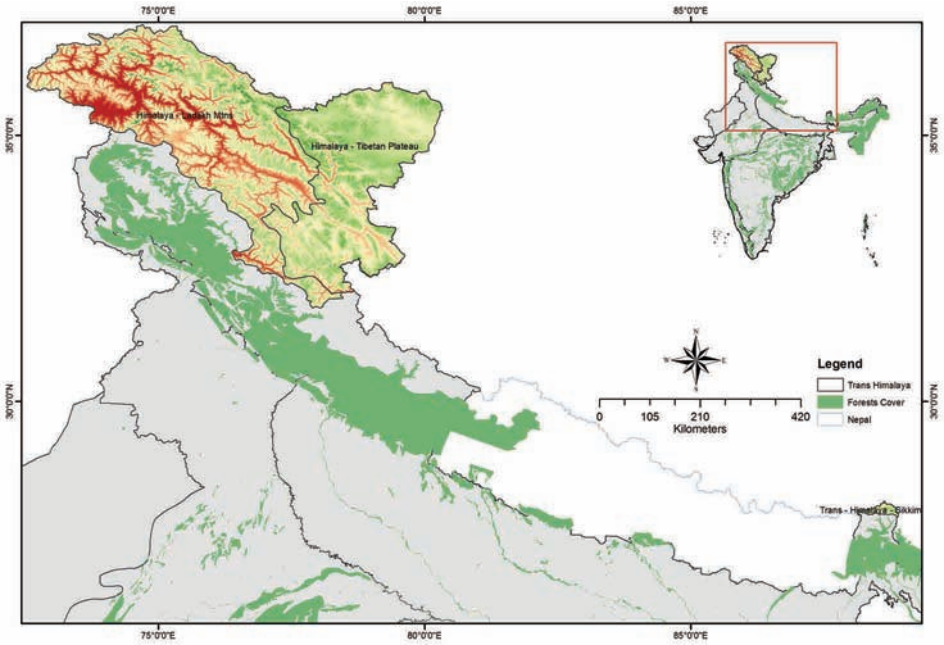
Asia contains the largest, highest and most populated mountain system among the world mountain areas. India covers about 5 lakh sq. km of Himalayas which is 16.2% of the total geographical area the country. Indian Trans-Himalaya is unique and distinct area of Himalayas which lies in the north crest line of the great Himalaya and contains Zaskar and Ladakh ranges (Mani, 1962). The Trans Himalayta is usually described as a "High Altitude Cold Desert" as it lies in the rain shadow of the main Himalayan range. It is characterized by low productivity, extreme aridity, reduced atmospheric pressure, low oxygen, extreme temperatures, high wind velocity and high intensity of solar radiations.



Elevation map of Indian Trans-Himalaya (Courtesy : S.K. Sajan)

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (Himachal Pradesh)
* Desert Regional Centre, Zoological Survey of India, Jodhpur-342005 (Rajasthan)
**Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053 (WB)
Email : avtarkaur2000@gmail.com

Citation
Chandra, K., Sidhu, A.K., Raghunathan, C., Sharma, I. and Kubendran, T. 2019. Fauna of Indian Trans-Himalaya : An Overview. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 1-22. (Published by the Director, Zool. Surv. India, Kolkata)



Forest cover map of Indian Trans-Himalaya (Courtesy : S.K. Sajan)

Trans-Himalaya is considered under Biogeographic Zone (1) which is one of the ten regions of India (Trans-Himalaya, Himalaya, Desert, Semi-arid, Western Ghats, Deccan Peninsula, Gangetic Plains, Northeast, Islands and Coasts) and is differentiated into 3 biotic provinces *viz.* Ladakh mountains (1A), Tibetan Plateau (1B) and Sikkim (1C). It has a total area of ~1,84.823 sq.km. and covers 5.62% (Table 1) of the country's landmass (Rodgers *et al.* 2002). It comprises a complex network of barren mountain ranges, lying in the north of the main Himalayan ranges and includes Zaskar, Ladakh (5,800 m) and Karakoram ranges (5,500-6,000 m) with average elevation of ~4,000

Coloured mountains in Cold Desert of Spiti.

m (Mani, 1974). Its ranges extend to a length of about 1000 km, with an average width of about 225 km in the central part and 40 km in the extremities (Rodgers *et al.* 2002). Trans-Himalaya in India is in fact, an extension of the Tibetan Plateau on the northwest, and it comprises the high altitude cold desert and arid mountain areas in the districts of Ladakh and Kargil (Jammu and Kashmir); Lingti plains (Lahaul Valley), Spiti Valley of district Lahaul & Spiti. Cold deserts also comprised of inner dry valleys of Pooh tehsil of district Kinnaur (Himachal Pradesh), small areas in the rain shadow of Nanda Devi range (Uttarakhand) and Kangchenjunga range (Sikkim) which are rain shadow zones between Higher Himalayan ranges (Mehta and Julka, 2001).

The major parts of Trans-Himalayan track are confined to Ladakh area of Jammu & Kashmir in India. Ladakh has an area of about 68,321 sq. km and constitutes over 80% of the Trans-Himalayan region in India. It lies between 32^0 15′ N and 75^0 15′-80^0 15′ E and covers from 2700 to 7650 m of altitude range. In Ladakh more than 85% of the area lies above 5000 m. The two major mountain chains *i.e.* the great Himalaya and the Karakoram demarcate its natural borders towards the south and the north respectively. Physiographically, it is divided into five major Valleys *viz.* Nubra, Indus, Suru, Changthang and Zanskar (Chadan *et al.* 2008 and Chaurasia *et al.* 2008). It is bordered in the east by Tibet, south by Himachal Pradesh (Lahaul & Spiti) north by Pakistan and west by the Valley of Kashmir. The cold desert in Himachal Pradesh has the total area of about 11,000 sq. kms. Out of which 7,600 sq. km is in Lahaul & Spiti and 3,400 sq. km areas is in district Kinnaur (Verma and Kapoor, 2010). The Lingti plains are situated in the north of the Bara Lacha Range in Lahaul Valley of district Lahaul & Spiti of Himachal Pradesh. Topographically, these plains along with Spiti area are very similar to Rupshu plateau of Ladakh. The Bara Lacha Pass separates the Ladakh from district Lahaul and Spiti. It has an area of 260 sq. km and has an average elevation more than 4400 mts. The Spiti Valley (district Lahaul Spiti) is a desert mountain Valley in the north eastern part of Himachal Pradesh. It lies between North latitude 31°44′57′′ and 32°59′57′′ and between East Longitude 76°46′29′′ and 78°41′34′′. The Valley consists of three distinct geographic regions *i.e.* Spiti Valley, Pin Valley and Northern high mountains. Its average elevation is 5485 m (Negi, 1995). It has a stretch of about 24 km from Lossar up to Tabo. The Spiti Valley is bordered by Ladakh in the north, Tibet to the east, Kinnaur to the south east and the Kullu Valley to the south. Pooh is one of the divisions of the district Kinnaur. It altitude ranges from 2,662 to 5816 m and lies between 31°45′08.09′′ N and 78°345′1.66′′ E and spread over an area of 3400 sq. km. Pooh and Kaza lies in the core of the cold deserts and hence the extreme aridity occurs here (Negi, 2002).

Chandertal Lake in Indian Trans-Himalaya

Scrub land in Indian Trans-Himalaya

The Trans-Himalaya is characterized by rugged/ barren mountains surrounded by glaciers, valleys, lakes, rivers, sand dunes, scrub land, pastures, high mountain passes, ancient monasteries and lush green patches of vegetation along the valleys. The climate of the area is unpredictable due to high solar radiation, high velocity of winds and less precipitation.

Glaciers and alpine pastures in Indian Trans-Himalaya

Climate

Due to high elevation and terrain, the climate is extreme with long winters from November to May, short summers from June to mid September and followed by the autumn from September to October. The average temperature during summer ranges between 20°C to 38°C around Leh and Kargil. However, in higher altitudes the temperature variation is between 5°C and -10°C. During winter average temperature ranges between -30°C in Leh & Kargil and it goes down to -60°C in Drass area of Ladakh. Drass is the second coldest inhabited place in the world (Negi, 2002; Sethi *et al.* 2003). The Spiti has one

Soil Erosion caused by strong winds in Indian Trans-Himalaya

Sand dunes- a habitat of Double humped camel in Nubra valley

of the harshest climates in the world Valley as it is positioned on the leeward side of the greater Himalayan ranges. The lack of precipitation and minimum elevations of over 3350 m, combine to produce in Spiti a bleak, seemingly devoid of vegetative cover (Harcout, 1874). The cool, high velocity winds blows throughout the year which are stronger at higher elevations. Fast wind blows 40 to 60 km per hour mainly in afternoon hours. Coarse, porous and immature sandy soils is prone to wind and water erosions. Precipitation is mostly in the form of snow, mainly during winters (Chaurasia *et al.,* 2008). The amount of oxygen is less than in many other places at a comparable altitude because of lack of vegetation. Due to extreme weather conditions and high altitude, the persons surveying the cold desert faces the problem of high altitude sickness. One should take adequate precautions prior to surveying in these areas. The problems of high altitude sickness (headache, dizziness, breathing problem,

Galacier Samudra tapu in Spiti

Wind Erosion in Indian Trans-Himalaya

abdomen ache, pin and Needles, numbness, loss of stamina, visual disturbances, sleeplessness, awakening frequently at night, loss of appetite, nausea etc.) varies from person to person. The Trans-Himalayan zones normally remains closed from November to mid-June as all the passes leading into the region are blocked due to heavy snow.

Passes

The cold deserts are usually landlocked by passes. The mountain passes on every hill side are with new picturesque, but road is treacherous in many places. One has to cross several passes to reach the Ladakh (Land of Passes) by road. There is a Rohtang Pass, Baralacha-La and Taglang-La on the Manali high way to reach Leh; South-East from Leh to Pangong Tso is Chang-La Pass; North-East from Leh into Nubra Valley is Khardung-La Pass. There is Zoji-La pass, which goes to Drass on Srinagar-Leh trail (Sethi *et al.,* 2003). There is a Kunzam La Pass which connects it with Lahaul to reach the Spiti Valley in Himachal Pradesh.

The cold deserts of (Spiti Valley and Ladakh) are known for many highest places records in the world. Spiti Valley: Kaza (3740 m) World's highest Petrol pump, Kibber (4200 m) Highest permanently inhabited village in Asia, Komic (4967 m) Highest village in Asia, Key Monastery (4166 m) Second highest monastery in the world, Hikkim (4400 m) World's highest post office, Bara Shigri (30 km) second largest glacier of the Himalaya. Lingti Valley in Spiti is known as a living geological museum. The Valley has preserved over 250 million years of geological history in the form of shales and fossils. Ladakh: A Bailey bridge (5602 m and 30 m long) World's highest bridge has been constructed between the Drass and Suru Rivers in Ladakh. The mystical magnetic hills are known as gravity hill are located near Leh. Khardungla pass (5359 m) World's highest motorable road is located in Ladakh.

Khardungla, the highest motorable pass in Ladakh

Kunjum Pass in Indian Trans-Himalaya, Altitude 4600 m

Highest motorable village of Asia, Komic, Altitude 5150 m asl

Highest Post Office of the World, Hikkim in Spiti 4400 m asl

Water Bodies

Wetlands: In Trans-Himalaya, most of the wetlands remain frozen from December to March due to glacial origin. There are brackish and freshwater resources in the Ladakh. Pangong Tso, Tso Morari, Tso Kar and Khyagar are brackish water wetlands in the Ladakh. Tsugal Tso, Chisul and Henle marshes are also some freshwater sources in the region. Pangong Tso Lake and Tso Morari Lake (Ramsar site) are the large brackish water lakes in the area. There are several species of birds that use these wetlands as their breeding grounds *viz.* Bar-headed Goose *(Anser indicus)*, Black-necked Crane (*Grus nigricollis*), Brown-headed Gull (*Larus brunicephalus*), Great-crested Grebe (*Podiceps cristatus*), Ruddy Shelduck (*Tadorna ferruginea*), Lesser Sand Plover (*Charadrius mongolus*) (Chandan *et al.,* 2008). Chandertal Lake is a high altitude lake (4300 m) which is located in the district of Lahaul and Spiti. It is 14 km from the Kunzam Pass which connects Spiti and Lahaul. The lake lies in large depression formed by glaciers and remains completely frozen during winter seasons. Its water is crystal clear with bluish tinge.

Rivers: Indus River flows throughout the Ladakh and is known as backbone of the area. The extreme northern tract of the Indus basin consists of cold deserts of Ladakh, Lahaul, Spiti and Pooh. Astor, Shyok, Shigar, Galiwan, Gilgit, Gurtang, Henle, Zanksar, Nubra, Shaksgam *etc.* are the various streams of the Indus River that traverses through Ladakh (Negi, 2002). Spiti River flows throughout

Tsomorari Brackish Water lake in Ladakh

Tsigul Tso marsh in Ladakh

Another view of Chandertal Lake of Cold Deserts

Spiti river in Spiti cold desert

Hot water springs in Changthang area of Ladakh

Confluence of Indus river with Janskar river in Ladakh

the Spiti Valley and all its main streams are perennial and are fed by glacier. Pin River is one of the important tributary of the Spiti River. The main stream of the Spiti River during its course through Spiti Valley is joined by different tributaries from both the sides (Mamgain, 1975).

Protected Areas

The eastern Ladakh region has Hemis National Park. This National Park is located at high altitude of about 3140 to 5840 m asl. It is the largest notified protected area and comprises an area of about 41,000 ha. The wildlife sanctuaries in Ladakh are Changthang Wildlife Sanctuary and Karakoram Wildlife Sanctuary. There are two main internationally important conservation areas in the Spiti Valley i.e. Kibber Wildlife Sanctuary and Pin Valley National Park. The Kibber Wildlife Sanctuary is a narrow Valley on the peak of the lime stone rock. It has an area of 1,40,050 ha and the elevation range of this sanctuary is 4000 to 5600 m. The Pin Valley National Park is spread over an area of approximately 67500 ha and average elevation of the park 4300 m (Islam and Rahmani, 2004). This park is contiguous with the buffer zone of the Great Himalayan National Park (Kullu) and Rupi Bhava Wildlife Sanctuary (Kinnaur) and thus very important from the faunal conservation point of view. The protected areas of the cold desert of Spiti Valley have been designated as a Biosphere Reserve in 2009. Pin Valley National Park and surroundings, Kibber Wildlife Sanctuary and Chandertal Lake of Spiti Valley (Himachal Pradesh) are under Biosphere Reserve with area of 7770 sq. km. and are internationally important conservation areas.

Pin Valley National Park of Spiti

Kibber Wildlife Sanctuary, Spiti Valley

Vegetation

High aridity and low temperatures in the cold deserts lead to sparse vegetation. The vegetation is restricted to moist shadow areas near the river Valleys. These are mainly dominated by dwarf bushes or shrubs. The plant species are mostly xerophytes followed by mesophytes. The vegetation is characteristics of the area showing typical adaptations for an arid zone. The flora has adapted itself to survive in the harsh climatic conditions of the region. The extensive root system also helps the plant to remain firm during high velocity winds, characteristics to the region. In addition, the root system acts as a storehouse of energy required by the plants during winter, providing a necessary food reserves for the plants to emerge immediately after the melting of snow (Tewari and Kapoor, 2013). Mostly poplar and willow trees have been planted in the cold deserts of Spiti Valley and Ladakh. Only 0.002% of the total land mass of Ladakh is estimated to be forested (Mann, 1986). Amongst the woody shrubs and trees (indigenous and introduced) are found in the area, includes *Saliix* spp., *Populus* spp., *Juniperus* spp., *Artemesia* spp., *Myricaria bracteata, Hippophae rhamnoides, Tamarix gallica* Linn., *Caragana pygmea. Ephedra* spp., *Rosa moscahata, Medicago sativa* etc. (Tewari and Kapoor, 2013). The cold desert flora comprises several medicinal, aromatic and nutritive value plants. It has about 337 species of medicinal plants (Kala, 2002). The people of Ladakh use different parts of 169 medicinal plants for curing various ailments (Kaul, 1997). *Ladakhi* medical practitioners are usually known as *Amchis*. They follow the Tibetan system of Medicine. Some of the medicinal plants used are *Achillea millefolium*, *Allium cepa*, *A. przewalskianum*, *A. sativum*, *Artemisia brevifolia*, *A. dracunculus*, *A. gmelinii*, *Berberis lyceum*, *Bunium persicum*, *Carum carvi*, *Clematis orientalis*, *C. tibetana*, *Dactylorhiza hatagirea*, *Dacus carota, Geranium pretense*, *Herminium monorchis*, *Hippophae rhamnoides*, *Hypecoum leptocarpum*, *Mentha longifolia, Nepeta coerulascens*, *N. glutnosa*, *Ocimum basilicum, Solanum*

Alpine meadow in Indian Trans-Himalaya

Grassland near Pangong Tso in ladakh

Alpine Pasture is one of the important parts of the cold deserts. These are found between the snow line and lines of trees between altitudinal range from 2500 to 4000 m (Negi, 2002). They provide nutrient rich forage for grazing livestock and wildlife. Dry alpine scrub and dwarf juniper scrub land are found here. The alpine pastures in Ladakh are dominated by low thorny scurb (Honeysuckles- *Lonicera spinoides*, Seabuchthorn -*Hippophae rhamnoides*), Tibetan furze (*Caragana* spp.) and a variety of grasses (*Festuca* spp. *Carex* spp., *Artemisia nigrum*, *Zea mays* etc. (Ballabh and Chaurasia, 2007). The flora can be divided into three zones: i) Dry Temperate zone (3275-4000 m) have woody species only in small patches. The main species are junipers (*Juniperus macropoda*), birch (*Betula utilis*), willow (*Salix* spp.), wild roses etc., ii) Alpine zone (4000-5000 m) is characterized by the absence of trees. The junipers, birch and rhododendron are found in the form of small shrubs. Karu *Gentiana kurroo*, Patish *Aconitum heterophyllum* are the herbs of the medicinal value. Common grasses found are *Poa* spp. and *Agropyron* spp. have high nutritive value. iii) Zone of perpetual snow (above 5000 m) is characterized by two zones *i.e.* Glacier and Tundra (Mamgain, 1975).

Grassland of Spiti

spp., *Draba* spp., etc. (Mehta and Julka, 2001). Beautiful meadows, vast pasture lands, colorful moraines, marshes and screes mostly cover the alpine zone. Some of the plants bear bright coloured flowers *viz. Aquilegia vulgaris, Paraquilegia grandiflorum, Delphinium cashmirianum, D. brunonianum, Aconitum heterophyllum*, *Potentilla biflora* and *Potentilla multifida* etc. (Mamgain, 1975).

Grassland of Indian Trans-Himalaya

Agro-ecosystems

The agro ecosystems in the Trans-Himalayan ecosystem have been developed near the inhabitant area or near the river Valleys. Barley and wheat are the staple crops along with mustard, lentils, pulses and vegetables. The agricultural operation are normally carried out only in one cropping season and until recent decades, agricultural practices were traditional, with high crop diversity. However, shift towards the cash crops such as potatoes, peas and hops in the recent past have gained favor and as a result of it, diversity of staple food crops as well as "wild" cash crops has decreased considerably (Tewari and Kapoor, 2013).

PEOPLE AND THEIR SUSTENANCE

Trans-Himalaya is the least populated regions of the world. These regions are mainly inhibited by the Buddhists. The people represent the western extremity of the Tibetan Plateau, and having close ecological and cultural affinities with Tibet (Vaurie, 1972). The people

Willow plantations in Indian Trans-Himalaya

Agro-ecosystem in Indian Trans-Himalaya

have adopted Buddhism as their faith and Tibetan is the spoken language. The temples of worship are called 'Gomphas'. The Kye monastery is one of the main learning centers of Buddhist and is oldest and biggest monastery in Spiti. Tabo monastery is the oldest monastery in the Valley and declared as the world heritage site by the UNESCO. People are sturdy and very hardworking. Traditionally, these people are agro pastoralists. They depend on agriculture and animal husbandry for their livelihood. The traditional crop varieties grown *viz. Hordeum vulgare* var. (barley), *Triticum* spp. (wheat), *Fagopyrum tataricum* (buckwheat), *Brassica nigra* car. (rapseed), *Pisum* spp. (pea); wild edible food plants *e.g.,* mushrooms, wild lilies, rhubarbs etc. (Tewari and Kapoor, 2013). Seabuckthorn is a multipurpose plant of Ladakh (Dwivedi *et al.* 2002). Pea, Potato, Kuth (*Saussera lappa*) and Hops (*Humulus lupulus*) are the cash crops of the cold deserts. Kuth is an important species and is extracted from the roots has the medicinal value (Negi, 2002). Animal husbandry is another important component of their livelihood. The Ladakh is raise cattle, sheep, goats, horses and Dzo (cross between yak and cow), as primary source of milk, meat, wool and other byproducts. Mostly sheep and goats are reared for wool, milk and meat purpose (Bhatt *et al.* 2015).

THREATS AND CONSERVATION

The cold deserts are landlocked for the most of the year and opened during short summer from June to September. Even then, the tourist influx is at peak in this limited period. However, tourism has increased the socio-economic status of the people residing in the cold deserts of the Ladakh and Spiti Valley. Many tours are organized by locals for the visitors and mostly foreign tourists visit the area. The locals have converted their houses into 'Home stays' for accommodating of tourists as well as many hotels are coming up in the far-flung areas of the cold deserts. Many roads are being constructed to connect the remote areas of the cold deserts. Thus, due to various turbulences, this fragile ecosystem is at alarm.

The Ladakh's landscape and unique cultural heritage have been the major attractions since it was opened to tourists in 1974. Number of tourists visiting Ladakh has increased considerably from 527 in 1974 to over 25000 tourists in 2005 and has crossed more than one lakh tourists during 2013 and 2014. Most of the tourists visit during June to September even up to mid of October for a variety of activities including trekking, rafting and sightseeing (Bhatt *et al.* 2015). Ladakh, like any

Alpine pasture in Cold deserts

other high altitude desert in the world has a very fragile ecosystem which is being threatened by unplanned and unregulated developmental and tourism activities. An important indirect threat to local wildlife is created by the disturbance and degradation of natural habitat due to overgrazing of pasturelands by ever growing livestock population. The excessive grazing near the wetlands is leading to the degradation of the vital breeding grounds of the rare and endangered migratory birds (Chandan *et al*. 2008). The climate change concerns in the regions are multifaceted encompassing human health, endangered species, biodiversity, agriculture, livelihood and food security (Xu *et al*. 2009).

During the surveys of Spiti Valley (2012-2014), it has been observed that the rain with chilly wind in afternoon is becoming common phenomenon. The cloud burst in Ladakh (August, 2010) has changed drastically natural ecosystem of the region. These cold deserts are very fragile, thus a slight disturbance will devastate ecology of the region and many faunal habitats will disappear from the planet. Subsequently, unique faunal diversity of the region will vanish from the earth enduringly.

Conservation education initiatives that illustrate the peculiarities and fragility of the local environment need to be taken up for the local people, tourists, researchers and officials etc. (Sambandam and Bashir, 2016).

Indian Trans-Himalayan landscape

Faunal Diversity

Overall, 3324 species/subspecies of both Protozoa (17) and Animalia (3307) have been recorded from Trans-Himalaya, representing about 10.94% of the total Indian Himalayan fauna (30377 species). Regarding taxonomic richness, phylum Arthropoda with about 2415 species/subspecies, represents approximately 9.15% of the total diversity of Trans-Himalaya, further including 2311 species/subspecies of Hexapods, 82 species/subspecies of Arachnids. Trans-Himalaya (Cold Deserts) has 100 species of mammals, 349 species of birds, 100 species of

Polyommatus eros, Meadow blue

fishes, 16 species of reptiles, and 8 species of amphibians, accounting about 31.55% of the total vertebrate diversity of the Indian Himalaya. Though, the diversity is less but all the species are unique and endemic to the area. The faunal elements of this region are unique, as they have evolved to withstand the rigours of extreme aridity, severe cold, reduced atmospheric pressure and high solar radiation (Mehta and Julka, 2001). The steep hill slopes here are not easily accessible but are habitat for the rare fauna. There is very good habitats for Apollo butterflies in the alpine zones of the cold deserts. The wetlands of Ladakh have the distinction of being the only known breeding ground of Black-necked Crane (*Grus nigricollis)* in India (Chandan *et al.* 2008). The snow leopard is a majestic large carnivore, distributed over most of the Trans-Himalayan region. The main mammalian fauna present in the region include snow leopard (*Panthera uncia*), Himalayan marmot (*Marmota himalayana*), Blue sheep (*Pseudois nayaur*), Tibetan woolly hare (*Lepus oiostolus*), Tibetan gazelle (*Procapra picticaudata*), Himalayan ibex (*Capra sibirica*), Tibetan argali (*Ovis ammon hodgsoni*), Tibetan antelope

Schizopygopsis stoliczkai Steindachner

Motacilla citreola Pallas, 1776

(*Pantholops hodgsoni*), Ladakh urial (*Ovis vignei vignei*), Tibetan wild ass (*Equus kiang polyodon*), and wild yak (*Bos grunniens*) (Namgail, 2009; Habib *et al.* 2015; Kumar *et al.* 2017).

Equus kiang Moorcroft, 1841

Camelus bactrianus Linnaeus, 1758

Table 1 : Faunal diversity of India, Indian Himalaya and Trans-Himalaya

Kingdom/Phylum/Class		India	Indian Himalaya	Trans-Himalaya
I	**Kingdom Protozoa**	**3,525**	**372**	**17 (16+1)**
II	**Kingdom Animalia**			
	Phylum Mesozoa	**10**	-	-
	Phylum Porifera	**549**	**6**	-
	Phylum Cnidaria	**1,445**	**2**	-
	Phylum Ctenophora	**19**	-	-
	Phylum Platyhelminthes*	**1,772**	**250**	**11**
	Phylum Rotifera*	**467**	**129**	**27**
	Phylum Gastrotricha	**162**	**1**	**01**
	Phylum Kinorhyncha	**10**	-	-
	Phylum Nematoda*	**2,970**	**744**	**170 (55+105)**
	Phylum Acanthocephala*	**302**	**37**	**01**
	Phylum Spiuncula	**41**	-	-
	Phylum Echiura	**47**	-	-
	Phylum Annelida*	**1,034**	**778**	**13**
	Phylum Onychophora	**1**	**1**	-
	Phylum Arthropoda	**76,149**	**26392**	**2415**
	Subphylum Chelicerata*	**6,045**	**1075**	**82**
	Subphylum Crustacea*	3,885	**277**	22
	Subphylum Hexapoda*	**65,837**	**24933**	**2311**
	Subphylum Myriapoda	**382**	**107**	-
	Phylum Phoronida	**3**	-	-
	Phylum Bryozoa (Ectoprocta)	**336**	**4**	-
	Phylum Entoprocta	**10**	-	-
	Phylum Brachiopoda	**8**	-	-
	Phylum Chaetognatha	**44**	-	-
	Phylum Tardigrada	**30**	**23**	-
	Phylum Mollusca	**5,212**	**422**	76
	Phylum Nemertea	**6**	-	-
	Phylum Echinodermata	**779**	-	-
	Phylum Hemichordata	**14**	-	
	Phylum Chordata	**6,736**	**1816**	**573**
	Subphylum Cephalochordata	6	-	-
	Subphylum Urochordata	531	-	-
	Subphylum Vertebrata [=Craniata]	**6,199**	**1816**	**573**
	Class Pisces	3,396	**316**	100
	Class Amphibia	417	**80**	8
	Class Reptilia	614	**200**	16
	Class Aves	1,343	**940**	349
	Class Mammalia	429	**280**	100
	Total (Animalia)	**98,156**	**30005**	**3307**
	Grand Total (Protozoa+Animalia)	**1,01,681**	**30377**	**3324**

* Species listed in Annexus

Pseudois nayaur (Hodgson, 1833)

Landscape of Spiti Valley

Landscape of Shyok valley of Ladakh

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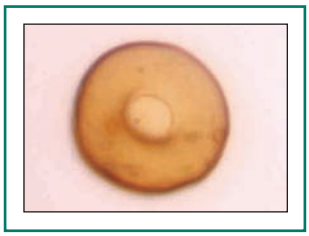
Chapter 2

Protozoa

L. BINDU



From Trans-Himalaya 16 species of moss dwelling testate amoebae have been recorded referable to five genera and five families. The highest number of species has been recorded under the family Centropyxidae. All the species are new records to Indian Trans-Himalaya. This group is least attended to in Trans-Himalayan region.

Keywords: amoebae, new record, Trans-Himalaya

INTRODUCTION

Protozoa are single celled Eukaryotes (cells with nucleus) which feed on organic matter. The Rhizopods (Testate amoebae) are polyphyletic assemblage of some major taxonomic group of eukaryotes (Adl *et al*., 2012). They are distributed widely in almost all moist habitats. Taxonomic and ecology related studies of these testate amoebae have increased recently because of their important role in environmental biomonitoring, cycling of elements in terrestrial ecosystems and biogeographical & evolutionary studies (Booth, 2002; Swindles *et al.,* 2008; Swindles *et al.,* 2015; Qin *et al.,* 2013). Inspite of its importance as biological indicators this is a least studied group in Trans Himalaya.

Perusal of literature reveals that approximately 206 species of free living protozoans have been recorded from Indian Himalaya including testate amoebae (Chattopadhyay and Das, 2003; Das and Chattopadhyay, 2005, Bindu, 2013). Total testate amoebae recorded from Indian Himalaya was about 88 species of which 66 species belong to Phylum Amoebozoa and remaining 22 species under the phylum Rhizaria. Considering the distribution of protozoa in different biotic provinces of Indian Himalayan biogeographic zone, from Trans-Himalaya the only recorded information is the 16 species of testate amoebae reported by the present author in 2018 from Spiti Valley.

The initial records of free living protozoa from Indian Himalayas were published by Penard (1907) who recorded 15 species of testate amoebae from Sikkim Himalaya. Das *et al.* (1993) documented 36 species of rhizopods. Chattopadhyay and Das (2003) reported 76 species of moss inhabiting testacids of North and North East India. Recently Bindu (2013) reported 41 species of testate amoebae from Pangi Valley, Himachal Pradesh. Bindu (2018) recorded 16 species of testate amoebae from Spiti Valley in Himachal Pradesh and this is the only record of testate amoebae from Trans-Himalaya. The study was made during 2012-14 from the moss samples of Chandertal lake (Latitude 32.47517, longitude 77.61686) and Kunjam Pass (Latitude 32.39445, longitude 77.63645) of Trans-Himalayan region of Spiti valley. So far no protozoan species has been demarcated as threatened or endemic.

Table 1 : Checklist of Testate Amoebae from Indian Trans-Himalaya

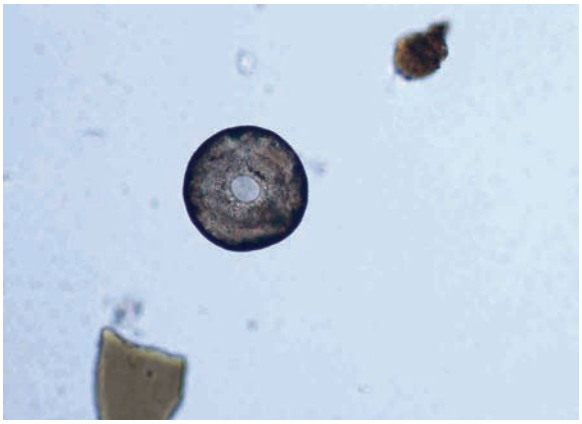
Sl. No.	Family	Name of the Species	Habitat
1	Arcellidae	*Arcella arenaria* Greeff, 1866	Mostly in dryer mosses; also on trees and in sphagnum
2		*Arcella catinus* Penard, 1890	Usually in freshwater among vegetation and in wet sphagnum
3		*Arcella discoides* Ehrenberg, 1843	Freshwater, moss, soil

Marine Biology Regional Centre, Zoological Survey of India,
130, Santhome High Road, Chennai-600 028
Email: bindulajapathi40@gmail.com

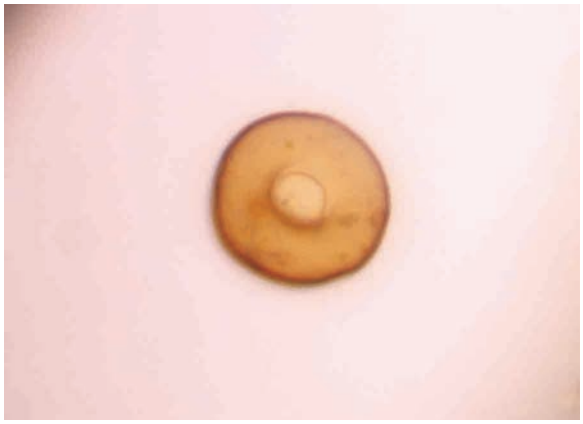
Citation
Bindu, L. 2019. Protozoa. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 23-26. (Published by the Director, Zool. Surv. India, Kolkata)

Table 1 contd.

Sl. No.	Family	Name of the Species	Habitat
4	Centropyxidae	*Centropyxis aculeata* (Ehrenberg, 1832) Stein, 1857	Moss, freshwater
5		*Centropyxis aerophila* Deflandre, 1929	Moss, fresh water, estuary, soil
6		*Centropyxis constricta* (Ehrenberg, 1841) Penard, 1902	Moss, soil
7		*Centropyxis discoides* Penard, 1902	Moss
8	Centropyxidae	*Centropyxis ecornis* (Ehrenberg, 1841) Leidy, 1879	Freshwater, moss
9		*Centropyxis laevigata* Penard, 1890	Moss, freshwater
10		*Centropyxis minuta* Deflandre, 1929	Freshwater, moss, soil
11	Trigonopyxidae	*Cyclopyxis eurystoma* Deflandre, 1929	Moss
12		*Cyclopyxis arcelloides* (Penard, 1902) Deflandre, 1929	Moss, freshwater
13	Difflugiidae	*Difflugia corona* Wallich, 1864	Moss, freshwater
14		*Difflugia globulosa* Dujardin, 1837	Moss, freshwater
15		*Difflugia oblonga* Ehrenberg, 1838	Moss, freshwater
16	Phryganellidae	*Phryganella paradoxa* Penard, 1902	Moss

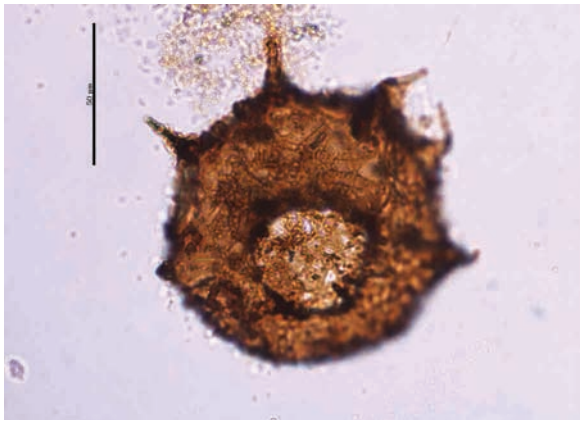


Arcella arenaria Greeff, 1866

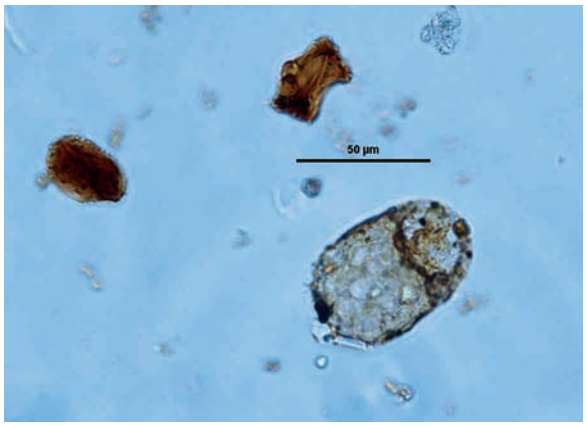


Arcella catinus Penard, 1890

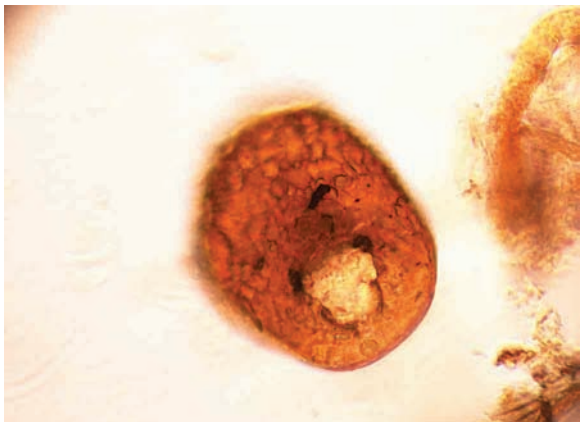
Arcella discoides Greeff, 1866



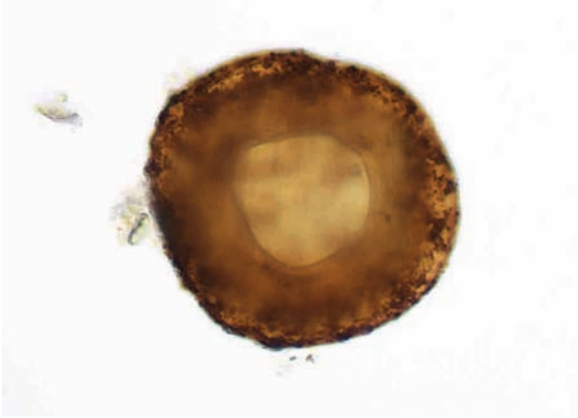
Centropyxis aculeata Ehrenberg, 1838



Centropyxis cassis Wallich, 1864



Centropyxis discoides Penard, 1902



Cyclopyxis arcelloides Penard, 1902

CONCLUSION

The study summarizes the reports of 16 species of moss dwelling testate amoebae span over five genera and five families. The highest number of species was recorded under the family Centropyxidae and the least under the family Phryganellidae. All the species are new records to Trans Himalaya.

RECOMMENDATIONS

Even though Himalaya is a highly diversified ecosystem the number of protist species reported are meagre (only 12% of the total species reported from India) and the true diversity may be far above the recorded number of species. In this context it is recommended to investigate protist diversity in a comprehensive manner and more workers should come up on this ecologically important biomonitors.

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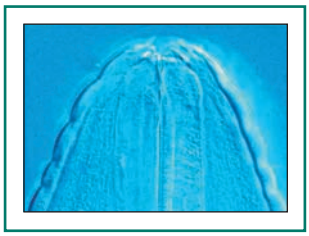
Chapter 3

Nematoda (Terrestrial Nematodes)

VINITA SHARMA



The information of terrestrial nematodes has been documented first time from Indian Trans-Himalaya. Fifty five species of nematodes are being recorded from this region, of which 12 species of plant-parasitic, 22 species of freeliving, only one species of predatorry and 16 species are bacterial feeders and 4 species of fungal feeder. The barley crop is infested by Molya disease in Laddak region.

Keywords: Terrestrial Nematode, Indian Trans-Himalaya, Molya Disease

INTRODUCTION

The Nematodes are most numerous, multicellular animals on earth. In handful of agriculture or other field of soil will contain thousands of the microscopic worms, many of them parasites of insects, plants or animals. Free living species are abundant, including nematodes that feed on bacteria, fungi and other nematodes, they are an important component of unity and assessment of nematode fauna provides a unique insight into soil biological processes (Ritz and Trudgill, 1999). Nematodes play a role in decomposition and nutrient cycling (Ferris and Matute, 2003). Free living nematodes that feed on bacteria and fungi promote rhizosphere colonization of beneficial rhizobacteria (Knox *et al.,* 2003). Nematode is one of the important components in soil microfauna and it is responsible for litter decomposition and soil nutrient dynamics in ecosystems. Therefore, an effort is made to compile the nematodes data from Trans-Himalaya to identify the research gaps for future study.

HISTORICAL RESUME

As per review of literature very little work has been done on nematodes of Trans-Himalya of India. A number of nematologists made their contribution by adding 51 species of terrestrial nematodes in nematode fauna Trans-Himalaya of India. From Ladakh, Zakir and Mir (1994) reported first time *Anguina tritici* (Thorne, 1949) from Ladakh. Mushtak and Ahmad added two new species of freeliving nematodes *Laimydorus vulvapapillatus* Mushtaq and Ahmad (2006) and *Mesodorylaimus ladakhiensis* Mushtaq and Ahmad (2006) in Dorylaimid fauna. Rizvi (2010; 2010a) published a data containing 17 genera and 3 species of nematodes from Ladakh. Tweny two species of plant and soil nematode species were found from Zanskar, Bacterivores represented 21% of all nematodes, fungivores 13%, root fungal feeders 56% and omnivores 9% (Devetter, 2017). *Hordeum vulgare* L. (Barley) is one of the most important staple food crops occupying 54% of the total acreage of 22443 ha in Ladakh (Anonymous, 2001; Sharma and Mir, 1997). Field survey was conducted for the first time during 2004-2005 to study of barley diseases. Vaish, (2011) studied the molya disease caused by cereal cyst nematode, *Heterodera avenae* and found the infested fields with incidence of molya disease between 5 and 20%. About 6% cereal cyst nematode infested fields showed the disease incidence between 30 and 40% with highest severity. Baqri and Bohra (2005) reported two species of *Meloidogyne* and one species of *Mylonchulus* of predatory nematodes from Lahaul and Spiti.

The present chapter reports 49 species of terrestrial nematodes belonging to 44 genera spread over 3 families of 6 orders from Ladakh and Lahaul & Spiti, Jammu & Kashmir under Trans-Himalaya of India. These 55 species are distributed in 6 orders : Tylenchida (12 species), Dorylaimida (20 species), Mononchida (1 species), Rhabditida (8 species belonging to 8 genera), Aphelenchida (4 species), Araeolaimida (4 species belonging to 3 genera).

GAP AREAS

i. Two states namely, Uttarakhand and Sikkim under Trans-Himalaya of India have not been studied/ covered for nematodes study so far.

ii. More studies are required on terrestrial nematodes in Trans-Himalaya region.

Northern Regional Centre, Zoological Survey of India, Dehradun, Uttarakhand-248 195
Email: vinitascb@gmail.com

Citation
Sharma, V. 2019. Nematoda (Terrestrial Nematodes). In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 27-30. (Published by the Director, Zool. Surv. India, Kolkata)

iii. Apart from diversity, community analysis of terrestrial nematodes is the need for further studies.

DISCUSSION

In compilation of information on nematodes fauna of Trans-Himalaya region, out of 55 species, only 12 species of plant parasitic nematodes show their presence and yield losses due to one species cereal cyst nematode is recorded 4-58% till date. Due to climate changes and tourism climatic conditions are changing. Therefore detailed study on terrestrial nematodes is required in future.

Table 1 : Checklist of Nematodes in Indian Trans-Himalaya

Sl. No.	Order	Family	Subfamily	Species
1.	Tylenchida	Tylenchidae	Tylenchinae	*Tylenchus naranensis* Maqbool, Zarina & Ghazala, 1987
2.				*Filenchus quartus* (Szczygieł, 1969) Siddiqi, 1986
3.		Anguinidae	Anguininae	*Anguina tritici* (Steinbuch, 1799) Filipjev, 1936
4.				*Ditylenchus* sp.
5.				*Nothotylenchus* sp.
6.		Hoplolaimidae	Hoplolaiminae	*Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961
7.		Pratylenchidae	Pratylenchinae	*Pratylenchus coffeae* (Zimmermann, 1898) Filipjev & Schuurmans Stekhoven, 19
8.		Meloidogynidai	Meloidogyninae	*Meloidogyne incognita* (Kofoid & White, 1919) Chitwood, 1949
9.				*Meloidogyne javanica* (Treub, 1885) Chitwood, 1949
10.				*Meloidogyne* sp.
11.		Heteroderidae	Heteroderianae	*Heterodera avenae* Wollenweber, 1924
12.		Telotylenchidae	Telotylenchinae	*Tylenchorhynchus mashhoodi* Siddiqi and Basir, 1959
13.	Aphelenchida	Aphelenchidae	Aphelenchidae	*Aphelenchus avenae* Bastian, 1865
14.		Aphelenchoididae		*Aphelenchoides lagenoferrus* Baranovskaya, 1963
15.				*Aphelenchoides* sp.
16.				*Paraphelenchus pseudoparietinus* Micoletzky, 1922
17.	Dorylaimida	Dorylaimidae	Dorylaiminae	*Laimydorus vulvapapillatus* Mushtaq & Ahmad, 2006
18.				*Mesodorylaimus ladakhiensis* Mushtaq and Ahmad, 2006
19.				*Amphidorylaimus* sp.
20.		Aporcelaimidae	Aporcelaiminae	*Aporcelaimellus* sp.
21.		Qudsianematidae	Qudsianematinae	*Eudorylaimus vulvastriatus* Mahboobi, 2006
22.				*Eudorylaimus* sp.
23.				*Crassolabium* sp.
24.				*Labronema nemella* Mushtaq & Ahmad, 2006
25.				*Ecumenicus monohystera* (De Man, 1880) Thorne, 1974
26.			Discolaiminae	*Discolaimus paramajor* Coomans, 1966

Table 1 contd.

Sl. No.	Order	Family	Subfamily	Species
27.				*Nygolaimoides gubernaculifer* (Andrassy, 1957) Andrassy, 1997
28.			Lordellonematinae	*Moshajia ladakhiensis* Ahmad *et al.*, 2009
29.		Nordiidae	Pungentinae	*Enchodelus (Paraenchodelus) brevidentatus* Thorne, 1939
30.		Belondiridae	Dorylaimellinae	*Dorylaimellus deviates* Baqri and Jairajpuri, 1969
31.		Tylencholaimidae	Tylencholaiminae	*Tylencholaimus proximus* Thorne, 1939
32.				*Tylencholaimus mongolicus* Andrássy, 1967
33.				*Tylencholaimus ladakhiensis* Ahad & Ahmad, 2016
34.		Loofilaimidae		*Loofilaimus phialistoma* Jairajpuri, Ahmad & Sturhan 1998
35.		Mydonomidae		*Dorylaimoides micoletzkyi* de Man, 1921) Thorne and Swanger, 1936
36.				*Dorylaimoides indicus* Jairajpuri, 1965
37.		Nygolaimidae	Nygolaiminae	*Paravulvus confusus* Akhtar, Ahmad and Jairajpuri, 1994
38.				*Morasia parva* Ahmad & Jairajpuri, 1983
39.	Mononchida	Mylonchulidae	Mylonchulinae	*Mylonchulus apapiliatus* Khan & Jairajpuri, 1979
40.	Rhabditida	Rhabditidae	Rhabditinae	*Rhabditis* sp.
41.			Mesorhabditinae	*Mesorhabditis* sp.
42.		Panagrolaimidae		*Panagrolaimus rigidus* (Schneider, 1866) Thorne, 1937
43.		Cephalobidae	Cephalobinae	*Eucephalobus oxyuroides* (de Man, 1876) Steiner, 1936
44.			Acrobelinae	*Acrobeles* sp
45.				*Acrobeloides nanus* (de Man, 1880) Anderson, 1968
46.				*Acrobeloides tricornis* (Thorne, 1925) Thorne, 1937
47.				*Cervidellus vexilliger* (de Man, 1880) Thorne, 1937
48.				*Cervidellus neftasiensis* Boström. 1986
49.				*Chiloplacus demani* (Thorne, 1925)
50.				*Chiloplacus* sp.
51.	Araeolaimida	Plectidae	Plectinae	*Chiloplectus* sp.
52.				*Plectus acuminatus* Bastian, 1865
53.				*Plectus* sp.
54.				*Stegelletina devimucronata* (Sumenkova, 1964) Boström & De Ley, 1996
55.				*Stegelletina similis* (Thorne, 1925) Boström & De Ley, 1996

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Chapter 4

Collembola

G.P. MANDAL

The present document comprised of 30 species of Collembola belonging to 15 genera under 4 families have been reported from Trans-Himalaya (Ladakh and Spiti) region of India. Out of 30 species recorded from Trans-Himalaya of Indian region, 24 species are endemic to the region.

Keywords: Collembola, diversity, Trans-Himalaya

INTRODUCTION

Baijal (1955a, b; 1958) had extensively studied the fauna of Collembola and described nineteen speices based on Prof. Mani's Entomological expedition to the North West Himalaya during 1954-56. Among these, twelve species described from the nival zone of North West Himalaya under Lahaul and Spiti. Six species of Collembola including family Isotomidae and Entomobryidae described from North West Himalaya (Denis, 1936). Bhagat (2013) published a checklist of fauna Collembola from Jammu & Kashmir and Ladakh regions of Himalaya.

In the present communication, fauna of collembolan is based on extensive collections made during August-September, 2008 from, Sakti, Darbuk, Tso Gul Tso wetland, Pangong Tso Lake, Chusul, Nyoma, Nider, Chumathang, Diskit, Hunder and Ganglatak areas of Ladakh districts of Jammu & Kashmir, India, as a part of the "Cold Desert Expedition" of Zoological Survey of India. Survey also conducted in Spiti Valley during 2010-11, as a part of state fauna of Himachal Pradesh (Table 1 and 2). As a result, the present author have been published two papers on Collembola from Ladakh region of Jammu & Kashmir, India (Baquero, Mandal and Jordana, 2014; Mandal and Arbea, 2014) whereseven new species viz., *Entomobrya diskitensis, Entomobrya ladakhi, Entomobrya choudhurii, Entomobrya mehtai, Himalnur abaijali, Seira nidarensis* and *Seira hazrai* were described and four new records to India (*Hypogastrula rangkuli*, *Corynothrix borealis, Seira delamarei* and *Lepidocyrtus* (*Allocyrtus*) *lepidornatus* has beenmade.

CHECKLIST OF COLLEMBOLA FROM TRANS-HIMALAYA (LADAKH AND SPITI)

Table 1 : Number of genera and species known from Indian Trans-Himalaya (Ladakh and Spiti)

Sl. No.	Family	Genera	Species
1.	Neanuridae Borner, 1913	1	1
2.	Hypogastruridae Borner, 1906	2	3
3	Isotomidae Schaffer, 1896	3	3
4	Entomobryidae Schaffer, 1896	9	23
	Total	**15**	**30**

Table 2 : List of the species recorded from Indian Trans-Himalaya (Ladakh and Spiti)

Sl. No.	Name of the Family, Genus and Species
1.	Family NEANURIDAE Borner, 1913 *Friesea excelsa* Denis, 1936
2.	Family HYPOGASTRURIDAE Borner, 1906 *Hypogastrura rangkuli* Martynova, 1975
3.	*Hypogastrura nivicola* (Fitch, 1847) Yosii, 1960

Zoological Survey of India, Apterygota, Section, M-Block, New Alipore, Kolkata-700053 (WB)
Email: gpmandal.zsi@gmail.com

Citation
Mandal, G.P. 2019. Collembola. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 31-34. (Published by the Director, Zool. Surv. India, Kolkata)

Table 2 contd.

Sl. No.	Name of the Family, Genus and Species
4.	*Ceratophysella communis* (Folsom, 1897)
5.	Family ISOTOMIDAE Schaffer, 1896 *Scutisotoma ladaki* (Denis, 1936) Potapov, Babenko, & Fjellberg, 2006
6.	*Isotoma spinicauda* Bonet, 1930
7.	*Aackia karakoramensis* Yosii, 1966
8.	Family ENTOMOBRYIDAE Schaffer, 1896 *Janetschekbrya brahamides* (Denis, 1936)
9.	*Entomobrya himalayensis* (Baijal, 1955) Salmon, 1964
10.	*Entomobrya indica* (Baijal, 1955)
11.	*Entomobrya kultinalensis* Baijal, 1958
12.	*Entomobrya logisticta* Baijal, 1958
13.	*Entomobrya manii* (Baijal, 1955) Salmon, 1964
14.	*Entomobrya nigrita* (Baijal, H.N., 1958)
15.	*Entomobrya rohtangensis* Baijal, 1958
16.	*Entomobrya nivalis* (Linnaeus, 1758) Agren, 1904
17.	*Entomobrya diskitensis* Baquero, Mandal and Jordana, 2014
18.	*Entomobrya ladakhi* Baquero, Mandal and Jordana, 2014
19.	*Entomobrya choudhurii* Baquero, Mandal and Jordana, 2014
20.	*Entomobrya mehtai* Baquero, Mandal and Jordana, 2014
21.	*Mesentotoma hutchinsoni* (Denis, 1936) Jordana, 2012
22.	*Himalanura indica* Baijal, H.N, 1958
23.	*Himalanura baijali* Baquero, Mandal and Jordana, 2014
24.	*Orchesellides boraoi* Bonet, 1930
25.	*Drepanosira subornata* (Denis, 1936) Bonet, 1942
26.	*Corynothrix borealis* Tullberg, 1877
27.	*Seira delamarei* Jacquemart, 1980
28.	*Seira nidarensis* Baquero, Mandal and Jordana, 2014
29.	*Seira hazrai* Baquero, Mandal and Jordana, 2014
30.	*Lepidocyrtus* (*Allocyrtus*) *lepidornatus* (Handschin, 1930)

SUMMARY

The present communication comprised of 30 species of Collembola belonging to 15 genera under 4 families have been recorded from Trans-Himalaya (Ladakh and Spiti) region of India. From Trans-Himalaya (Ladakh and Spiti), Collembola fauna represents 30 species under 15 genera of 4 families. Out of 30 species recorded from Trans-Himalaya of Indian region, 24 species are endemic to the region.

CONCLUSION

The present author have been published two papers on Collembola from Ladakh region of Jammu & Kashmir, India (Baquero, Mandal and Jordana, 2014; Mandal and Arbea, 2014) whereseven new species viz., *Entomobrya diskitensis, Entomobrya ladakhi, Entomobrya choudhurii, Entomobrya mehtai, Himalnura baijali, Seira nidarensis* and *Seira hazrai* were described and four new records to India (*Hypogastrura rangkuli*, *Corynothrix borealis, Seira delamarei* and *Lepidocyrtus* (*Allocyrtus*) *lepidornatus* has been made.

Entomobrya diskitensis Baquero, Mandal and Jordana, 2014

Entomobrya ladakhi Baquero, Mandal and Jordana, 2014

Entomobrya mehtai Baquero, Mandal and Jordana, 2014

Himalanura baijali Baquero, Mandal and Jordana, 2014

Seira hazrai Baquero, Mandal and Jordana, 2014

Seira nidarensis Baquero, Mandal and Jordana, 2014

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Chapter 5

Diversity of Insects in Trans-Himalaya : An Overview

T. KUBENDRAN, AVTAR KAUR SIDHU and KAILASH CHANDRA*

The present chapter documented insect diversity of Indian Trans-Himalaya which is represented by 2261 species of insects. It is also interesting to observe that 21 orders of Insects has been reported from Indian Trans-Himalaya. The following orders viz., Hymenoptera (589 species), Hemiptera (519 species), Lepidoptera (276 species), Diptera (213 species), Trichoptera (165 species) and Coleoptera (93species), have been found to be dominant in this region.

Keywords: Insects, Diversity, Trans-Himalaya

INTRODUCTION

Insects are the most diverse group of animals on earth. Their diversity is so high that every fourth animal in this world is an insect. In adult stage they have two antennae, six legs and usually two or four wings, with the body covered with exoskeleton. This makes them highly adaptive and dominant almost in every ecosystem. Insects are the most dominant group of animals regarding their global 10,53,578 species and Indian diversity 64,479 species (Chandra *et al.,* 2018). Indian Trans-Himalaya (bio-geographical region 1 with provinces 1A, 1B and 1C) is represented by 2261 species of insects (Chandra *et al.,* 2018).

Insects form most important component of the food chain of an ecosystem owing to their abundance and diversity. They are pollinators, pests, vectors and much more. In Trans-Himalaya insects being cold blooded animals, are active during short summers. They form a part of nival insects or hypsobiont species which occur beyond timber line. It is also interesting to observe that out of 26 orders of insects from the plains of India and 21 orders recorded from Indian Trans-Himalaya (1A, 1B & 1C), the orders Hemiptera, Hymenoptera, Trichoptera, Coleoptera, Lepidoptera, and Diptera found to be dominant in this region. Much of the area of Trans-Himalaya is unexplored from insect point of view, so the diversity recorded so far of insects is far from completion. The brief account of various Trans-Himalayan insects order is as given in Table 1.

Order ARCHAEOGNATHA (Thysanura) (Silver fish and Bristletails)

The species of this order are known as jumping bristletails, represented by 513 species globally (Foottit and Adler, 2009). This order is poorly studied from India, with 11 species belonging to 6 genera and 2 families being documented so far. Archaeognatha fauna of Himalaya is represented by 9 species belonging to 4 genera under 2 families, accounting for 81.82% of the total Indian diversity of this group (Chandra *et al.,* 2018). Trans-Himalaya only one species has been reported so far i.e. *Machilinus hutchinsoni* Siv. (Usually found up to 5300 m and never below 3500 m).

Order EPHEMEROPTERA (Mayflies)

Though of cosmopolitan distribution, Ephemeroptera apparently reach their maximum development in temperate and mountainous areas. Relatively few species are known to inhabit the Trans-Himalayan zone of the Northwest Himalaya, but the order flourishes almost up to the permanent snow-line. The global diversity of mayflies is represented by 3240 species under 400 genera of 42 families, of which, 146 species belonging to 58 genera belonging to 13 families of 4 suborders are reported from India (Selvakumar, 2018). Himalaya includes 49 species of mayflies under 26 genera belonging to 7 families (Sivaramakrishnan, 2016; Subramanian *et al.,* 2017). Trans-Himalaya includes 13 species belonging to 7 genera and 5 families described so far.

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (HP)
*Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053 (WB)
Email: tkbaetis@gmail.com; avtarkaur2000@gmail.ocm; kailash 616@gmail.com

Citation
Kubendran, T., Sidhu, A.K. and Chandra, K. 2019. Diversity of Insects in Trans-Himalaya : An Overview. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 35-43. (Published by the Director, Zool. Surv. India, Kolkata)

Order ODONATA
(Dragonflies and Damselflies)

The order Odonata is one of the ancient groups of insects. The word Odonata is derived from the Greek word odonates meaning the toothed, which highlights the toothed nature of mandibles of this insect group. The adults are terrestrial and the larvae aquatic. This order includes dragonflies and damselflies. The larvae of Odonata feeds on aquatic organisms such as mosquito larvae etc., and adults feed on mosquitoes, flies, termites, aphids, and small moths. Odonata larval stage live in freshwater habitats and only a few species can tolerate brackish waters. They are highly specific to particular aquatic habitat and utilize them an ideal model system to address question in ecology, evolutionary biology, biogeography and for monitoring health of freshwater ecosystem (Subramanian and Babu, 2017). Species diversity is quite less in Trans-Himalaya (Subramanian and Babu, 2018). Globally 6233 species in 685 genera of Odonates are known, of this 488 species and 27 subspecies in 154 genera and 18 families (Subramanian and Babu, 2017) exist in India. Out of 488 species, 257 species belonging to 112 genera of 18 families are reported form Himalaya, including 23 species endemic to Himalaya. Trans-Himalaya includes 47 described species belonging to 27 genera and 10 families (Chandra *et al.,* 2018).

Order ORTHOPTERA
(Grasshoppers and Crickets)

The order Orthoptera, most familiar representatives are grasshoppers, locusts, crickets, and katydids. Though essentially a thermophile group typically characteristic of hot desert to tropical and subtropical regions, many Orthoptera have however, become adapted for life in the cold deserts, both in the north latitudes and on high mountains. On mountains they are exclusively geophiles and inhabit stony slipes or elevated grassy meadows. Hibernation occurs in the egg stage in soil, usually at depths of about 10-20 cm, under cover of snow and lasts for September to end of May, where the Orthoptera passes a single generation in the year (Mani, 1989). Global diversity of Orthoptera fauna is 27790 species out which, 1,033 (Shishidia *et al.,* 2010) species are of Indian orthoptera. Indian Himalaya diversity includes 454 species/subspecies belonging to 285 genera under 18 families. Out of these, 38 species are found to be endemic to the Himalaya (Chandra *et al.,* 2018). Trans-Himalaya represented by 24 species belonging to 15 genera and 2 families.

Order PHASMIDA
(Leaf insects and stick insects)

The walking sticks and leaf insects are noted for their near-perfect imitations of plants. Some that resemble twigs are drawn out to improbable lengths, measuring as much as 13 inches; others are flattened and expanded like a leaf. They are nocturnal insects that move slowly and clumsily as they feed on green leaves of trees and bushes. There are approximately 2000 phasmid species, which live mostly in warm countries and owe their existence largely to their penchant for catalepsy (trancelike state), for even the most deceptive 'twig' or perfect 'leaf' loses its disguise when it walks (Linsenmanier, 1972). Although 3046 species represent the global diversity of phasmids, Indian fauna includes only 144 species belonging to 41 genera in 4 families with 99 endemic species. Himalaya represents 37 species belonging to 20 genera under three families of phasmidis. In Trans-Himalaya only one species has been reported so far. The order Phasmida is so far represented by the recently described *Ladakhomorpha longipes* belonging to family Pachymorphidae from Ladakh.

Order EMBIOPTERA
(Web spinners)

The order Embioptera commonly referred to as web spinners is a unique group among the small insect orders with the species distributed throughout the warmer regions of the world (Miller *et al.,* 2012). This order includes about 457 species from the world, and 32 species belonging to 5 genera under 2 families are known from India (Zhang, 2013; Chandra and Dawn, 2014). Trans-Himalaya only one species has been reported so far (Chandra *et al.,* 2018).

Order PLECOPTERA
(Stoneflies)

Plecoptera are essentially a holarctic order and are particularly abundant on mountains. As is well known, Plecoptera are amphibiotic insects and their aquatic larvae need cold and well aerated with rich oxygen in fresh water. They are consequently confined to the torrential streams of melt water. Stoneflies constitute an important group of nival insects. They are extremely abundant in streams immediately below the permanent snow and ice. Hibernation in winter is in the second larval stage, but nearly every stage of the larva is capable of passing into hibernation (Mani, 1989). The members of this order, global diversity accounts for 3,625 species. Of those, 128 species belonging to 24 genera in 8 families are reported from India (Babu *et al.,* 2017). Indian Himalaya includes, 89 species belonging to 23 genera under 8 families are reported (Chandra *et al.,* 2018). From Trans-Himalaya 10 species belonging to 6 genera and 4 families are recorded so far.

Order DERMAPTERA
(Earwigs)

The typical earwig is a long, thin insect with a pair of pincers at the end of its body. The extended wing of

certain species of earwigs looks like an ear, the earwig's pincers resemble instruments once used to pierce women's ears for the insertion of earrings and there was once a widespread notion that earwigs crept into the ears of sleeping persons (Linsenmanier, 1972). Only a few species of this group are extremely abundant as individuals, often at fairly high elevations. Global species richness of this order is about 1942 species belonging to 245 genera in 16 families (Hopkins *et al.,* 2017), of which 284 species belonging to 72 genera of 7 families are reported from India (Srivastava, 2013). 152 species under 52 genera and 7 families are recorded from Himalaya (Chandra *et al.,* 2018) From Trans-Himalaya only 1 species belonging to 1 genera and 1 family was reported.

Order MANTODEA
(Praying Mantids)

Mantodea, over there sits a creature that looks something like a grasshopper. It creeps almost sinuously through the grass. But when threatened it halts, raises its head high, spreads its forelegs, revealing astonishing designs, and fans its rattling wings in and out (Linsenmanier, 1972). Globally, the mantid fauna consists of 2425 species belonging to 434 genera in 15 families (Ehrmann, 2002; Zhang, 2013), out of these 169 species in 71 genera of 11 families reported from India (Mukherjee *et al.,* 2014). Indian Himalayas harbours about 65 species belonging to 36 genera in 17 subfamilies of 8 families (Chandra *el al.,* 2018). Trans-Himalaya 2 species belonging to 2 genera and 2 families are reported so far.

Order: BLATTODEA
(Cockroaches)

The cockroaches (Blattodea) are a primeval order of insects. These run very fast due to modified strong coxae, the leg segments that join with the body. These insects are flattened, oval build which allows them to take refuge in narrow crevices, within which these even can move backward, feeling its way with a posterior narrow of appendages (cerci) that might almost be dubbed 'abdominal antennae' (Linsenmanier, 1972). The order Blattodea comprises of about 4641 species under 492 genera in 8 families in the world. In India, there are 156 species belonging to 57 genera under 5 families. From Indian Himalaya 44 species belonging to 27 genera, 10 subfamilies and 5 families are recorded (Prabakaran and Senraj, 2018). In Trans Himalaya includes 3 species belonging to 2 genera and one family reported so far.

Order PSOCOPTERA
(Booklice)

The order Psocoptera includes minute insects, 3 to 6mm long, with or without wings. These are popularly known as the booklice, in view of their frequenting the bindings of books, feeding on the glue. Though not very important from the economic point of view, still they can cause sufficient nuisance by being present in stored tea, cereal products & flour and also causing enough damage in museums dried specimens exhibitions (Nayer *et al.*, 1989). Psocopterans include 5,732 described species globally (Zhang, 2013), whereas the Indian fauna is represented by only 122 species belonging to 40 genera in 16 families (Lienhard, 2016). From Himalaya is assessed to be 40 species belonging to 28 genera of 14 families (Ramesh *et al.*, 2018). The present status of Psocopteran diversity known from Trans Himalaya 07 species belonging to 05 genera and 03 families are reported so far.

Order PHTHIRAPTERA
(Sucking lice)

The members of this order include small, wingless, tough-skinned, dorsoventally flattened often dark-coloured insects ectoparasitic on all kinds of wild and domesticated mammals and man. They live exclusively by sucking the blood of the host and are called the sucking lice (Nayer 1989). The order Phthiraptera is divided into 4 suborders: Amblycera, Ischnocera, Rhynchophthirina, and Anoplura (Chatterjee, *et al.,* 2018). Globally, the faunal status of Phthiraptera is represented by 5136 species, and the Indian diversity includes 466 species. About 130 species belonging to 38 genera in 8 families are recorded from Indian Himalaya (Chandra *et al.,* 2018) and 32 species belonging to 13 genera and 4 families are recorded from Trans-Himalaya.

Order THYSANOPTERA
(Thrips)

The order Thysanoptera includes comparatively minute insects ranging from 0.5 to 1.0 mm in size and commonly known as 'thrips' or fringe wings. They have also received the name 'Physapoda' because of the possession of a protrusible bladder-like structure at the end of the tarsus. They are known to be of considerable importance as pests of the food plants and horticultural plants and also due to their ability to act as vectors of some bacterial, fungal and viral diseases of plants. Thysanoptera, with two suborders, includes approximately 6100 species the world over (Thrips and Wiki, 2017). The Indian Thysanoptera is known by 739 species in 259 genera sharing 309 species in 116 genera of suborder Terebrantia, and 430 species in 143 genera of suborder Tubulifera (Tyagi and Kumar, 2016). As many as 222 species belonging to 110 genera under 6 subfamilies of 3 families are reported from Indian Himalaya (Chandra *et al.,* 2018) out of these 88 species belonging to 3 families are reported from Trans-Himalaya.

Order HEMIPTERA
(Bugs, Cicads, Leafhoppers, Plamthoppers, Aphids, Scale Insects)

The most distinctive feature of the order Hemiptera is the piercing and sucking mouthparts by which they are easily recognized from other insects. They have complex and essential roles in the balance of nature occupying an intermediate position in the ecological food chain (Nayer *et al.,* 1989). In most cases the body is broad and flattened dorsoventrally. Metamorphosis is gradual or incomplete (Nayer *et al.,* 1989). This order constitutes about 5% of the total insect fauna of cold desert region and comprises mostly Lygaeidae (Chandra and Sidhu, 2009). There is but a single generation in the Trans-Himalayan zone and hibernating adult bugs regain activity in late spring or more usually in early summer. Global faunal diversity of this order is represented by 1,03,590 species, of which about 6,479 species in 92 families have been reported from India. Altogether 1,841 species belonging to 70 families are known from Himalaya (Chandra *et al.,* 2018). From Trans-Himalaya 648 species belonging to 42 families are reported so far.

Order HYMENOPTERA
(Ants, Bees and Wasps)

This is a large order comprising of a great many insects which are beneficial to man. The bees are well known for their role in pollination of plant and honeybees yield honey and wax, in addition. Hymenopteran insects are highly specialized in structure and in this respect only Diptera slightly surpass them. These insects shown a great diversity of habits and their behaviour are very complex. Individuals live together in societies culminating in social organization as in wasps, bees and ants (Nayer *et al.,* 1989). In Trans-Himalaya Formicidae is the most dominant and important family. The global diversity of Hymenopteran fauna is about 1,53,088 species (Zhang, 2013), of which approximately 10,605 species are known from India. Indian Himalayan biogeographic region has the representation of 3,054 species under 816 genera of 52 families and 16 superfamilies. Trans-Himalaya 566 species belonging to 215 genera and 35 families are reported (Chandra *et al.,* 2018).

Order COLEOPTERA
(Beetles and Weevils)

Coleoptera comprises the hard-bodied beetles and weevils and forms the largest order in the class Insecta, represented by the highest number of known species of insects. They are insects of high economic importance, very diverse in size, abundance, appearance, and remarkable habits found nearly in all climates. The highest altitude at which Colecoptera flourish in the region is about 5600 mts. Himalaya has a rich representation of beetle fauna with a diversity of 10533 species belonging to 2684 genera under 107 families, which accounts about 47.3% of the total beetle diversity of India (22,299 species) (Chandra *et al.,* 2018). In Trans-Himalaya 93 species belonging to 16 families are reported so far (Chandra *et al.,* 2018).

Order NEUROPTERA
(Dobsonflies, Alderflies, Snakeflies, Lacewings, Antions and Mantispids)

Neuroptera, comprising the lacewings and antlions, is an essential group of insects functioning as biological control agents because of their predacious habits. Global fauna of this order is currently represented by 5937 species, of which 312 species are known from India (Oswald, 2007; Chandra, 2011b). The diversity of Neuroptera known from Himalaya comes to 124 species belonging to 69 genera under 10 families. Trans-Himalaya 2 species belonging to 2 genera and 2 families recorded so far. These two nival species, *Myrmecaelurus punctulatus* Froman elevation of 3450 m in the Indus Valley above Leh and another species *Chrysopa carnea* belonging to family Chrysopidae was recorded by Pawar and Parry (1989) as natural enemy of fruit pest in Ladakh (Chandra and Sidhu, 2009).

Order TRICHOPTERA
(Caddisflies)

The order Trichoptera has terrestrial adults and aquatic larvae present in variety of habitats such as rivers, streams, lakes, temporary water bodies etc. Around 49 families of Trichoptera have been presently recognized the world over, comprising 616 genera and 14548 species (Zhang, 2013). Of these, 28 families having 102 genera with the overall diversity of 1,227 species of this group occur in India. In Indian Himalaya, Trichoptera is represented by 425 species, belonging to 53 genera under 21 families (Chandra *et al.,* 2018). From Trans-Himalaya 170 species are coming under 15 families have been recorded so far.

Order LEPIDOPTERA
(Butterflies and Moths)

The butterflies and moths included in this order are soft bodied insects and vary greatly in size from minute to very large insects. The adults act as pollinators and bio-indicators, whereas the larvae infest a variety of crops. This order comprise about 1,58,423 globally, and India is represented by approximately 12500 species distributed in all the biogeographic zones of the country. About 1501 species of butterflies are known from the mainland of India (Kehimkar, 2008). The India Himalaya includes 4,107 species (Chandra *et al.,* 2018), of which about 280 species are known to occur in the high altitude biogeographic zone of the Indian Trans-Himalaya region 1A, 1B & 1C. Of these, 167 species reported from Trans-

Himalaya region 1B. Though the butterflies are better studied, but the diversity of moths is very less explored from this region.

Order DIPTERA
(True-Flies)

One of the world's most diverse insect groups commonly called as true 'flies', the Diptera make up more than 8.05% of the known global biodiversity and 15.3% of the global insect diversity (Chapman, 2009). The total number of species reported from Indian Himalaya is 1,698, belonging to 427 genera and 64 families, of which 329 species and 64 genera are endemic to the region. The Diptera from the nival zone are outstanding for the number of generations many species pass through in the greatly abbreviated summer at these high elevations. Most terrestrial Diptera normally have three or four generations, beginning from early May or even late or middle April in some localities and continuing almost up to the end of September. Like Collembola, Diptera revive from the winter hibernation much earlier than most other insects and remain active equally longer than the rest in autumn, when most nival insects have already begun hibernation. Exceedingly few species have a single generation-even near the permanent snow-line, the majority of species manage to squeeze in at least two generations during August-September. The spring and late summer generations are somewhat more prolonged and develop more slowly than the midsummer generations. There is reason to suspect that even during the winter the adult flies of all the nival species do not become totally inactive, at least immediately above the timber-line. Hibernation in the nival Diptera takes place in the larval stage (Mani, 1969). The total number of species reported from Indian Himalaya is 1698 belonging to 427 genera and 64 families, of which 329 species and 64 genera are endemic to the region (Chandra *et al.,* 2018), of which about 250 species are known to occur in the Indian Trans-Himalaya. Out of these 213 species belonging to 32 families are reported from Trans-Himalaya region.

Order SIPHONAPTERA
(Fleas)

Siphonaptera includes small, secondarily wingless insects known as fleas. The females feed on the blood of its host before laying fertile eggs. They are most abundant in the tropics but also occur in the temperate and even in the Polar Regions. Himalaya has the diversity of 38 species belonging to 22 genera under seven families (Chandra *et al.,* 2018). From Trans-Himalaya 14 species belonging to 5 families have been recorded, out of these 4 species are from Ladakh.

SUMMARY AND CONCLUSION

The taxonomy of Indian Trans-Himalaya is passing through its transitional phase as species lists from India have been changing with the levels of morphological resolutions and current updates from global knowledge. It is also interesting to observe that out of 26 orders of insects from the plains of India and 21 orders recorded from Indian Trans-Himalaya (1A, 1B & 1C), the orders Hemiptera, Hymenoptera, Trichoptera, Coleoptera, Lepidoptera, and Diptera found to be dominant insect orders in this region. The future research priorities should focus on exploration of under unexplored areas, especially Trans-Himalaya, DNA barcoding studies to delineate species boundaries, establish species biology studies. The development of adequate taxonomic expertise, a national depositary and collaborative efforts are keys to future biodiversity exploration in Trans-Himalaya.

Table 1 : List of Insects orders present in Indian Trans-Himalaya

Sl. No.	Name of the Order	Number of Families	Number of Genera	Number of species distribution in Indian Geographical Region 1A, 1B & 1C
1.	Archaeognatha (Thysanura)	01	01	01
2.	Ephemeroptera	05	07	13
3.	Odonata	09	26	47
4.	Orthoptera	02	15	24
5.	Phasmida	01	01	01
6.	Embioptera	01	01	01
7.	Plecoptera	04	06	15
8.	Dermaptera	01	01	07
9.	Mantodea	02	02	04
10.	Blattodea	01	02	03
11.	Psocodea	03	05	07

Table 1 contd.

Sl. No.	Name of the Order	Number of Families	Number of Genera	Number of species distribution in Indian Geographical Region 1A, 1B & 1C
12.	Phthiraptera	06	14	46
13.	Thysanoptera	3	6	88
14.	Hemiptera	41	155	648
15.	Hymenoptera	35	215	585
16.	Coleoptera	16	33	93
17.	Neuroptera	01	01	01
18.	Trichoptera	10	12	170
19.	Lepidoptera	12	63	280
20.	Diptera	6	40	213
21.	Siphonaptera	02	04	14

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Hymenoptera

Orthoptera

Dermaptera

Diptera

Odonata

Coleoptera

Diptera

Orthoptera

Lepidoptera (moth)

Coleoptera

Neuroptera

Hymenoptera

Chapter 6

INSECTA : EPHEMEROPTERA

T. KUBENDRAN, AVTAR KAUR SIDHU, KAILASH CHANDRA* and AKHIL NAIR

In total 5 families under which Trans-Himalayan Ephemeroptera occur are Ameletidae (1 species under 1 genera); Ephemerellidae (2 species under 2 genera); Heptageniidae (1 species under 1 genera); Caenidae (1 species under 1 genera) and Baetidae (3 species under 2 genera). There is a big knowledge gap on diversity of mayflies of Himalayan zone in our country and Trans-Himalaya is no exception. Present checklist of around 8 species of the Ephemeroptera recorded so far in Trans-Himalaya and highlights the aspects of investigation mainly to fine tune the species limits with emphasis on larval stages which are rendering crucial ecosystem services in lentic and lotic aquatics.

Keywords: mayfly, aquatic insects, ecosystem services, Trans-Himalaya

INTRODUCTION

The mayflies or Ephemeroptera are a small but significant order of the most primitive winged insects living since Carboniferous or Permian times, having a worldwide distribution. They can reasonably consider as "flying Thysanura", and almost certainly derived from lepismatoid origins (Edmunds, 1972). The Trans-Himalaya is that of a tableland or plateau intersected by a complex network of barren mountain ranges like Zanskar, Ladakh and Karakoram ranges in Ladakh and Kargil areas. The altitude gradients vary from 2800 m to 7000 m asl between Indus Valley and the Himalayan Karakoram ranges (Metha and Julka 2009).

The Ladakh and Kargil region is drained by the major river Indus. The Ladakh occupies very large brackish water lakes namely Pangong Tso, Tso Morari, Tso Kar etc. This area also harbours some vast fresh water marshes in the River Valley. There are several glaciers of various sizes in the upper slopes of mountain ranges (Metha and Julka, 2009). Though of cosmopolitan distribution, Ephemeroptera apparently reach their maximum development in temperate and mountainous areas. Relatively few species are known to inhabit the nival zone of the North-West Himalaya, but the order flourishes almost up to the permanent snow-line. Unlike those in the plains, the larvae of the nival mayflies are almost exclusively inhabitants of the torrential streams and enormous numbers of them are found clinging to submerged stones.

Only very exceptionally the larvae of one or two species on the submerged stones near the shore of shallow ponds and lakes in exposed and wind-blown localities, where the wind ensures constant movements of the water. The larvae move but little, since even near the shore the force of the current in the torrential streams is very strong. The free tracheal gill lamellae are relatively small and immovable. The most optimum temperature for mayflies larvae to lie below 8° C. The larvae feed on rich algal slime growing on the surface of the submerged stones and rocky bottoms, but often also turn into detritus and occasionally predatory feeders. Hibernation is usually in the larval stage. The development may be completed within a single summer, especially immediately above the tree-line, but usually takes two or even three years. The subimago may often be found in amazingly large numbers during June and, all on a sudden on a calm sunny afternoon, huge swarms of the adult mayflies emerge. The next morning the snow-fields might be littered with immense number of the dead mayflies to be devoured by various kinds of predators and carrion feeders (Mani, 1961). Dankes (2006) studied the behavior of water and ice within an insect depends on water status and availability. The water can be closely associated with biological structures and surfaces and storage water not closely associated with the

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (HP)
*Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053 (WB)
Email: tkbaetis@gmail.com; avtarkaur2000@gmail.com; kailkash616@gmail.com

Citation
Kubendran, T., Sidhu, A.K., Chandra, K. and Nair, A. 2019. Insecta : Ephemeroptera. In: *Faunal Diversity of Biogeographic Zones* : *Indian Trans-Himalaya*: 45-48. (Published by the Director, Zool. Surv. India, Kolkata)

cells. Ice is another important state in freezing tolerant spices. Typically water and insect are in dynamic balance among the various states, depending on the condition of the insect and the nature of the environment.

Globally, about 3,000 described valid species in 400 genera 42 families (Barber-James *et al.,* 2006). The ephemeropteralogist knowledge of High Altitude Ephemeroptera of Himalaya is comprised of 49 species under 26 genera and 7 families. Current status of ephemeropteran fauna of India is represented by 4 suborders, 13 families, 58 genera and 146 species (Subramanian *et al.,* 2017; Selvakumar 2018). Trans-Himalaya 8 species belonging to 7 genera and 5 families described so for.

HISTORICAL RESUME

Pioneering workers such as Bengtsson, (1914) described *Cloeon inscripum* belonging to the family Baetidae; Brodsky, (1930) originally described *Drunella traverae* later this species synonymed in to *(Drunella) submontana* belonging to the family Ephemerellidae; followed by Traver, (1939) described *Ameletus primitives* belonging to family Ameletidae; *Caenis srinagari* belonging to the family Caenidae; *Baetiella ladakae* and *Cloeon kashmiri* belonging to the family Baetidae; Braasch and Soldan (1982) described *Epeiron kashmirensis* belonging to the family Heptageniidae. Most of the species reported from Trans-Himalaya are known from a single collection and there are no recent studies on this order.

LIFE CYCLE

Emergence: The uptake of food stops in the last larval instar, the alimentary canal and malpighian tubules will get degenerate, the former of the leg fills up with water and later with air to develop into an aerostatic organ. During this period, increases oxygen uptake and drift activity. Subimago, leave the larval skin by rupturing the mesonotal cuticle along the midline, which is completed in 10-15 minutes. The subimago, depending upon the species emerge either from the water surface, above water or underwater. Temperature and light intensity influence the metamorphosis. In tropical region, most of the species emerge within two hours after sunset. Swarming: Conspicuous mating swarms of males are typical of mayflies. The mating swarm typically consists of several specimens to thousands of individuals. They swarm over land marks such as vegetation, rock, bush, tree, shore line, bridge, road etc. Typically tropical species swarm during night. However, in the high altitudes of Himalaya and Western Ghats swarming is also observed in the afternoon. Mating: Mating usually takes place in flight which lasts from a few seconds to several minutes. Oviposition: Eggs are always deposited in water. Larval stages: Species are morphologically adapted to current velocity which includes hydrodynamic body shape, stabilizing and retention structures, friction discs, sclerotized gill margins with microtrichia or suckers formed by gills. Adult stage: Adult mayflies do not feed and reproduction and dispersal are the sole functions of adults. Longevity: The lifespan of typical adult mayflies usually lasts for 24 hours (Subramaniam *et al.,* 2017).

ROLE IN FOOD CHAINS

The plants utilize energy from the sunlight and convert it into energy molecules like sugars. Mayflies are central to the flow of energy within and between aquatic and terrestrial ecosystems, because they generally feed on fallon plant material that is grazers or detritivores, incorporating this energy into their own bodies. As mayfly is semi-aquatic, it lives in the aquatic ecosystem and then moves away and flies in the terrestrial environment. Mayflies of adult provide vital food for wide range of predatory species (e.g. birds and their young). Without this link, many species (e.g. birds and their young) would be unable to benefit from the energy that plants trap from sunlight (McCafferty, 1981).

DETAILED OBSERVATIONS

Srivastava, (1983) reported mayfly fauna of India from high altitude is approximately 4% of known Indian ephemeropterans being 31: 146. Most of these species occur in the range of 3000-4000 meters. A few though found in transitory altitude of 2000-3000 meters are also included in present consideration as they do belong to torrential streams of Himalayan mountain ranges. In total 5 families under which Trans-Himalayan Ephemeroptera occur are Ameletidae (1 species under 1 genera); Ephemerellidae (2 species under 2 genera); Heptageniidae (1 species under 1 genera); Caenidae (1 species under 1 genera) and Baetidae (3 species under 2 genera) so far.

ENDEMISM

Ephemeroptera fauna of India, a country endowed with two mega diversity hotspots, appears to be an assemblage of ancient Gondwanan derivatives, with a high percentage of endemism, a few Laurasian spillovers, along with some younger faunal elements that might have diversified in several spells at different periods in geological history by vicariant and dispersal events, through "out of India and towards India" exchanges between Indian Subcontinent on the one hand and Afrotropics including Madagascar, Oriental Southeast Asia and Palearctic North on the other. Due to poor dispersal ability of adults, most of the mayfly species have restricted distribution. Generally, species of lakes, ponds and other lentic habitats have wide distribution when compared to the species of lotic habitats (Sivaramakrishnan, 2016; Selvakumar, 2018).

CONSERVATION AND SIGNIFICANCE

In aquatic insects, Ephemroptera fauna are an important group, especially in lotic and lentic habitats. They have a significant role in food chain of the wetland ecosystem. The larvae and adults are prey for many species of invertebrate (Dragonflies) and vertebrate (Fishes and Bats) predators. In addition to the role in wetland ecosystem function, their value as indicators of quality of the biotope is very well recognized. Studies across the world have shown that mayflies are very sensitive bioindicators of aquatic pollution and how species assemblages change with levels of human disturbance. Mayflies found at undisturbed habitats with less pollution and good riparian vegetation were specialists with narrow distribution. On the other hand, species recorded at industrial or urban areas with polluted wetlands and disturbed riparian vegetation were generalists with wide habitat preference and distribution. These studies also show that mayflies are sensitive not only to the quality of the wetland but also to the major landscape changes, especially changes in the riparian zone. They are ideal objects for integrated phylogenetic, biogeographic and phylogeographic studies, being endowed with several archaic traits in all life stages along with rather weak dispersal powers. Many of the montane mayflies, both larvae and adult are equally charismatic.

Presently, there is a biodiversity crisis due to mainly erratic climate change and habitat destruction worldwide. We are in the midst of sixth anthropogenic megaextinction and the impact is deeply felt in fragile freshwater ecosystems. In this context, we have to leave no stone unturned in our efforts to conserve aquatic mega and microfauna. Ephemeroptera or mayflies, an important component of aquatic entomofauna, along with stoneflies (Plecoptera) and caddisflies (Trichoptera), are vital components of fish food chain, are sensitive bioindicators of aquatic pollution and are ideal objects of biogeographic analysis. Hence, they need in-depth taxonomic investigation in tune with state-of-art situation in developed countries of the temperate belt. There is a big knowledge gap on diversity of mayflies of Himalayan zone in our country and Trans-Himalaya is no exception. Present checklist of around 8 species of the Ephemeroptera recorded so far in Trans-Himalaya and highlights the aspects of investigation mainly to fine tune the species limits with emphasis on larval stages which are rendering crucial ecosystem services in lentic and lotic aquatics.

FUTURE DIMENSIONS

Sivaramakrishnan (2016) suggested the following salient feature to young mayfly researchers towards future studies on mayfly systematics in India should focus on: 1. Intensive explorations in unexplored and under-explored areas, primarily to avoid bias in understanding patterns of mayfly species diversity and distribution; 2. Larval-adult associations employing modern molecular techniques; 3. Species delimitation fine-tuning and unraveling the mysteries of intra specific genetic diversity; 4. Combined molecular and morphological systematic and phylogenetic studies; 5. Molecular phylogeography of genera representing ancient evolutionary lineages; 6. Study of cryptic variation in species inhabiting evolutionary refugia, ecological refuges and in crucial ecological indicator taxa; and 7. Study of impacts of habitat fragmentation, climate changes and anthropogenic pollution on present mayfly genus and species composition; range contractions and range extensions of imperiled species and those vulnerable to extinction especially due to genetic erosion in lotic and lentic aquatics in different biogeographic regions of India.

Table 1 : High Altitude Ephemeroptera diversity across family and genera of Indian Trans-Himalaya

Sl. No.	Family	Genus	Species	Described life stages (L, SI, I)	Type Locality
1	Ameletidae	*Ameletus*	*Primitives* (Traver, 1939)	♀ subimago; imago	Kyam, Igu Ladak, J&K
2	*Ephemerellidae*	*Drunella*	*submontana* (Brodsky, 1930)	♂&♀ Larvae	East of Nurla, J&K
3		Epeiron	*kashmirensis* (Braasch & Soldan, 1982)	♂ subimago	Daksun, J&K
4	*Heptageniidae*	*Ororotsia*	*hutchinsoni* (Traver, 1939)	♀ imago	Ororotse Tso J&K
5	*Caenidae*	*Caenis*	*srinagari* (Traver, 1939)	♂ subimago & ♀ imago	Gagirbal, J&K
6	Baetidae	*Baetiella*	*ladakae* (Traver, 1939)	♂imago	Igu Ladak, J&K
7		*Cloeon*	*kashmiri* (Traver, 1939)	♂ imago & ♀ imago	Sumbal & Wular Lake, J&K
8		*Cloeon*	*inscripum* (Bengtsson, 1914)	♂ imago & ♀ Larvae	Nurba Valley, J&K

Baetiella sp. Traver, 1939

Drunella submonata Brodsky, 1930

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Chapter 7

INSECTA : ORTHOPTERA

KAMAL SAINI

In the present study documented 24 species of Orthoptera in typical cold deserts of India. It is also observed that there is rapid decrease in the numbers and the species as the altitude increase. The ectothermic nature of grasshopper makes them the good biodiversity indicator of minor climate changes in the Trans-Himalayan region. The grazing in the pastures and scrubland of cold desert are the major threat to grasshopper population in the area.

Keywords: bio indicator, diversity, climate changes, cold deserts

INTRODUCTION

The Orthoptera are the primary herbivorous insects. They generally feed on vegetation and their tastes stimulate the specific foliage selection. Some grasshoppers are the pest of seedlings and saplings of forest nursery. Worldwide Acrididae are branded as locust during sympathetic condition of temperature, humidity and chow. Adaptation at cold temperature and low oxygen level makes them atypical cold desert insects. Orthoptera are ground loving with mandibulate mouth appendages, leathery forewing (tegmina), powerful hind legs and incomplete metamorphosis insects. They reproduce nymph which grow to be adult after five molting in life cycles (Pfadt, 2002). They are of two type's *i.e.* short horned and long horned including grasshopper, crickets and katydids. Jumping ingenuity and astonishing singing talents make them important module of the ecosystem. Listing abilities in Orthoptera are quite specific as their ears are present on the abdomen in grasshoppers and on front legs in cricket and katydids (Robinson and Hall, 2002). Since immortal they are recognized for economic consequence insects. Swarming condition of some species are highly destructive in some part of the country. In 2006-2008 *Locusta migratoria* Linnaeus infestation was reported from Chushul and Changthang area of Cold Desert Ladakh and cause rigorous damage in the area (Chandra and Sidhu, 2009). In high altitude areas family Acrididae is the dominant inhabitant. The utmost elevation at which these insects have been found in North West Himalaya is between 4775 and 4875 meter above sea level (Mani, 1968). In the present study, it is observed that there is rapid decrease in the numbers and the species as the altitude increase. Numerous other studies also advocate the descending trend in species richness with altitude (Kikkawa and Williams 1971; Hagvar, 1976; Wolda 1987; Bruhl, *et al.,* 1999).

Presently 28,142 validated Orthopteran species are available throughout the world (Cigliano *et al.,* 2018), in India 1033 species are enumerated by Shishodia *et al.* (2011). Since accessibility to this region, many enthusiastic workers like Mani (1954), Pruthi (1957), Kapur (1958), Bhowmil (1983), Bhowmik and Halder (1985), Ingrisch (2002), Thakur and Mattu, (2006), Shishodia (2008), Chandra and Sidhu (2009), Azim and Reshi (2010), Veer *et al.* (2013) and Gupta and Chandra (2018) worked in Trans-Himalayas.

AGEING IN ORTHOPTERA

Ageing start since inception and end at the death. Orthopetrans are average life span insects, with total life of 45-60 days. They reproduce once in a year except locust. Male produce a courtship call and female orthopterans lays egg into the soil or foliages. Acrididae lays egg in egg pod and Tettigoniididae lays single eggs. Eggs remain in diapauses condition for snow times and hatching occurs from June-August.

THERMOREGULATION BEHAVIOR

Orthopetans are ectotherms insects and they depend on external source of energy/temperature to start their

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (HP)
Email: zsikamal@gmail.com

Citation
Saini, K. 2019. Insecta : Orthoptera. In: *Faunal Diversity of Biogeographic Zones* : *Indian Trans-Himalaya*: 49-52. (Published by the Director, Zool. Surv. India, Kolkata)

daily activities in winter or low temperature. They can't produce energy themselves. To combat this situation they wait for sun rise to receive radiant sunrays to warm up or basking or dilate their body vessels to move in and out of shrubs (Pfadt, 2002). As ectotherm they are very sensitive to change in the micro climatic condition of living ecosystems.

IMPORTANT FAMILIES IN TRANS-HIMALAYA

Distribution of grasshoppers is dearth in the high altitude area, but the study revealed the following families present in the area. Acrididae: Short horned grasshoppers, Greek *akris* means Locust so also known as locust family. Gryllidae: True or field Crickets, mainly residing in winter houses and pest on stored vegetables. Tettigoniidae: Long horned Grasshoppers or Bush crickets mainly nocturnal.

NATURAL PREDATORS OF ORTHOPTERA

They are strong linker of food chain to maintain the prey-predator relationship in the ecosystem. The main predators are arthropods like spiders, mantis etc. In vertebrate's lizards (Reptilian) & insectivores birds feeds on the grasshopper as main food. They are rich sources of protein.

CONSERVATION AREA SURVEYED IN TRANS-HIMALAYA

Present work contributed by the authors on his survey conducted in the Trans-Himalaya region and important conservation area of cold desert Ladakh & Spiti Valley *i.e.* Pin Valley National Park, Kibber Wildlife Sanctuary, Hemis National Park and Changthag Wildlife Sanctuary.

ENDEMIC SPECIES

No doubt half of the orthoptera species are endemic to the Trans-Himalayan region due to sever ecological and environmental circumstance (Chandra and Sidhu, 2009). The confluences of Palearctic and Oriental fauna are also a major limited factor in endemicity of the grasshopper.

SIGNIFICANCE OF ORTHOPTERA IN TRANS-HIMALAYA

Grasshoppers are found in two life phases *i.e.* solitary and gregarious. In general the maximum species are in solitary phases and not damage to agriculture and forest. The gregarious phases are exclusive pest on primary productivity of nature. The pests are famous as locust. The only locust species significantly affected the Trans Hinmalyan region is *Locusta migratoria* Linnaeus. Beside the locust grasshopper are good foods for insectivores birds of Himalaya. The ectothermic nature of grasshopper makes them the good biodiversity indicator of minor climate changes in the Trans-Himalayan region. The grazing in the pastures and scrubland of cold desert are the major threat to grasshopper population in the area. Inspite of the wealth indicator of ecosystem they are also the lucky charm of the human beings.

Table 1 : Orthoptera species diversity in Indian Trans-Himalayas

Sl. No.	Genus/Species	Distribution	Habitat	Reference
1	*Acrida exaltata* (Walker, 1859)	(1B, 1C)	Grassland	Gupta & Chandra (2018)
2	*Phlaeoba infumata* Brunner von Wattenwyl, 1893	(1B)	Wild fields	Gupta & Chandra (2018), Saini (2018)
3	*Phlaeoba panteli* Bolivar, 1902	(1B)	Wild fields	Gupta & Chandra (2018)
4	*Locusta migratoria* Linnaeus, 1758	(1A)	Scrub vegetation	Veer *et al,* 2013
5	*Truxalis nasuta* (Linnaeus, 1758)	(1B)	vegetation	Gupta & Chandra (2018)
6	*Acorypha glaucopsis* (Walker, 1870)	(1B)	Wild fields	Gupta & Chandra (2018)
7	*Indomerus noxius* Drish, 1951	(1B)	Wild fields	Gupta & Chandra (2018)
8	*Diabolocatantops innotabilis* (Walker, 1870)	(1B, 1C)	Wild fields	Gupta & Chandra (2018)
9	*Diabolocatantops pinguis* Stal, (1861)	(1B)	Wild fields	Gupta & Chandra (2018)
10	*Bryodema luctuosa indicus* Saussure, 1884	(1B)	Low oxygen area	Chandra & Sidhu (2009), Saini (2018)
11	*Gastrimargus africanus africanus* (Saussure, 1888)	(1B, 1C)	Vegetation	Gupta & Chandra (2018)
12	*Gastrimargus africanus sulphureus* Bey-Bienko, 1951	(1B)	Stony vegetation	Thakur & Mattu (2006)

Table 1 contd.

Sl. No.	Genus/Species	Distribution	Habitat	Reference
13	*Gastrimargus marmoratus* (Thunberg, 1815)	(1B)	Stony vegetation	Gupta & Chandra (2018)
14	*Heteropternis respondens respondens* (Walker, 1859)	(1B, 1C)	Wild fields	Gupta & Chandra (2018)
15	*Paraconophyma scabra* (Walker,1870)	(1B)	Wild fields	Thakur & Mattu (2006)
16	*Oedaleus abruptus* (Thunberg, 1815)	(1B)	Vegetation	Gupta & Chandra (2018)
17	*Sphingonotus longipennis* Saussure, 1884	(IB, IC)	Scrub High Lands	Shishodia (2008), Saini (2018)
18	*Sphingonotus savingnyi* Saussure, 1884	(1A)	Dry land	Chandra & Sidhu (2009)
19	*Sphingonotus rubescens fallax* Mishchenko, 1937	(1A)	Dry land	Chandra & Sidhu (2009)
20	*Trilophida annulata* (Thunberg, 1815)	(1B, 1C)	Dry land	Gupta & Chandra (2018)
21	*Spathosternum prasiniferum prasiniferum* (Walker, 1871)	(IB, IC)	Dry land + Vegetation	Saini (2018)
22	*Atractomorpha crenulata crenulata* (Fabricius, 1793)	(1B, 1C)	Vegetation	Gupta & Chandra (2018)
23	*Gryllus (Gryllus) bimaculatus* De Geer, 1773	(1B)	Under stone near human vegetation	Saini (2018)
24	*Oedipoda himalayana* Uvarov, 1925	(1B)	Vegetation	Shishodia (2008)

Bryodema luctuosum indum Saussure, 1884

Gryllus bimaculatus De Geer, 1773

Locusta migratoria Linnaeus, 1758

Sphingonotus longipennis Saussure, 1884

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Chapter 8

INSECTA : PLECOPTERA

T. KUBENDRAN, AVTAR KAUR SIDHU., AKHIL NAIR and KAILASH CHANDRA*

Stoneflies are an essential component of the aquatic biodiversity of high elevation montane streams and rivers of India, being sensitive biological indicators of water quality and assessing the regional effects of climate change along with mayflies and caddisflies. The current status of Plecoptera diversity in Indian Trans-Himalaya is 10 species belonging to 6 genera and 4 families. Future research should focus on unexplored regions, DNA barcoding studies to delineate species boundaries, establish larva-adult associations and species biology studies.

Keywords: Stoneflies, Indian Trans-Himalaya, biological indicators

INTRODUCTION

Plecoptera are essentially a Holarctic order and are particularly abundant on mountains (Mani, 1962). It is a small monophyletic order of hemimetabolous insects. They are commonly called stoneflies. For a very long time, stoneflies have been the subject of scientific study in Europe. The first species was described by Linnaeus in 1758 and placed within the genus *Phryganea* of the order Trichoptera. The order name Plecoptera was propsed by Burmeister in 1839. The order name Plecoptera comes from the Latin "plecto", meaning folded or plaited and the Greek "pteron" meaning feather or wing, and refers to the ability of the adult to fold its wings over their back. Species diversity of Plecoptera is highest in cold, fast flowing and rocky streams (Sivec and Yule, 2004). In globally 3625 species are described under 303 genera and 16 families (De Walt *et al.,* 2017). Stonefly fauna of India encompasses 128 species, 24 genera and 8 families with 91 endemic species (Babu *et al.,* 2017). Plecoptera diversity in the Indian Himalaya is 89 species belonging to 23 genera under 8 families. Trans-Himalaya includes 10 species belonging to 6 genera and 4 families are recorded (Selvakumar, 2018).

Stoneflies are significant ecological component of running water ecosystems and distributed over all continents except Antarctica (Fochetti and Tierno de Figueroa, 2008). Stonefly larvae are generally found in high altitude streams of cold temperate streams though some genera have penetrated to the cool areas of subtropics and tropics. The larvae are distributed in stony streams attached to the surfaces of boulders and the adults are found near the streams or on tree trunks, stones and bushes. They are not conspicuous insects except the Chloroperlidae which are bright green in colour. The larvae play vital role in the food chain of freshwater ecosystems. Adults are week fliers and prefer to run to elude predators. They are diurnal except a few species of Setipalpia which are nocturn*al.* Food of the adults consists of algae, lichen and foliage though many species may not feed at all as adults and live only for a few weeks. The composition of stonefly fauna varies in different seasons and in different habitats. Brachyptery or winglessness is usually found during the winter season.

Plecoptera are amphibiotic insects and their aquatic larvae need cold and well aerated fresh water. They are therefore confined to the torrential streams of melt water. While the mayflies are common enough even near sea level in various parts of India, the stoneflies are almost absent in the plains, but come to occupy a conspicuous place in the nival fauna. They are extremely abundant in streams immediately below the permanent snow and ice. The temperature of the water, optimal to the stonefly larvae in the North West Himalaya lies between 4°C and 8° C. though many species remain normally active even at temperatures in the neighborhood of 1.5°C, temperatures of about 10-12°C usually prove lethal to most larvae. This pronounced cold stenothermy is a characteristic of Plecoptera in all parts of the world and it has been reported

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (HP)
*Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053 (WB)
Email: tkbaetis@gmail.com; avtarkaur2000@gmail.com; kailkash616@gmail.com

Citation
Kubendran, T., Sidhu, A.K., Nair, A. and Chandra, K. 2019. Insecta : Plecoptera. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 53-56. (Published by the Director, Zool. Surv. India, Kolkata)

that adult stoneflies usually emerge in the coldest part of the year in North America (Dodds and Hisaw, 1925; Frison, 1929; Jewett and Stanley, 1959).

ADAPTATIONS IN COLD DESERT

The filamentous gills, found in the neck, on the sides, prosternum or coxae of the legs, are poorly developed when compared to those of the species that occur exclusively within the taiga zone in the Himalaya, where the current in most streams is never as fast as in the nival zone. The larvae of most species in the nival zone are phytophagous and feed on the algal slime on submersed stones; but many are typically carnivorous and predate upon numerous other aquatic insect larvae, hydracarina and also often on the mayfly larvae. In some cases they are unquestionably omnivorous. Hibernation in winter is in the second larval stage, but nearly every stage of the larva is capable of passing into hibernation. Though some species complete a generation within the year, especially in the zone immediately above the timber-line, most other species require two or even three years to complete a generation. The subimago apparently waits for days in summer, ready to emerge as an adult. The emergence of the adult takes place late in the afternoon or early in the evening and always synchronizes with an abrupt cessation of the constant howling wind. The adults are short lived, but many survive longer than adult mayflies. After mating, many of the females may be found crawling into the edges of the icy cold torrents for egg laying. There is a phenomenal increase of the dead stoneflies after the emergence of adults on grassy meadows and snow-fields and a marked increase in the food supplies of numerous carnivorous species. The aquatic larvae are hunted by Himlayan dipper (Mani, 1962).

BIO-MONITORING POTENTIAL

Stoneflies are an essential component of the aquatic biodiversity of high elevation montane streams and rivers of India, being sensitive biological indicators of water quality and assessing the regional effects of climate change along with mayflies and caddisflies. Accurate identification of stoneflies and other aquatic insects is crucial for employing biotic indices as sensitive tools in bio-monitoring. Unfortunately, larvae and female specimens of stoneflies are very difficult to identify to species level which precisely compromises our ability to accurately assess water quality and to conduct ecological and conservation assessments of individual species (Gattolliat *et al.,* 2016).

HISTORICAL RESUME

Needham (1909) was the first American entomologist who worked on Indian Plecoptera. Taxonomic publications regarding Indian Trans-Himalayan species of Plecoptera includes 10 species belonging to 6 genera and 4 families. Pioneering workers such as Samal, (1935) described *karakorum* belonging to the family Taeniopterygidae; Kimmins, (1946) described *pedestris,* Zhiltzova, (1969) described *longicauda,* Jewett, (1960) described *gibbera* belonging to the family Capniidae; Jewett, (1958) described *tricantha,* Aubert, (1959) described *skardui,* Aubert, (1959) described *lilami and polystigma* belonging to the family Nemouridae; Aubert, (1959) described *kishanganga,* Zwick and Sivec, (1980) *acuta* belonging to the family Chloroperlidae. Checklist of Indian stoneflies was published by Chandra and Sharma (2009b). Sivaramakrishnan *et al.* (2011) provided brief conspectus and research priorities on Plecoptera (stoneflies) of India.

THREATS AND CONSERVATION

Stoneflies are very sensitive to pollution and other anthropogenic disturbances in streams flowing through natural riparian zones. Long-term conservation of stoneflies depends upon conservation of natural riparian vegetation and prevention of human influenced alteration of lentic and lotic habitats. Extensive exploration in developed nations undoubtedly reveal that stonefly species have vanished from parts of landscape and in the context of absence of extensive survey of stoneflies in many eco-regions of India, we really do not know how many of our stonefly species have become locally extinct and how many species are really threatened. Improvements in water and land management may bring them back through natural decolonization (Babu *et al.,* 2017; Selvakumar, 2018). Though holistic study of freshwater biota is far more desirable compared to taxon focused ecology. Stoneflies warrant attention as vital components of lotic zoo-benthos since they also provide different environmental information than other aquatic insect orders (Heino *et al.,* 2003; Park *et al.,* 2003).

Table 1a : Number of genera and species of order PLECOPTERA recorded from Indian Trans-Himalaya

Sl. No.	Family	Genera	Species
1.	Family Capniidae (Banks, 1900)	1	3
2.	Family Nemouridae (Newman, 1853)	3	4
3.	Family Taeniopterygidae (Klapálek, 1905)	1	1
4.	Family Chloroperlidae (Okamoto, 1912)	1	2
	Total	**6**	**10**

Table 1b : List of the species of the order Plecoptera (Stoneflies) recorded from Indian Trans-Himalaya

Sl. No.	Name of the Species
	Order PLECOPTERA Suborder ARCTOPERLARIA Superfamily NEMOUROIDEA Newman, 1853
1.	Family CAPNIIDAE (Banks, 1900) *Capnia gibbera* (Jewett, 1960)
2.	*Capnia longicauda* (Zhiltzova, 1969)
3.	*Capnia pedestris* (Kimmins, 1946)
4.	Family NEMOURIDAE Newman, 1853 *Amphinemura tricantha* (Jewett, 1958)
5.	*Mesonemoura skardui* (Aubert, 1959)
6.	*Illiesonemoura lilami* (Aubert, 1959)
7.	*Illiesonemoura polystigma* (Aubert, 1959)
8.	Family TAENIOPTERYGIDAE Klapálek, 1905 *Mesyatsia karakorum* (Samal, 1935)
9.	Family CHLOROPERLIDAE Okamoto, 1912 *Xanthoperla kishanganga* (Aubert, 1959)
10.	*Xanthoperla acuta* (Zwick, 1980)

Neoperla sp. Zwick, 1981

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Chapter 9

INSECTA : HYMENOPTERA (EXCLUDING ANTS)

P.M. SURESHAN and P. GIRISH KUMAR

In the present chapter, compiled 400 species of hymenopteran insects (except ants) from the Indian Trans-Himalayan region which consists of 36 families, 76 genera and 400 species under 11 superfamilies. The family Braconidae is the largest family with 54 species from the Indian Trans-Himalaya. The other largest families are Apidae (49 species), Tenthredinidae (38 species), Ichneumonidae (35 species), Vespidae (34 species), Halictidae (26 species), Pteromalidae (20 species) and Eulophidae (18 species). Among hymenoptera, the bees are dominating, followed by the parasitic and predatory forms and phytophagous forms.

Keywords: Apidae, hymenoptera, diversity, Trans-Himalaya

INTRODUCTION

The Trans-Himalaya or Cold Desert is characterized by its peculiar topography and harsh climatic conditions. The fauna of the region is very distinct and unique due to its location being at the confluence of the Palearctic and the Oriental Regions. High level of endemism and species richness occurs in the area and Palearctic elements dominate in the fauna of the region followed by the local endemics and Oriental elements (Mani, 1974). The insect order Hymenoptera dominates the entomofauna of Trans-Himalayan region and they are mainly active during the short summer periods. As in other terrestrial ecosystems, Hymenoptera play an important role in the agroecosystems of this region as pollinators, predators, seed dispersers and parasitoids. Bees and wasps are the main pollinating insects in the Trans-Himalaya followed by flies. Among the bees, family Apidae (honey bees, bumble bees and carpenter bees), Megachilidae (leaf cutter bees), Anthophoridae (cuckoo bees and digger bees) are commonly occurring in the area. When compared to the social bees, the diversity of solitary bees is high in the region. Most of the bees apparently make their nests in the holes of dead trees, rock crevices and underground holes, thereby avoiding exposure to the harsh climatic conditions prevailing in the area (Sureshan, 2009). In this paper, we compiled 402 species of hymenopteran insects from the Indian Trans-Himalayan region which consists of 36 families, 76 genera and 400 species under 11 superfamilies.

HISTORICAL RESUME

Bingham (1897 & 1903) did the first in-depth works in Hymenoptera of the Indian subcontinent which covered the Himalayan fauna also. Recently, Saini *et al* (2006) published a checklist of Indian Sawflies in which they listed all the Trans-Himalayan species of sawflies. Sureshan (2010 & 2012), Narendran (2011) and Narendran *et al.* (2013) reported parasitic wasps of the superfamily Chalcidoidea from Ladakh of the Trans-Himalaya including many new species. Rajmohana *et al.* (2018) recently compiled the data of Hymenoptera of Indian Himalaya in which they listed all Trans-Himalayan species so far reported. Other major works consulted for compiling the Trans-Himalayan species are Bohart and Menke (1976), Gupta and Tikar (1976), Gupta and Maheswari (1976), Jonathan (1980), Gupta and Gupta (1983), Das and Gupta (1989), Gupta and Jonathan (2003), Gupta (2003a; 2003b), Lelej (2005), Deans (2005), Rajmohana and Bijoy (2012), Saini and Vikram (2012), Noyes (2018).

SUMMARY

In this paper, we compiled 400 species of hymenopteran insects from the Indian Trans-Himalayan region which consists of 36 families, 76 genera and 400 species under 11 superfamilies. The family Braconidae is the largest family with 54 species from the Indian Trans-Himalaya. The other largest families are Apidae (49 species), Tenthredinidae (38 species), Ichneumonidae (35 species), Vespidae

Western Ghat Regional Centre, Zoological Survey of India, Kozhikode-673 006 (KL)
Email: pmsuresh43@yahoo.com

Citation
Sureshan, P.M., Girish Kumar, P. 2019. Insecta : Hymenoptera (Excluding Ants). In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 57-72. (Published by the Director, Zool. Surv. India, Kolkata)

(34 species), Halictidae (26 species), Pteromalidae (20 species) and Eulophidae (18 species). Since the number of pollinator species are very limited in the harsh conditions of Trans-Himalaya, insects especially Hymenoptera have to play great role in the production food in a short period of cropping season. Among hymenoptera, the bees are dominating, followed by the parasitic and predatory forms and phytophagous forms.

Table 1a : Systematic account of Hymenoptera (excluding ants) found in the Indian Trans-Himalaya

Sl. No.	Family	Subfamily	Genus/Species
1.	Tenthredinidae	Allantinae	*Athalia antennata* Cameron
2.			*Athalia circularis* (Klug)
3.			*Athalia kashmirensis* Benson
4.			*Athalia nigromaculata* Cameron
5.			*Athalia pahalgamensis* Saini & Deep
6.			*Athalia rosae ruficornis* (Jakovlev)
7.			*Athalia sikkimensis* Benson
8.			*Hennedyella athaloides* Forsius
9.			*Hypsathalia przewalskyi* (Jakovlev)
10.		Dolerinae	*Dolerus ferrugenosa* (Saini & Singh)
11.			*Dolerus infuscatus* (Saini & Singh)
12.			*Dolerus kashmirensis* (Cameron)
13.			*Dolerus nigripleuris* Saini & Vasu
14.			*tangmargensis* Saini & Singh
15.		Nematinae	*Megadineura himalayana* Benson
16.		Tenthredininae	*Pachyprotasis caerulescens kashmirica* Malaise
17.			*Pachyprotasis pallens* Malaise
18.			*Tenthredo abdominalis* (Matsumura)
19.			*Tenthredo asperata asperata* (Konow)
20.			*Tenthredo asperata kashmirensis* Malaise
21.			*Tenthredo assamensis* Konow
22.			*Tenthredo felderi* Radoszkowsky
23.			*Tenthredo foveolata* Saini & Vasu
24.			*Tenthredo gulmargi* Singh & Saini
25.			*Tenthredo hymalayensis* (Radoszkowsky)
26.			*Tenthredo infucubitus* Saini & Vasu
27.			*Tenthredo karakorumensis* (Forsius)
28.			*Tenthredo kashmirica* Malaise
29.			*Tenthredo nigromaculata* Smith
30.			*Tenthredo nigrorufusata* Saini & Bharti
31.			*Tenthredo opposita* (Smith)
32.			*Tenthredo pompilina* Malaise
33.			*Tenthredo provida* (Smith)
34.			*Tenthredo pulchra* Jakovlev
35.			*Tenthredo rotundiventris* (Cameron)
36.			*Tenthredo simulata* Smith
37.			*Tenthredo spinigera* Konow

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
38.			*Tenthredo variicolor* Malaise
39.			*Tyloceridius dorsatus* (Mocsáry)
40.	Diprionidae		*Diprion kashmirensis* Saini & Thind
41.	Pamphiliidae		*Pamphilius kashmirensis* Beneš
42.	Siricidae		*Neoxeris melanocephala* Saini & Singh *Neoxeris Sirex cyaneus* Fabricus
43.			*Neoxeris imperialis* W.F. Kirby
44.			*Neoxeris juvencus* (Linné)
45.			*Neoxeris melanopoda* Benson
46.			*Urocerus xanthus* (Cameron)
47.			*Xeris himalayensis* Bradley
48.	Evaniidae		*Evania appendigaster* (Linnaeus)
49.	Diapriidae		*Belyta heretica* Buhl
50.			*Zygota kashmirensis* Buhl
51.			*Coptera srinagari* (Mukerjee)
52.	Cynipidae		*Saphonecrus excisus* (Kieffer)
53.			*Plagiotrochus semicarpifoliae* (Cameron)
54.			*Diplolepis rosae* (Linnaeus)
55.	Figitidae		*Alloxysta consobrina* (Zetterstedt)
56.			*Alloxysta pleuralis* (Cameron)
57.			*Phaenoglyphis indica* Ferrer-Suay and Pujade-Villar
58.			*Phaenoglyphis longicornis* (Hartig)
59.	Aphelinidae		*Aphelinus abdominalis* (Dalman)
60.			*Aphelinus albipodus* Hayat & Fatima
61.			*Aphelinus albipodus* Hayat & Fatima
62.			*Aphelinus mali* (Haldeman)
63.			*Aphytis diaspidis* (Howard)
64.			*Aphytis paramaculicornis* DeBach & Rosen
65.			*Aphytis proclia* (Walker)
66.			*Centrodora idioceri* Ferrière
67.			*Coccophagus tschirchii* Mahdihassan
68.			*Encarsia citrina* (Craw)
69.			*Encarsia perniciosi* (Tower)
70.			*Marietta carnesi* (Howard)
71.			*Protaphelinus nikolskajae* (Yasnosh)
72.			*Pteroptrix chinensis* (Howard)
73.	Azotidae		*Ablerus perspeciosus* Girault
74.	Chalcididae		*Brachymeria femorata* (Panzer)
75.			*Brachymeria lasus* (Walker)
76.			*Brachymeria masoodii* Jamal Ahmad
77.			*Brachymeria rufotibialis* Husain & Agarwal

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
78.			*Brachymeria tibialis* (Walker)
79.			*Epitranus albipennis* Walker
80.			*Epitranus husaini* Ahmad, Khursheed & Azim
81.	Encyrtidae		*Anagyrus aquilonaris* (Noyes & Hayat)
82.			*Anagyrus gracilis* (Hayat)
83.			*Anagyrus subflaviceps* (Girault)
84.			*Apoleptomastix bicoloricornis* (Girault)
85.			*Cheiloneurus pyrillae* Mani
86.			*Copidosoma floridanum* (Ashmead)
87.			*Eotopus beneficus* (Shafee)
88.			*Erencyrtus dewitzii* Mahdihassan
89.			*Syrphophagus aphidivorus* (Mayr)
90.			*Tachardiaephagus tachardiae* (Howard)
91.			*Teleterebratus indicus* (Narayanan)
92.			*Teleterebratus* Compere & Zinna
93.	Eulophidae		*Aprostocetus neglectus* (Domenichini)
94.			*Cirrospilus denitus* Narendran
95.			*Cirrospilus pictus* (Nees)
96.			*Chrysocharis cuticisi* Narendran & Sureshan
97.			*Chrysocharis differentis* Narendran & Sureshan
98.			*Diglyphus pachyneurus* Graham
99.			*Diglyphus isaea* (Walker)
100.			*Diglyphus kashmiricus* Ahmad, Khurseed & Azim
101.			*Elachertus kashmiricus* Narendran
102.			*Eulophus razaki* Narendran
103.			*Euplectrus coimbatorensis* Ferrière
104.			*Farooqiella kashmiriensis* Jamal Ahmad
105.			*Hemiptarsenus olaticus* Narendran
106.			*Hyssopus licinus* Narendran
107.			Pnigalio camicalis Narendran
108.			*Sympiesis acicus* Narendran
109.			*Sympiesis kazmii* Narendran
110.			*Tetrastichus cotesiae* Narendran
111.	Eupelmidae		*Anastatus japonicus* Ashmead
112.			*Anastatus kashmirensis* Mathur
113.			*Eupelmus kashmiricus* Narendran
114.			*Eupelmus valsus* Narendran
115.			*Eupelmus vindex* Erdös
116.	Eurytomidae		*Eurytoma morio* Boheman
117.			*Eurytoma neoverticillata* Narendran
118.			*Eurytoma samsonowi* Vassiliev

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
119.	Mymaridae		*Lymaenon aureus* (Girault)
120.			*Lymaenon munnarus* (Mani & Saraswat)
121.			*Palaeoneura unimaculatum* (Hayat & Anis)
122.			*Polynema anantanagana* Narayanan
123.	Pteromalidae		*Asaphes suspensus* (Nees)
124.			*Cheiropachus quadrum* (Fabricius)
125.			*Coruna clavata* Walker
126.			*Dibrachys cavus* (Walker)
127.			*Dibrachys microgastri* (Bouché)
128.			*Halticoptera circulus* (Walker)
129.			*Halticoptera smaragdina* (Curtis)
130.			*Heydenia indica* Narendran
131.			*Lamprotatus splendens* Westwood
132.			*Macromesus harithus* Narendran
133.			*Metacolus unifasciatus* Förster
134.			*Pachyneuron aphidis* (Bouché)
135.			*Pachyneuron groenlandicum* (Holmgren)
136.			*Pachyneuron nelsoni* Girault
137.			*Pteromalus puparum* (Linnaeus)
138.			*Pteromalus semotus* (Walker)
139.			*Rhaphitelus maculatus* Walker
140.			*Schizonotus latus* (Walker)
141.			*Sphaeripalpus lacunosus* Huang
142.			*Systasis shalimarensis* Ahmad, hursheed & Azim
143.	Torymidae		*Ecdamua lehensis* Sureshan
144.			*Megastigmus kashmiricus* Sureshan
145.			*Monodontomerus obscurus* Westwood
146.			*Torymus barsulicus* Narendran & Razak
147.	Trichogrammatidae		*Trichogramma chilonis* Ishii
148.			*Trichogramma dendrolimi* Matsumura
149.			*Trichogramma embryophagum* (Hartig)
150.			*Trichogramma japonicum* Ashmead
151.			*Trichogramma kashmiricum* Nagaraja, Ahmad & Gupta
152.	Braconidae		*Adialytus ambiguus* (Haliday)
153.			*Adialytus salicaphis* (Fitch)
154.			*Aphidius absinthii* Marshall
155.			*Aphidius areolatus* Ashmead
156.			*Aphidius cingulatus* Ruthe
157.			*Aphidius colemani* Viereck
158.			*Aphidius erysimi* (Stary)
159.			*Aphidius hortensis* Marshall

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
160.			*Aphidius matricariae* Haliday
161.			*Aphidius salignae* Watanabe
162.			*Aphidius setiger* Mackauer
163.			*Aphidius smithi* Sharma and Subba Rao
164.			*Aphidius transcaspicus* Telenga
165.			*Aphidius uzbekistanicus* Luzhetzki
166.			*Areopraon lepelleyi* (Waterston)
167.			*Betuloxys hortorum* (Stary)
168.			*Betuloxys intermedius* (Shuja-Uddin)
169.			*Binodoxys acalephae* (Marshall)
170.			*Binodoxys basicurvus* (Shuja-Uddin)
171.			*Binodoxys centaureae* (Haliday)
172.			*Binodoxys indicus* (Subba Rao and Sharma)
173.			*Binodoxys jaii* (Bhagat)
174.			*Binodoxys kashmirensis* Takada and Rishi
175.			*Binodoxys longispinus* (Shuja-Uddin)
176.			*Binodoxys rubicola* (Shuja-Uddin)
177.			*Binodoxys uroleucon* Takada and Rishi
178.			*Diaeretiella rapae* (M'Intosh)
179.			*Ephedrus laevicollis* (Thomson)
180.			*Ephedrus niger* Gautier, Bonnamour and Gaumont
181.			*Ephedrus persicae* Froggatt
182.			*Ephedrus plagiator* (Nees)
183.			*Ephedrus srinagarensis* Stary and Bhagat
184.			*Ephedrus urticae* Bhagat
185.			*Kashmiria aphidis* Stary and Bhagat
186.			*Lipolexis gracilis* Foerster
187.			*Lipolexis oregmae* (Gahan)
188.			*Lysaphidus confusus* Tremblay and Eady
189.			*Pauesia gulmargensis* Bhagat
190.			*Pauesia hazratbalensis* Bhagat
191.			*Pauesia himalayensis* Bhagat
192.			*Pauesia pini* (Haliday)
193.			*Praon abjectum* Haliday
194.			*Praon dorsale* (Haliday)
195.			*Praon kashmirensis* Bhagat
196.			*Praon stagona* Takada & Rishi
197.			*Praon volucre* (Haliday)
198.			*Toxares deltiger* (Haliday)
199.			*Toxares macrosiphophagum* Shuja-Uddin
200.			*Toxares shigai* Takada

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
201.			*Toxares zakai* Shuja-Uddin
202.			*Trioxys pallidus* (Haliday)
203.			*Trioxys rishii* Stary and Bhagat
204.			*Trioxys rosaecola* Bhagat
205.			*Trioxys soporensis* Shuja-Uddin
206.	Ichneumonidae		*Anilasta ebenina* Gravenhorst
207.			*Anilasta simlaensis* Cameron
208.			*Anomalon apicale* Cameron
209.			*Banchopsis ruficornis* (Cameron)
210.			*Bassus clotho Morley*
211.			*Campoplex longipes* Smith
212.			*Cephalobolus parvipes* Morley
213.			*Coccygomimus carinifrons* (Cameron)
214.			*Coccygomimus erebus* (Cameron)
215.			*Coccygomimus indra* (Cameron)
216.			*Coccygomimus laothoe* (Cameron)
217.			*Coccygomimus turionellae* (Linnaeus)
218.			*Cryptus nursei* Cameron
219.			*Cryptus violaceotinctus* Cameron
220.			*Exetastes fornicator* (Fabricius)
221.			*Ischnoceros himalayensis* Chandra
222.			*Gregopimpla himalayensis* (Cameron)
223.			*Itoplectis alternans* Gravenhorst
224.			*Itoplectis tibetensis* Perkins
225.			*Klutiana townesi* (Baltazar)
226.			*Netelia virgata* (Fourcroy)
227.			*Netelia fuscicornis* (Holmgren)
228.			*Mesoleius wahlbergi* Holmgren
229.			*Ophion albopictus* Smith
230.			*Paniscus montanus* Cameron
231.			*Paniscus ocellaris* Thomson
232.			*Pimpla arctica* Zetterstedt
233.			*Scambus aithomelus* Gupta & Tikar
234.			*Scambus indicus ndicus* Gupta & Tikar
235.			*Scambus kashmiricus* Gupta & Tikar
236.			*Scolobates auriculatus* Fabricius
237.			*Xanthopimpla nana* Schulz
238.			*Xorides anthracinus* Gupta & Chandra
239.			*Xorides minimus* Gupta & Chandra
240.	Chrysididae	Chrysidinae	*Elampus kashmirensis* (Nurse)
241.			*Holopyga cupreata* Nurse

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
242.			*Chrysis stilboides* Spinola
243.			*Praestochrysis shanghaiensis* (Smith)
244.			*Spinolia kashmirae* Kimsey
245.	Dryinidae	Gonatopodinae	*Gonatopus nivosus* Olmi
246.	Vespidae	Vespinae	*Dolichovespula intermedia* (Birula)
247.			*Vespula austriaca* (Panzer)
248.			*Vespula flaviceps* (Smith)
249.			*Vespula germanica* (Fabricius)
250.			*Vespula nursei* Archer
251.			*Vespula structor* (Smith)
252.			*Vespa analis* Fabricius
253.			*Vespa auraria* Smith
254.			*Vespa orientalis* Linnaeus
255.			*Vespa vivax* Smith
256.		Polistinae	*Polistes gallicus* (Linnaeus)
257.			*Polistes nimpha* (Christ)
258.			*Polistes associus* Kohl
259.			*Polistes tenebricosus sulcatus* Smith
260.			*Polistes olivaceus* (De Geer)
261.			*Polistes wattii* Cameron
262.			*Polistes rothneyi carletoni* van der Vecht
263.			*Polistes quadricingulatus* Gusenleitner
264.			*Ropalidia variegata* (Smith)
265.		Eumeninae	*Ancistrocerus antelope* (Panzer)
266.			*Ancistrocerus nigricornis* (Curtis)
267.			*Antepipona kashmirensis* Giordani Soika
268.			*Antepipona pruthii* Giordani Soika
269.			*Anterhynchium coracinum* (van der Vecht)
270.			*Antodynerus limbatus* (de Saussure)
271.			*Delta dimidiatipenne* (de Saussure)
272.			*Eumenes affinissimus* de Saussure
273.			*Eumenes persimilis* Giordani Soika
274.			*Eumenes placens* Nurse
275.			*Eumenes pomiformis* Fabricius
276.			*Pseudepipona vicina* Gusenleitner
277.			*Symmorphus gracilis* (Brullé)
278.			*Tropidodynerus hostis* (Nurse)
279.			*Xenorhynchium nitidulum* (Fabricius)
280.	Scoliidae		*Campsomeriella annulata annulata* (Fabricius)
281.			*Megacampsomeris prismatica* (Smith)
282.			*Megascolia rubida* (Gribodo)

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
283.			*Scolia affinis* Guerin
284.			*Scolia cyanipennis* Fabricius
285.	Tiphiidae		*Tiphia pulchaukiae* Allen
286.			*Tiphia davarae* Allen
287.			*Tiphia rufipes* smith
288.			*Tiphia consueta* smith
289.	Mutillidae	Mutillinae	*Mutilla semiviolacea* André
290.			*Smicromyrme kashmirensis* Hammer
291.			*Pagdenidia hymalajensis* (Radoszkowski)
292.	Pompilidae		*Pompilus moestus* Bingham
293.	Apidae		*Amegilla confusa* (Smith)
294.			*Anthophora atroalba* (Lepeletier)
295.			*Anthophora plagiata* (Illiger)
296.			*Apis cerana* Fabricius
297.			*Apis dorsata* Fabricius
298.			*Apis florea* Fabricius
299.			*Apis laboriosa* Smith
300.			*Bombus asiaticus* Morawitz
301.			*Bombus avinoviellus* (Skorikov)
302.			*Bombus biroi* Vogt
303.			*Bombus branickii* (Radoszkowski)
304.			*Bombus ferganicus* (Radoszkowski)
305.			*Bombus festivus* Smith
306.			*Bombus haemorrhoidalis* Smith
307.			*Bombus himalayanus* (Skorikov)
308.			*Bombus hypnorum* (Linnaeus)
309.			*Bombus keriensis* Morawitz
310.			*Bombus ladakhensis* Richards
311.			*Bombus lemniscatus* Skorikov
312.			*Bombus lepidus* Skorikov
313.			*Bombus lucorum* (Linnaeus)
314.			*Bombus melanurus* Lepeletier
315.			*Bombus novus* (Frison)
316.			*Bombus oberti* Morawitz
317.			*Bombus personatus* Smith
318.			*Bombus pyrosoma* Morawitz
319.			*Bombus rufofasciatus* Smith
320.			*Bombus semenovianus* (Skorikov)
321.			*Bombus simillimus* Smith
322.			*Bombus skorikovi* (Popov)
323.			*Bombus subtypicus* (Skorikov)

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
324.			*Bombus trifasciatus* Smith
325.			*Bombus tunicatus* Smith
326.			*Eucera diana* Nurse
327.			*Melecta kashmirensis* (Nurse)
328.			*Nomada annexa* Nurse
329.			*Nomada arida* Nurse
330.			*Nomada beata* Nurse
331.			*Nomada glabriventris* Schwarz
332.			*Nomada jammuensis* Schwarz
333.			*Nomada ladakhiensis* Schwarz
334.			*Nomada radiata* Nurse
335.			*Xylocopa ruficornis* Fabricius
336.			*Xylocopa assimilis* Ritsema
337.			*Xylocopa auripennis* Lepeletier
338.			*Xylocopa fenestrata* (Fabricius)
339.			*Xylocopa tenuiscapa* Westwood
340.			*Xylocopa valga* Gerstäcker
341.			*Xylocopa violacea* (Linnaeus)
342.	Andrenidae		*Andrena floridula* Smith
343.			*Andrena patella* Nurse
344.			*Andrena rupshuensis* Cockerell
345.	Colletidae		*Colletes eous* Morice
346.			*Colletes floralis* Eversmann
347.			*Colletes laevigena* Noskiewicz
348.			*Colletes sanctus* Cockerell
349.			*Colletes tibeticus* Kuhlmann
350.			*Hylaeus advocata* (Nurse)
351.			*Hylaeus fervidus* (Smith)
352.			*Hylaeus kashmirensis* (Nurse)
353.			*Hylaeus secretus* (Nurse)
354.			*Hylaeus vetustus* (Nurse)
355.	Halictidae		*Dufourea gkuruensis* (Warncke)
356.			*Dufourea kashmirensis* (Warncke)
357.			*Dufourea ladakhensis* (Warncke)
358.			*Halictus duplocinctus* Vachal
359.			*Halictus paropamisos* Ebmer
360.			*Halictus resurgens* Nurse
361.			*Halictus subauratus* (Rossi)
362.			*Halictus vicinus* Vacha
363.			*Lasioglossum catileps* (Blüthgen)

Table 1a contd.

Sl. No.	Family	Subfamily	Genus/Species
364.			*Lasioglossum didomenon* Ebmer
365.			*Lasioglossum dolus* Ebmer
366.			*Lasioglossum dynastes* (Bingham)
367.			*Lasioglossum himalayense* (Bingham)
368.			*Lasioglossum hypsiston* Ebmer
369.			*Lasioglossum krishna* (Nurse)
370.			*Lasioglossum leucozonium* (Schrank)
371.			*Lasioglossum marginatum* (Brullé)
372.			*Lasioglossum massuricum* (Blüthgen)
373.			*Lasioglossum melachloron* Ebmer
374.			*Lasioglossum nursei* (Blüthgen)
375.			*Lasioglossum tardum* (Cameron)
376.			*Lasioglossum tschibuklinum* (Blüthgen)
377.			*Sphecodes gibbus* (Linnaeus)
378.			*Sphecodes monilicornis* (Kirby)
379.			*Sphecodes perplexus* Nurse
380.			*Sphecodes tantalus* Nurse
381.	Megachilidae		*Anthidium conciliatum* Nurse
382.			*Anthidium kashmirense* Mavromoustakis
383.			*Coelioxys lata* Cameron
384.			*Euaspis carbonaria*(Smith)
385.			*Hoplitis indostana* (Cameron)
386.			*Megachile centuncularis* (Linnaeus)
387.			*Megachile kashmirensis* (Tkalců)
388.			*Megachile ladacensis* Cockerell
389.			*Megachile ladakhensis* (Tkalců)
390.			*Megachile rupshuensis* Cockerell
391.			*Megachile vigilans* Smith
392.			*Osmia gulmargensis* Nurse
393.			*Osmia kashmirensis* Nurse
394.			*Protosmia devia* Tkalců
395.	Melittidae		*Melitta harrietae* (Bingham)
396.	Crabronidae	Pemphredoninae	*Psen orientalis* Cameron
397.		Larrinae	*Tachytes vicinus* Cameron
398.			*Tachytes vischnu* Cameron
399.		Crabroninae	*Crossocerus annandali* (Bingham)
400.			*Crossocerus diacanthus* (Gussakovskij)
401.			*Crossocerus kohli* (Bischoff)
402.		Nyssoninae	*Bembix fossoria* Smith

Table 1b : A summary of number of genera and species of Hymenoptera (excluding ants) found in the Trans-Himalaya

Sl. No.	Superfamily	Family	No. of genus	No. species
1.	Tenthredinoidea	Tenthredinidae	8	38
2.		Diprionidae	1	1
3.	Pamphilioidea	Pamphiliidae	1	1
4.	Siricoidea	Siricidae	4	7
5.	Evanoidea	Evaniidae	1	1
6.	Diaprioidea	Diapridae	3	3
7.	Cynipoidea	Cynipidae	3	3
8.		Figitidae	2	4
9.	Chalcidoidea	Aphelinidae	8	14
10.		Azotidae	1	1
11.		Chalcididae	2	7
12.		Encyrtidae	9	12
13.		Eulophidae	13	18
14.		Eupelmidae	2	5
15.		Eurytomidae	1	3
16.		Mymaridae	3	4
17.		Perilampidae	1	1
18.		Pteromalidae	15	20
19.		Torymidae	4	4
20.		Trichogrammatidae	1	5
21.	Ichneumonoidea	Braconidae	14	54
22.		Ichneumonidae	22	35
23.	Chrysidoidea	Chrysididae	5	5
24.		Dryinidae	1	1
25.	Vespoidea	Vespidae	15	34
26.		Scoliidae	4	5
27.		Tiphiidae	1	4
28.		Mutillidae	3	3
29.		Pompilidae	1	1
30.	Apoidea	Apidae	8	49
31.		Andrenidae	1	3
32.		Colletidae	2	10
33.		Halictidae	4	26
34.		Megachilidae	7	14
35.		Melittidae	1	1
36.		Crabronidae	4	7
		TOTAL	**76**	**400**

Antepipona pruthii Giordani Soika, 1982

Antodynerus limbatus de Saussure, 1852

Campsomeriella annulata annulata, Fabricius, 1793

Delta dimidiatepenne de Saussure, 1852

Eumenes affinissimus Saussure, 1852

Eumenes placens Nurse, 1903

Eumenes pomiformis Fabricius, 1781

Megacampsomeris prismatica Smith, 1855

Ropalidia variegata Smith, 1952

Tropidodynerus hostis Nurse, 1903

Vespa orientalis Linnaeus, 1771

Vespula flaviceps Smith, 1872

Vespula germanica Fabricius, 1793

Xenorhynchium nitidulum Fabricius, 1798

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Chapter 10

INSECTA : HYMENOPTERA (BUMBLEBEES)

RIFAT H. RAINA and MALKIAT SINGH SAINI*

Bumblebees are very important species for their pollination services to medicinal plants of Trans-Himalaya and play a deciding role to conserve the vegetation germplasm. This paper describes the diversity, threats and floral visits of bumblebee species available in the upper reaches of ladakh and Spiti (Trans-Himalaya). These anthophilous insects are completely dependent on pollen and nectar on the high altitude flora and in turn help in their pollination. The bumblebees are generally associated with different types of flowers (wild or cultivated) and are found foraging in various mountainous regions. The species confined to high altitudes are small in size, dull in colour and during flight produce a high buzzing sound. This small size of high altitude species is correlated with the fact that the vegetation present in these areas is in the form of small bushes having very small flowers preferring smaller insects which can easily feed and pollinate them. These species are so adapted to their specific habitats that many of species that are found here are not reported from low altitude areas and vice-versa. An updated check list of 23 species of bumblebees of Trans-Himalayan belt is provided with ecological notes.

Keywords: Bumblebees, Hymenoptera, Diversity, floral visits, Threats, Trans-Himalaya.

INTRODUCTION

Bumblebees belong to the genus *Bombus* of the family Apidae, order Hymenoptera. These are insects thriving among the most abundant and conspicuous of flower visitors in alpine, temperate and arctic environment of the northern continents. They are called primitively eusocial and are associated with the high lands and play a key role in the functioning of agricultural ecosystems as pollinators of orchards, crops and wild flowers. Almost all species of bumblebees are generalists in their choice of food plants, visiting any remunerative flowers. These characteristics of bumblebees may account for their abundance in cool environments that have a predictable season of adverse conditions, where flowers are often fairly evenly dispersed. The Trans-Himalaya Mountain Region, a floristically rich region is located to the north of the Great Himalayas which consists of Karakoram, Ladakh, Zaskar and Kailash mountain ranges. It is also called the Tibet Himalayan region because most of the part of these ranges lies in the Tibet. The Karakoram Range is known as the 'backbone of high Asia', has tremendous variation in latitude, altitude, rainfall, topography and climate. This is responsible for great amount of biodiversity of the region, due to the varied climate, rainfall, geography, location and altitude. Because of extremely variegated physiography, the Trans-Himalayan range shows an equally incredible diversity in climate in its different regions. Bumblebees of Trans-Himalaya are of specific interest as this narrow corridor of mountain is almost the only major point of contact between the large and divergent bumblebee fauna of Oriental and Palaearctic regions. The fauna of these regions is separated by deserts in central Asia and in China, except for another corridor of contact near Beijing but with relatively few species. Greater Kashmir covers almost the entire mountain system that links the high Tibetan (Xizang-Qinghai) plateau in the east with the Hindu Kush, Pamir and Tien Shan mountain ranges to the west and north covering segments of Great Himalaya, Pir Panjal, Zanskar, Karakoram, Ladakh and Hindu Raj ranges which include some of the highest peaks in the World with an altitudinal range of 400-8600m. High relief of Trans-Himalaya (Ladakh and Spiti) provides a wide range of habitats for bumblebees. Due to local altitudinal zonation and variation in local exposure these two climatic regions differ in their flora, contributing towards

Zoological Survey of India, Desert Regional Centre, Jodhpur-342 005 (RJ)
*Asian Educational Institute, Sirhind Road, Patiala-147 001 (Pb)
Email: rifat72001@rediffmail.com

Citation
Raina, R.H. and Saini, M.S. 2019. Insecta : Hymenoptera (Bumblebees). In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 73-78. (Published by the Director, Zool. Surv. India, Kolkata)

a wide range of habitats. In comparison with some parts of Himalaya, Kashmir retains comparatively large forests yet access to these diverse alpine areas is no longer difficult.

DIVERSITY

There are two hundred and sixty-five known species of bumblebees present worldwide. The majorities of these species is known as 'true' bumblebees, and have a social worker caste which is more or less sterile. In fauna of British India 23 species of Bumblebees were recorded that included some records from the neighbouring countries as Bhutan, Myanmar, Nepal, etc. (Bingham, 1897). Subsequent workers added 149 species to this list, raising the total species number to 172, but due to lot of synonymy as put forth by Williams, 1998 only 47 species stand as valid. Genus *Bombus* is at present represented by 48 species from India out of which 17 species are reported from Trans-Himalaya (Ladakh and Spiti), Saini *et al.,* 2011. The only recent revision of some part of the Trans-Himalayan fauna has been conducted by Saini *et al*, 2015 and included description of 22 bumblebee species. 17 species are recorded from Ladakh and 14 from Spiti Valley and 9 species of bumblebees are common in both the regions. Although there are many elements in common between the faunas of Spiti and Ladakh. The only key that has been intended to cover any part of the Himalayan fauna is that published by Bingham, The only commendable work on the bumblebees from Indian Himalaya including the Trans-Himalayan belt is done by Williams, 1991; Saini *et al.,* 2011; 2012 & 2015.

FLORAL VISIT

In the upper Himalayas particularly the tree less alpine meadows situated mostly between 3500 m to 5600 m above mean sea level, the flora that is conserved particularly by the bumble bees include large variety of medicinal plants, herbs, shrubs and grasses having tiny flowers. Extremely harsh and inhospitable environment of these snow clad mountains, particularly the, Leh-Ladakh of Jammu and Kashmir and Spiti Valley, located high in the Himalayas in the north western part of the northern Indian state of Himachal Pradesh, where only some selected species of medicinal plants are maintaining their existence, bumble bees play a very positive and deciding role in conserving them. This is because of the fact that at these altitudes, excepting bumblebees the insect actively is very rare, only some species of Butterflies, Diptera, Aphids and Coccinellid beetles occur which are labeled as the accidental pollinators because of very low temperature they are very sluggish. The common flora existing at these reaches and repeatedly visited by these bees include *Anaphalis busua* DC, *Circbita cineria* Linn., *Senecio chrysanthemoides* DC, *Taraxacum officinale, Saussurea jacea* (Klotz) Cl., *Saussurea lappa*, *Scorzonera virgata, Senecio chrysanthemoides, Saussurea costus, Lactuca orientalis, Saussurea albescens, Saussurea auriculata, Rudbeckia laciniata, Saussurea fastuosa Leontopodium alpinum, Tanacetum dolicophyllum* (Asteraceae) *Potentilla atrosanguinea* Lodd. (Rosaceae), *Thymus serpyllum* Linn., *Mentha longifolia* Linn., *Phlomis bracteosa* Royle, *Stachys serecia* Wall. ex Benth., *Nepeta discolor* Linn., *Hyssopus officinalis* Linn., *Dracocephalum heterophyllum* Benth., *Nepeta laevigata* (D. Don) Hand. -Mazz. (Lamiaceae), *Polygonum amplexicaule* D.Don. (Polygonaceae), *Pedicularis pectinata* Wall., *Euphrasia officinalis* (Scrophulariaceae), *Gypsophil cerastioides* D. Don (Caryophyllaceae), *Myosotis sylvatica* Ehrh. et Hoffm. (Boraginaceae), *Melilotus officinalis* (L.) Pall (Leguminosae), *Cyanthus lobatus* Wall. (Campanulaceae), *Gypsophila cerastioides* (Caryophyllaceae), *Rhodiola crenulata* Linn., *Sedum ewersii* Ladeh (Crassulaceae) and *Hyoscyamus niger* Linn. (Solanaceae). Dr. Anzar Ahmad Khuroo, Assistant Professor and Dr. Akhter H. Malik Curator Centre of Plant Taxonomy University of Kashmir (India) helped in identification of plant species.

This long list of plants clearly shows that the most of the high altitude flora is mainly and frequently visited by these bees. In addition to their soil binding nature and numerous other ecological roles, these plants have a lot of medicinal importance as well. The species of Bumble bees that are mainly found foraging on the above mentioned flora are: *B. asiaticus, B. keriensis, B. melanurus, B. personatus, B. semenovianus, B. waltoni, B. lepidus, B. biroi, B. oberti, B. lemniscatus, B. rufofasciatus, B. kashmirensis, B. himalayanus, B. ladakhensis, B. miniatus, B. tunicatus* and *B. subtypicus.*

THREATS

Due to the massive induction of modern agricultural practices and numerous other anthropogenic factors a large assemblage of highly valuable category of anthophilous insects, particularly the bumble bees, which are mainly responsible for pollinating or cross pollinating a bewildering variety of cultivated plants and other wild flowering angiosperms of higher elevations, has come under a great ecological stress and strain. This is not only going to result or has already resulted, in the reduction of their populations and species diversity, but has also threatened the coexistence of the, bewildering variety of cultivated as well as wild flowering plants (particularly the medicinal plants) constituting a fabulous tapestry of biodiversity. If the present trend continues, time is not far off when most of the medicinal plant species growing up to the permanent snow line in the high altitude alpine meadows, much above the timber line, will earn the dubious distinction of being threatened or endangered components of the vegetation biota. At a time when the World at large is arousing to the hazards of impoverishment of the biodiversity, nothing seems to be done to curb the rapidly deteriorating mountain ecology in India.

CONCLUSION

It is high time to record the population densities, diversity, and distribution (altitudinal stratification) of these anthophilous insects. It is rather more crucial to gather information on relationship of these insects with the entomophilous flowering plants (particularly the medicinal plants) growing up to the permanent snow line. It is also important to underline some commercially important bumblebees so that their pollination potential may be exploited to increase the yield of some regional cash crops such as alfalfa, mustard, peas, clover; some vegetables such as reddish, tomato, brinjal, onion, bottle and bitter gourd; some fruit trees including cherry, pear, apricot, peach, almond; numerous medicinal plants and variety of citrus plants. Studies on the pollination biology along with other insect plant associations in the higher reaches of Himalaya can go a long way in protecting and preserving the rarest type of vegetation gene-pool. It is probable that 18 bumble bee species so far recorded purely from the neighbouring countries (Pakistan, Bhutan, Tibet, Afghanistan, Nepal and Myanmar) may be found from Indian faunistic limits. Another major problem with these insects is that in spite of the presence of host plants; the same species may not remain confined to the same place every year. Since, they are very strong fliers so they keep on shifting their colonial sites every year. So while making the complete survey of these insects, Zanskar range in Ladakh and Himalayan Spiti valley in Himachal Pradesh belt must be taken into consideration so that the actual position of these insects can be brought in to light. Baseline data generated will serve for the future investigations of bumblebees at habitat level and consequently devising conservation strategies at landscape level.

Table 1 : Checklist of Bumblebees (Apidae: Hymenoptera) from Indian Trans-Himalaya

Sl. No.	Name of the species	Ladakh	Spiti	Present status
1.	*Bombus asiaticus* Morawitz, 1875	+	+	Common
2.	*B. avinoviellus* Skorikov, 1914	-	+	Common
3.	*B. biroi* Vogt, 1911	+	+	Rare
4.	*B. branickii* Radoszkowski, 1893	+	-	Common
5.	*B. cornutus* Frison, 1933	+	-	Rare
6.	*B. ferganicus* Radoszkowski, 1893	+	+	Common
7.	*B. himalayanus* Skorikov,1914	+	+	Rare
8.	*B. kashmirensis* Friese, 1909	-	+	Rare
9.	*B. keriensis* Morawitz, 1886	+	+	Common
10.	*B. ladakhensis* Richards, 1928	+	-	Rare
11.	*B. lemniscatus* Skorikov, 1912	+	-	Rare
12.	*B. lepidus* Skorikov, 1912	+	+	Rare
13.	*B. lucorum* Linnaeus, 1761	+	-	Common
14.	*B. melanurus* Lepeleitier, 1836	+	+	Common
15.	*B. miniatus* Bingham, 1897	+	-	Rare
16.	*B. oberti* Morawitz, 1883	+	-	Rare
17.	*B. personatus* Smith, 1879	-	+	Rare
18.	*B. rufofasciatus* Smith, 1852	+	+	Common
19.	*B. semenovianus* Skorikov, 1914	+	+	Common
20.	*B. simillimus* Smith, 1852	-	+	Common
21.	*B. subtypicus* Skorikov, 1914	+	-	Rare
22.	*B. tunicatus* Smith, 1852	+	+	Common
23.	*B. waltoni* Cockerell, 1910	-	+	Rare

Bombus asiaticus Morawitz, 1875

Bombus biroi Vogt, 1911

Bombus kashmirensis Friese, 1909

Bombus keriensis Morawitz, 1886

Bombus lepidus Skorikov, 1912

Bombus lucorum Linnaeus, 1761

Bombus melanurus Lepeleitier, 1836

Bombus pyrosoma Morawitz, 1890

Bombus rufofasciatus Smith, 1852

Bombus rufofasciatus Smith, 1852

Bombus semenovianus Skorikov, 1914

Bombus simillimus Smith, 1852

Bombus tunicatus Smith, 1852

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Chapter 11

INSECTA : TRICHOPTERA

T. KUBENDRAN, AVTAR KAUR SIDHU,
AKHIL NAIR and ANJOO DHAR

The caddisfly larvae are a well known group with high species diversity in montane streams and rivers and are widely used in water quality assessment. The current status of Trichoptera is 34 species belonging to 12 genera and 10 families in Trans-Himalaya. Most of the species described earlier based on the adult alone, hence association of larvae with respective adults by larva-adult associations using DNA barcoding is rather indispensable to arrive at precise taxonomic conclusions.

Keywords: caddisfly, diversity, aquatic insects, bioindicator

INTRODUCTION

Trichoptera (Caddisflies) are among the most diverse holometabolous aquatic insects which along with dragonflies, mayflies, stoneflies and dobsonflies are primary invaders of freshwaters. They are distributed in every continent except Antarctica. They are exceeded in number of species only by aquatic Diptera (Mackay and Wiggins, 1979). Trichopteran insects are closely related to the Lepidoptera and the two orders together form the superorder Amphiesmenoptera (Kristensen, 1991). Their eggs, larvae and pupae are usually found in or very near freshwater bodies. Imagos are aerial and perch on leaves and twigs of riparian flora. They are moth-like insects with wings covered by hairs, not scales, a diagnostic feature of the Lepidoptera. In fact, the word Trichoptera is derived from the Greek word 'trichos' meaning hairs, and "pteron" meaning wing i.e., wings covered with hairs. Adult antennae are usually prominent, in some species exceptionally long and have well developed maxillary and labial palps, but never with coiled proboscis, diagnostic of adult Lepidoptera (de Moor and Ivanov, 2008).

Also like Lepidoptera, larvae of Trichoptera have exploited silk in constructing retreats and larval cases of marvellous bio architecture that are keystone adaptations accounting for the ecological diversity and success of the order as a whole (Wiggins, 2004). Fittingly, caddisfly larvae are called "underwater architects" (Wiggins, 2004). Larvae of Trichoptera can be distinguished from all other insects with segmented thoracic legs, presence of a pair of anal prologs, with a single curved terminal claw and very short antennae consisting of a single segment. The pupa is exarate and possesses a pair of strong functional mandibles and in the adult nonfunctional mandibles. The abdomen has a number of segments adorned with characteristics sclerotized, dorsal hook bearing plates. Larval and pupal stages entirely depend on an aquatic environment. The larvae have exploited every conceivable microhabitat of the freshwater systems from montane springs, streams both intermittent and perennial, rivers, big and small, the splash zones of waterfalls and the depth of lakes to temporary waters and even rain water-filled treeholes (phytotelma).

ADAPTATIONS IN COLD DESERT

With about more than 30 species, the order constitutes only 7% of the nival insect fauna. There is a high proportion of endemic species and nearly all the species are Palaearctic forms. Most Trichoptera occur at elevations from 3000 to 4000 mts. The larval stage of the nival species are mostly found in the melt water torrents near the margin of rivers and springs and remain anchored to the submerged stones. Rarely some of them found to prefer the quieter parts of the stream. The cases of the larvae inhabiting the torrents

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (HP)
Email: tkbaetis@gmail.com; avtarkaur2000@gmail.com

Citation
Kubendran, T. Sidhu, A.K. Nair, A. and Dhar, A. 2019. Insecta : Trichoptera. In: *Faunal Diversity of Biogeographic Zones* : *Indian Trans-Himalaya*: 79-84. (Published by the Director, Zool. Surv. India, Kolkata)

are constructed of heavier material like stones and small pebbles, compact and rigid. The adult caddisflies emerge mostly towards the end of July and a succession of species continues in August; stay specimens often emerge even in the middle of September in some localities. There is only a single annual generation (Mani, 1969).

HISTORICAL RESUME

Though European workers have been pioneers in caddisfly research followed by North Americans and experts from other developed countries, there has not been enough progress on Trichoptera in India. Kolentini (1864-1873), Walker (1852), Mac Lachlan (1873, 1875, 1886) and Hagen (1864-1873) initiated study of Indian Trichoptera In the latter half of eighteenth century. Subsequently Morton (1900-1902), Banks (1909-1939) and MacLachlan (1916) added significantly in early nineteenth century. Martynov (1935-36) worked on the collections of the Indian Museum (Zoological Survey of India) followed by Mosely (1935-1939) on some Indian Trichoptera. Taxonomic investigations on adult cadisflies of India were continued by Kimmins (1950-1956), Schmid (1958-1995), Wiggins (1968) and Malicky and his group (1979-2012). Schmid personally collected adults from various states and published several monographs. He predicted that there would be more than ten thousand species of Trichoptera which remain to be unpublished from inland waters of India (Schmid, 1984). Though perhaps this appears to be slightly an overestimate, India's unexplored species diversity of caddisflies is undoubtedly explosive. Ghosh and Chaudhury (1987) from Zoological Survey of India published on a new species of Phryganeidae. Sharma and Chandra (2009) updated the checklists of Higler (1992) and Saini *et al.* (2001). Recently Parey (2015) has updated the checklist of Plenitentoria Group of caddisflies. Saini and Kaur (2012) collated scattered information on published literature on Indian Trichoptera. Morse of Climson University, South Carolina is motivating caddisfly workers from India to continue systematic work on this taxon. Recently Saini and his co-workers, Parey, Pandherand Kaur (2005-2016) published extensively on more than forty species of adult Trichoptera of Indian Himalaya. Around 49 families of Trichoptera have been presently recognized the world over, comprising 616 genera and 14,548 species (Zhang, 2013). Of these, 28 families having 102 genera with the overall diversity of 1,227 species of this group occur in India. In Indian Himalaya, Trichoptera is represented by 425 species, belonging to 53 genera under 21 families (Selvakumar, 2018; Chandra *et al.,* 2018). From Trans-Himalaya 34 species, 12 genera and 10 families have been recorded so far.

BIOMONITORING POTENTIAL

In worldwide, caddisfly larvae are a well known group with high species diversity in montane streams and rivers and are widely used in water quality assessment. Sivaramakrishnan *et al.,* (1996) made pioneering investigations on the utility of benthic macroinvertebrate assemblages on biomonitoring of Kaveri river catchment. Subramanian and Sivaramakrishnan (2005) prepared a working manual on biomonitoring techniques using aquatic insects of Indian genera. The biomonitoring potential of the larvae of trichopteran genera of India are highlighted in these publications.

GAP AREAS

Intensive survey is needed to generate data on spatio-temporal distribution dynamics and unknown larval stage of many species of caddisflies. Most of the species described earlier are based on the adult alone, hence association of larvae with respective adults by larva-adult associations using DNA barcoding is rather indispensable to arrive at precise taxonomic conclusions. Moreover, few regions of India are under explored areas, especially in the Western Himalaya and Western Ghats. Future research should focus on correlating adult and larval stages and exploring under-explored regions. Combined studies on morphological and molecular systematics, phylogeny and phlylogeography are essential to get a holistic picture of the origin and diversification of the fauna (Selvakumar, 2018).

DISCUSSION

Presently we are in an "Era of anthropogenic megaextinction". Habitat fragmentation, global climate change impacts and alien species invasion have created a "biodiversity crisis" in our fragile lentic and lotic inland waters jeoperdizing the "biotic integrity" of lakes, streams and rivers. Ecological, biotechnological, socio-cultural and legal conservation measures are to be promoted to protect the precious biological heritage of our inland waters including aquatic insects of which the larval caddisfly species assemblages constitute a dominant component. Prioritization of caddisfly taxa and microhabitats for conservation is yet another important research area (Sivaramakrishnan, *et al.,* 2017).

Table 1a : Number of genera and species of order Trichoptera recorded from Indian Trans-Himalaya

Sl. No.	Family	Genera	Species
1.	Family Hydropsychidae Curtis, 1835	1	1
2.	Family Stenopsychidae Martynov, 1924	1	2
3	Family Ecnomidae Ulmer, 1903	1	1
4	Family Limnephilidae Kolenati, 1848	3	7
5	Family Lepidostomatidae Ulmer, 1903	1	8
6	Family Phryganeidae Leach, 1815	1	3
7	Family Glossosomatidae Wallengren, 1891	1	1
8	Family Hydroptilidae Stephens, 1836	1	2
9	Family Hydrobiosidae Ulmer, 1905	1	1
10	Family Rhyacophilidae Stephens, 1836	1	8
	Total	**12**	**34**

Table 1b : List of the species of the order Trichoptera (Caddisflies) recorded from Indian Trans-Himalaya

Sl. No.	Name of the Species
	Order TRICHOPTERA Kriby, 1813 Suborder ANNULIPALPIA Superfamily HYDROPSYCHOIDEA Curtis, 1835
1.	Family HYDROPSYCHIDAE Curtis, 1835 *Hydropsyche orectis* Mey, 1999
2.	Family STENOPSYCHIDAE Martynov, 1924 *Stenopsyche himalayana* Martynov, 1926
3.	*Stenopsyche similis* Ulmer, 1927
4.	Family ECNOMIDAE Ulmer, 1903 *Ecnomus montanus* Mosely, 1932
5.	Family LIMNEPHILIDAE Kolenati, 1848 *Limnephilus morsei* Saini and Parey, 2012
6.	*Phylostenax himalus* Mosely, 1935
7.	*Pseudostenophylax arwiel* Schmid, 1991
8.	*Pseudostenophylax gulmargensis* Parey, Saina and Pandher, 2013
9.	*Pseudostenophylax kashmirensis* (Mosely, 1936)
10.	*Pseudostenophylax micraulax* (McLachlan, 1878)
11.	*Pseudostenophylax mitchelli* (Mosely, 1936)
12.	Family LEPIDOSTOMATIDAE Ulmer, 1903 *Lepidostoma inerme* (McLachlan, 1878)
13.	*Lepidostoma kashmiricum* Saini and Parey, 2011
14.	*Lepidostoma lidderwatense* Parey, Morse and Pandher, 2016
15.	*Lepidostoma margula* (Mosely, 1949)

Table 1b contd.

Sl. No.	Name of the Species
16.	*Lepidostoma nagana* (Mosely, 1939)
17.	*Lepidostoma parvulum* (McLachlan, 1875)
18.	*Lepidostoma sonmargae* Parey and Saini, 2012
19.	*Lepidostoma sonomax* (Mosely, 1939)
20.	Family PHRYGANEIDAE Leach, 1815 *Eubasilissa asiatica* (Betten, 1909)
21.	*Eubasilissa maclachlani* (White, 1862)
22.	*Eubasilissa schmidi* Parey and Saini, 2012
23.	Family GLOSSOSOMATIDAE Wallengren, 1891 *Glossosoma moselyi* Kimmins, 1953
24.	Family HYDROPTILIDAE Stephens, 1836 *Stactobia hurin* Schmid, 1983
25.	*Stactobia martynovi* Schmid, 1959
26.	Family HYDROBIOSIDAE Ulmer, 1905 *Apsilochorema kashmirensis* Saini, Lakhwinder, Pandher and Parey, 2013
27.	Family RHYACOPHILIDAE Stephens, 1836 *Himalopsyche todma* Schmid, 1963
28.	*Himalopsyche kadaphes* Schmid, 1959
29.	*Himalopsyche kashmirensis* Kaur and Saini, 2013
30.	*Himalopsyche kedara* Schmid, 1970
31.	*Himalopsyche lhadzongpa* Schmid, 1970
32.	*Himalopsyche nigricans* Saini, Kaur and Rathor, 2012
33.	*Himalopsyche obscura* Martynov, 1927
34.	*Himalopsyche scissa niyampa* Schmid, 1970

Hydropsyche sp. (Larva) Ulmer, 1905

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Chapter 12

INSECTA : LEPIDOPTERA (BUTTERFLIES)

AVTAR KAUR SIDHU and T. KUBENDRAN

Trans-Himalayan region of India is represented by 90 species of butterflies belonging to 11 subfamilies and 5 families. This region habours mainly Palaearctic species, which are unique and endemic to this region. The butterflies there are also having prevalent population variations as well as sibling complexes. Molecular studies are required to separate out these complexes. Many species of this region come under Wildlife (Protection) Act, 1972, evaluating the genetic diversity in these species will act as a tool in preventing species loss.

Keywords: distribution, Apollo butterflies, high altitude, cold deserts

INTRODUCTION

Butterflies are the most beautiful group of insects known for their remarkably coloured wings which flutter during the day to add on to the beauty of nature. Besides their fascinating appeal, they not only act as incidental pollinators but also as bioindicators. They are considered as flagship species for insect conservation. Though they form only 1.87% of the total insect fauna of the world, but their charismatic appeal made them the most prominent group of insects. In world there are 18,768 species of butterflies falling under the superfamily Papilionoidea of the order Lepidoptera (van Nieukerken *et al.,* 2011) and in India according to an estimate, as many as 1400-1600 species of the butterflies dwell in different habitats (Evans, 1932; Talbot, 1939, 1947; Wynter-Blyth, 1957; Haribal, 1992; Vaishney, 1994; Kehimkar, 2008; Varshney and Smetacek, 2015). Out of these, four hundred and fifty one species of the butterflies have been included in different schedules of the Wildlife (Protection) Act, 1972, with a view to protect and conserve them. From Indian Himalayan region 1013 species of butterflies has been reported, out of which, the biogeographic zone 1 represents 134 species (1A : 111 species; 1B : 76 species and 1C : 5 species) (Das *et al.,* 2018). As per Mani (1962), the Zanskar range and Ladakh range constitute the Trans-Himalayan region of India and this region is represented by 90 species of butterflies.

ADAPTATIONS

As the Trans-Himalaya is a distinct biogeographic unit characterized by harsh climate with oxygen deficiency, low atmospheric pressure, excessive cold, aridity, high velocity winds and intense radiation. The climate is dry temperate to arctic characterized by extreme of heat and cold coupled with excessive dryness which has almost no rain and is snow-covered for 8 months of the year. The tree line is absent and the vegetation is sparse and restricted to valleys. The butterflies species dwelling in this region have adapted to endure the rigors of the extreme climatic conditions. Butterflies are holometabolus insects that pass through four life history stages viz. egg, larva, pupa and adult. These are closely associated with flowering plants. The larvae of butterflies forage on the host plants and the adults act as incidental pollinators. The flowering season in Trans-Himalaya last only few days i. e. from July to end of August, which is also called the summer period. Being cold blooded animals and the dependency of adults on flowers, butterflies are active only during this period of the year in Trans-Himalaya. They hibernate as egg stage (as in genus *Parnassius*) or in pupal stage to pass the long winter. There is only one generation of butterflies in Trans-Himalaya as the summers are very short.

The wings and bodies of butterflies present in Trans-Himalaya are more wholly and hairy. Even the cosmopolitan species like *Pieris brassicae, Pieris canidia, Colias erate, Colias fieldii* can be easily recognized from

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (HP)
Email: avtarkaur2000@gmail.com; kailash616@gmail.com

Citation
Sidhu, A.K. and Kubendran, T. 2019. Insecta : Lepidoptera (Butterflies). In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 85-94. (Published by the Director, Zool. Surv. India, Kolkata)

their lower altitude counterparts from their excessive hairy body and wooly wings. The dominant wing colour in Trans-Himalayan butterflies is white, black, copper or blue, the colours which can absorb and also reflect more heat to get the body warmed quickly. The behavioural thermoregulation is very prevalent in Trans-Himalayan butterflies. They become active around 10-11 am and can be seen sitting on dry sand, stones, leaves to bask in the sunshine. They adopt various postures for basking. It may be lateral basking (folding completely their wings over their body and pressing the body to stones or sand to absorb heat from substratum) or dorsal basking (completely spreading their wing to have maximum heat) or later basking (where the wings are kept at an angle to reflect the heat onto their body) or appressed basking (here the wing are pressed against the ground to form a tent like structure to trap the warm heat). The appressed basking is observed only in trans-himalayan butterflies. Owing to strong wind velocity in Trans-Himalaya, the butterflies always keep their flight low; thereby there is occurrence of highly localized populations and great diversity of subspecies.

HABITATS AND HABITS

The butterflies dwell almost in every habitat of Trans-Himalaya ranging from an altitude of 2500 to 5500 m. However the dominance both in terms of species diversity and abundance is found in lower altitudes. In higher reaches of Trans-Himalaya, the butterfly species are highly habitat specific. Apollo butterflies (genus *Parnassius*) are present above 4000 m (except *Parnassius hardwickii),* confined to moist alpine pastures with highly localized populations. The other genera associated with alpine pastures are *Baltia* of family Pieridae, *Hesperia* and *Erynnis* of family Hesperiidae, *Baltia* of family Pieridae, and *Albulina* of family Lycaenidae. The genera *Colias, Pontia, Pieris, Argynnis* and the members of family Lycaenidae are dominant in agriculture fields. The genus *Hyponephele* of family Nymphalidae is quite dominant in dry scrub lands. The genera *Papilio, Karanasa, Paralasa, Argynnis* and *Aglais* are dominant along the edges of fresh water and brackish water lakes of Trans-Himalaya.

The butterflies become active around 10 am in Trans-Himalayan region. In early hours they are less active due to cold and often seen baking in stones, leaves and other substratum to increase their body temperature required for active flight. During noon hours they become active and often seen pollinating the flowers in wild as well as in the crops grown in the fields. The seasonal variations in Trans-Himalayan butterflies are not prevalent as there is only single brood due to short summers, however sexual dimorphism exists. The Trans-Himalayan butterflies are tough to identify in the fields due to presence of individual variations and sibling complexes in most of the species, especially of the genera *Polyommatus, Albulina, Parnassius, Argynnis, Aglais, Karanasa, Hyponephele, Colias* etc. Certain species of Trans-Himalaya (of genera *Pieris*, *Colias, Karanasa, Aulocera, Polyommatus, Albulina)* exhibits mudpuddling behaviour in males, however they puddle individually or in a group of 2-5, but never in large numbers. The species of genera *Karanasa, Hyponephele, Baltia* and *Parnassius* exhibits excellent camouflage with the surroundings. The Apollo butterflies and *Baltia* species settle often on the white pebbles on the ground, totally mimicking with the substratum and very hard to find once settled. The species of genera *Karanasa* and *Hyponephele* fold their wings and mostly settle on sand with their brown wavy wings pattern blends with the brown sand. A unique defense behavior has been observed in three satyrid butterfly species in Trans-Himalaya that occurs close to the fresh water lakes i.e. the Scarce Mountain Argus (*Paralasa kalinda*), Tawny Satyr (*Karanasa astorica*) and Modest Satyr (*Karanasa modesta*). When disturbed, these butterflies take a quick flight, dive and float on the water, and come back to shores after some time to doze the threat.

ENDEMISM, THREATS AND CONSERVATION

Most of the Indian Trans-Himalayan butterfly species are hypsobiont and Palaearctic. Due to harsh climate and strong wind velocity, most of the species have restricted and localized distribution. Genus *Parnassius,* popularly called as Apollo butterflies are dominant in this region and have maximum number of endemic species/subspecies in this region. The other endemic species are of genera *Karanasa, Hyponephele, Baltia, Albulina* and *Polyommatus.* Though the butterfly diversity is less but the endemism is higher in this region than the other Himalayan species. The major threats to butterflies of Trans-Himalaya are from smugglers and by habitat loss coupled with Tourism. The butterfly resources of Trans-Himalayan butterflies are of more significance when compared with other Himalayan species. Butterfly collectors feed a global butterfly smuggling industry. Dead butterflies are used as wall hangings, earrings, decorative items. The commercially important butterflies especially the Apollo butterflies are now endangered and need immediate attention for their preservation and protection. The Trans-Himalaya is a very fragile ecosystem with quite less but endemic diversity in its floral and faunal components. It remains a forbidden land for a long time due to its remoteness and inhospitable terrains which preserved its diversity. However in recent past the eco-degradation of this region began which pose a threat to its flora and fauna. The construction of roads, increase to tourism and other developmental activities made this fragile ecosystem unstable which ensued a great threat to the survival of butterflies. The need for their protection and conservation is most demanding in view of their fast depleting populations.

ECONOMIC IMPORTANCE

Butterflies perform diverse roles; however they are inadequately researched as potential resource in agro-ecosystems of India. In world market, there is a vibrant commercial front for pupae as cash crop. They are extensively farmed in various countries of America, south-east Asia, Africa and Europe and exported to butterfly houses and exhibits, national parks and museums. The global turnover of butterfly trade is more than 100 million dollars (Rich *et al.,* 2014; Chengappa and Devika, 2017). Trans-Himalaya is one of the remote and inaccessible regions of India. Due to isolation from rest of the world, the people of this region largely depend upon agriculture plants or wild plants for their fundamental needs. The butterfly diversity of this region is highly priced in international market and smugglers involved in the commercial collection of butterflies are taking the aid of local farmers who lived adjacent to rare butterfly habitats. The farmers are usually paid a small fraction of the market value of the specimens. The butterfly Farming and Trading Agency can be established by the government which can encouraged the farmers to take part in commercial exploitation of a renewable resource. This agency can control all trade in butterfly specimens and foster a program of butterfly ranching/farming to encourage protection of rare butterflies' habitats in the vicinity of a farm or village. It will greatly support the economy of the people of this region and the rare butterflies will be conserved in their natural habitats. Thus the butterfly conservation can be linked with livelihoods and sustainable development.

RECOMMENDATIONS

Though the Trans-Himalayan region of India is well studied in butterfly diversity but the recent surveys to estimate their populations and to study their distribution pattern are very less. As most of the species present in this area are endemic and threatened, there is urgent need to study their micro habitats, host plants and immature stages in order to conserve them. Further due to tourist influx and other anthropogenic activities in this region, the habitats of butterflies are being destroyed at rapid pace, as seen at Khardungla (Ladakh) where rare *Parnassius* species are being crushed under vehicles. These activities need to be controlled. Butterflies act as bioindicators, the study of any change in their distribution range, particularly for those species that occur above 4000 m can give a clear picture of the pace of climate change. In Trans-Himalayan butterflies there are population variations as well as many sibling complexes as observed in Family Lycaenidae in genera *Polyommatus, Albilina,* family Papilionidae in genus *Parnassius* and in subfamily Satyrinae. Molecular studies are required to separate out these complexes. Many species of this region come under Wildlife (Protection) Act, 1972, evaluating the genetic diversity in these species will act as a tool in preventing species loss.

Table 1 : Family, Genus and species of butterflies in Indian Trans-Himalaya

Sl. No.	Subfamily	Genus/Species	Common Name	Subspecies
Family PAPILIONIDAE				
1.	Papilioninae	*Papilio machaon* Linnaeus	Common Yellow Swallowtail	*P. machaon ladakensis* Moore
2.	Parnassiinae	*Parnassius acco* Gray	Varnished Apollo	*P. acco tagalangi* Bang-Haas
				P. acco transhimalayensis Eisner
3.	Parnassiinae	*Parnassius acdestis* Grumm-Grshimailo	Banded Apollo	*P. acdestis ladakensis* Avinoff
				P. acdestis rupshuana Avinoff
4.	Parnassiinae	*Parnassius charltonius* Gray	Regal Apollo	*P. charltonius corporaali* Bryk
				P. charltonius eisnerianus Bryk
				charltonius otto (Bryk and Eisner)
5.	Parnassiinae	*Parnassius epaphus* Oberthur	Common Red Apollo	*P. epaphus gyaella* Eisner
				P. epaphus puella Bryk
6.	Parnassiinae	*Parnassius hardwickii* Gray	Common Blue Apollo	*P. hardwickii* Gray
7.	Parnassiinae	*Parnassius jacquemontii* Boisduval	Keeled Apollo	*P. jacquemontii himalayensis* Elwes
				P. jacquemontii rhodius Honrath
				P. jacquemontii jacquemontii Boisduval, Sch II part II of WLPA
8.	Parnassiinae	*Parnassius maharaja* Avinoff	Rupshu Apollo	*P. maharaja erici* Hanus
				P. maharaja maharaja Avinoff

Table 1 contd.

Sl. No.	Subfamily	Genus/Species	Common Name	Subspecies
9.	Parnassiinae	*Parnassius delphius* Eversmann	Banded Apollo	*P. delphius mamaievi* Bang-Haas
10.	Parnassiinae	*Parnassius simo* Gray	Black-edged Apollo	*P. simo kangruensis* Eisner and Weiss
				P. simo lanaki Bryk and Eisner
				P. simo peteri Bang-Haas
				P. simo zarraensis Bang-Haas
11.	Parnassiinae	*Parnassius stenosemus* Honarth	Pir Panjal Banded Apollo	*P. stenosemus divinus* Bryk and Eisner
				P. stenosemus nadiae Weiss and Michel
				P. stenosemus pensi Eisner and Weiss
12.	Parnassiinae	*Parnassius stoliczkanus* C. & R. Felder, Sch. I, Part-IV of WLPA	Ladak Banded Apollo	*P. stoliczkanus beate* Eisner
				P. stoliczkanus stoliczkanus C. and R. Felder
				P. stoliczkanus tenuis Bryk and Eisner
				P. stoliczkanus thomas Eisner
13.	Parnassiinae	*Parnassius actius* Eversmann	Pale Keeled Apollo	*P. actius yelyangi* Bang Haas
Family HESPERIIDAE				
14.	Hesperiinae	*Hesperia comma* (Linnaeus)	Silver-spotted Skipper	*H. comma dimila* (Moore, [1875])
15.	Pyrginae	*Pyrgus cashmirensis* Moore	Kashmir Skipper	*P.cashmirensis cashmirensis* Moore
Family PIERIDAE				
16.	Coliadinae	*Colias thrasibulus* Fabricius	Lemon Clouded Yellow	*C. thrasibulus thrasibulus* Fabricius
17.	Coliadinae	*Colias phiolodice* (Godart)	Clouded Sulphur butterfly	*Colias phiolodice* (Godart)
18.	Coliadinae	*Colias erate* (Esper)	Pale Clouded Yellow	*Colias erate erate*
19.	Coliadinae	*Colias fieldii* (Menetries)	Dark Clouded Yellow	*Colias fieldii fieldii*
20.	Coliadinae	*Colias eogene* C.and R. Felder, Sch II part II of WLPA	fiery clouded yellow	*C. eogene eogene* C. and R. Felder
21.	Coliadinae	*Colias ladakensis* C.and R. Felder, Sch II part II of WLPA	Ladakh clouded yellow	*C. ladakensis* C.and R. Felder
22.	Coliadinae	*Colias leechi* Grum-Grshimailo	Glaucous Clouded Yellow	*C. leechi* Grum-Grshimailo
23.	Coliadinae	*Colias stoliczkana* Moore	Orange Clouded Yellow	*C. stoliczkana stoliczkana* Moore
24.	Pierinae	*Aporia leucodice* Eversmann	Himalayan Blackvein	*A.leucodice belucha* (Marshall)
25.	Pierinae	*Baltia butleri* Moore	Butler's Dwarf	*B. butleri butleri* Moore, Sch II part II of WLPA
26.	Pierinae	*Baltia shawii* (Bates)	Shaw's dwarf	*B. shawii* (Bates)
27.	Pierinae	*Cepora nerissa* (Fabricius)	common gull	*C. nerissa phryne* (Fabricius)
28.	Pierinae	*Pieris brassicae* Linnaeus	Large cabbage White	*P. brassicae nepalensis* Gray
29.	Pierinae	*Pieris canidia* (Linnaeus)	Indian Cabbage White	*P. canidia indica* Evans
30.	Pierinae	*Pieris deota* (de Niceville), Sch II part II of WLPA	Kashmir White	*P. deota* (de Niceville)
31.	Pierinae	*Pieris krueperi* Staudinger	Krueper's small white	*P. krueperi devta* (de Niceville), Sch I part IV of WLPA
32.	Pierinae	*Pieris melete* Menetries	Asian green veined white	*P. melete ajaka* Moore
33.	Pierinae	*Pieris rapae* (Linnaeus)	Small Cabbage White	*P. rapae rapae* (Linnaeus)
34.	Pierinae	*Pontia callidice* Hubner	Lofy Bath White	*P. callidice kalora* (Moore)
35.	Pierinae	*Pontia chloridice* Hubner	Lesser Bath White	*P. chloridice alpina* (Verity), Sch II part II of WLPA

Table 1 contd.

Sl. No.	Subfamily	Genus/Species	Common Name	Subspecies
36.	Pierinae	*Pontia daplidice* (Linnaeus)	Bath White	*P. daplidice moorei* (Roeber)
Family LYCAENIDAE				
37.	Polyommatinae	*Agriades jaloka* (Moore)	Jaloka Mountain Blue	*A. jaloka jaloka* (Moore)
				A. jaloka leela (de Niceville) Sch I part IV of WLPA
38.	Polyommatinae	*Celastrina argiolus* (Linnaeus)	Hill Hedge Blue	*Celastrina argiolus* (Linnaeus)
39.	Polyommatinae	*Aricia agestis* (Schiffermüller)	Brown Argus	*Aricia agestis* (Schiffermüller)
40.	Polyommatinae	*Albulina galathea* Blanchard	Green Underwing	*A. galathea depreei* (Tytler)
41.	Polyommatinae	*Albulina lehanus* (Moore)	Leh Mountain Blue	*A. lehanus* (Moore)
42.	Polyommatinae	*Albulina metallica*(C. and R. Felder), Sch II part II of WLPA	Small Green Underwing	*A. metallica metallica* (C. and R. Felder)
43.	Polyommatinae	*Albulina pheretes* (Hubner)	Mountain Blue	*Albulina pheretes* (Hubner)
44.	Polyommatinae	*Albulina omphisa* (Moore)	Dusky Green Underwing	*A. omphisa* (Moore)
45.	Polyommatinae	*Alpherakya devanica* (Moore), Sch II part II of WLPA	Dusky Meadow Blue	*A. devanica devanica* (Moore)
46.	Polyommatinae	*Lampides boeticus* (Linnaeus), Sch II part II of WLPA	Pea Blue	*L. boeticus* (Linnaeus)
47.	Polyommatinae	*Plebejidea loewii* (Zeller)	Large Jewel Blue	*P. loewii laura* (Evans)
48.	Polyommatinae	*Plebejus christophi* Staudinger	Small jewel blue	*Plebejus christophi* Staudinger
49.	Polyommatinae	*Plebejus samudra* (Moore)	Ladakh Jewel Blue	*Plebejus samudra samudra* (Moore)
50.	Polyommatinae	*Polyommatus stoliczkanus* (C. and R. Felder)	Himalayan Meadow Blue	*P. stoliczkanus stoliczkanus* (C. and R. Felder)
51.	Polyommatinae	*Polyommatus orbitulus* de Prunner	Greenish Mountain Blue	P. orbitulus marlane
52.	Polyommatinae	*Polyommatus eros* (Ochsenheimer)	Common meadow blue	*Polyommatus eros* (Ochsenheimer)
53.	Polyommatinae	*Polyommatus floerenciae* Tytler	Silvery Meadow Blue	*Polyommatus floerenciae* Tytler
54.	Polyommatinae	*Polyommatus icarus* (Rottemburg)	Violet Meadow Blue	*P. icarus fugitiva* (Butler)
55.	Polyommatinae	*Polyommatus loewii* (Zeller)	Large Jewel Blue	*P. loewii laura* (Evans)
56.	Polyommatinae	*Polyommatus ariana* Moore	Lahaul Meadow Blue	*Polyommatus ariana* Moore
57.	Polyommatinae	*Pseudophilotes vicrama* (Moore)	Chequered Blue	*P. vicrama vicrama* (Moore)
58.		*Superflua deria* (Moore)	Indian White-line Hairstreak	*Superflua deria* (Moore)
59.	Lycaeninae	*Lycaena solskyi* Erschoff	Golden Copper	*Lycaena solskyi* Erschoff
60.	Lycaeninae	*Lycaena kasyapa* (Moore)	green copper	*L. kasyapa* (Moore)
61.	Lycaeninae	*Lycaena phlaeas* (Linnaeus)	Common Copper	*L. phlaeas baralacha* Moore
Family NYPMPHALIDAE				
62.	Heliconiinae	*Argynnis jainadeva* Moore, Sch II part II of WLPA	Highbrown Silverspot	*A. jainadeva persephone* Hemming
63.	Heliconiinae	*Boloria jerdoni* (Lang)	Jerdon's silverspot	*B. jerdoni jerdoni* (Lang)
64.	Nymphalinae	*Aglais caschmirensis* (Kollar)	Indian Tortoiseshell	*A. caschmirensis caschmirensis* (Kollar)
65.	Nymphalinae	*Aglais ladakensis* (Moore)	Ladak Tortoiseshell	*A. ladakensis* (Moore)
66.	Nymphalinae	*Aglais rizana* (Moore)	mountain tortoiseshell	*A. rizana rizana* (Moore)

Table 1 contd.

Sl. No.	Subfamily	Genus/Species	Common Name	Subspecies
67.	Nymphalinae	*Melitaea arcesia* Bremer	Blackvein Fritillary	*M. arcesia balbita* Moore
68.	Nymphalinae	*Vanessa cardui* (Linnaeus)	Painted Lady	*V. cardui* (Linnaeus)
69.	Nymphalinae	*Vanessa indica* (Herbst)	Indian red admiral	*V. indica indica* (Herbst)
70.	Nymphalinae	*Polygonia egea* (Cramer)	Eastern Comma	*P.egea undina* (Grum-Grshimailo
71.	Heliconiinae	*Clossiana hegemone* Staudinger	Whitespot Fritillary	*Clossiana hegemone* Staudinger
72.	Heliconiinae	*Clossiana jerdoni* (Lang)	Jerdon's Silverspot	*Clossiana jerdoni* (Lang)
73.	Heliconiinae	*Speyeria aglaja* (Linnaeus)	Dark-green Silverspot	*Speyeria aglaja* (Linnaeus)
74.	Satyrinae	*Aulocera brahminus* Blanchard, Sch II part II of WLPA	Narrow-banded Satyr	*A. brahminus brahminus* Blanchard
75.	Satyrinae	*Aulocera padma* (Kollar)	Great Satyr	*A. padma avatara* (Moore)
76.	Satyrinae	*Aulocera saraswati* Kollar	Striated Satyr	*Aulocera saraswati* Kollar
77.	Satyrinae	*Aulocera swaha* Kollar	Common Satyr	*A. swaha gilgitica* Tytler
78.	Satyrinae	*Hyponephele davendra*	White-ringed Meadowbrown	*H. davendra brevistigma* (Moore)
				H. davendra davendra
79.	Satyrinae	*Hyponephele coenonympha* (C. and R. Felder)	Spotted Meadowbrown	*H. coenonympha* (C. and R. Felder)
80.	Satyrinae	*Hyponephele pulchella* (C. and R. Felder)	Tawny Meadow brown	*H. pulchella* (C. and R. Felder)
81.	Satyrinae	*Hyponephele pulchra* Felder & Felder	Dusky Meadow brown	*H. pulchra astorica* (Tytler)
				H. pulchra neoza (Lang)
82.	Satyrinae	*Karanasa astorica*	Astor Satyr/Tawny Satyr	*K. astorica balti*
				K. astorica astorica pallida
				K. astorica expressa Avinoff and Sweadner
83.	Satyrinae	*Kanetisa digna* Marshall	Chitrali Satyr	*K. digna pallas* (Marshall)
84.	Satyrinae	*Karanasa modesta* Moore	Modest Satyr	*K. modesta gemina* Avinoff and Sweadner
				K. modesta modesta Moore
85.	Satyrinae	*Lasiommata menava* Moore	Dark Wall	*L. menava menava* Moore
				menava maeroides C. and R. Felder, Sch I part IV of WLPA
86.	Satyrinae	*Paralasa kalinda* (Moore)	Scarce Mountain Argus	*P. kalinda kalinda* (Moore), Sch II part II of WLPA
87.	Satyrinae	*Paralasa mani* (de Niceville)	Yellow Argus	*P. mani mani* (de Niceville), Sch II part II of WLPA
88.	Satyrinae	*Pseudochazara baldiva* (Moore)	Tawny Rockbrown	*P. baldiva baldiva* (Moore)
				P. baldiva lehana (Moore)
89.	Satyrinae	*Satyrus pimpla* (C. and R. Felder)	Black Satyr	*S. pimpla pimpla* (C. and R. Felder)
90.	Satyrinae	*Hipparchia parisatis* (Kollar)	White-edged Rockbrown	*H. parisatis shiva* (Le Cerf)

Pseudochazara mniszechii Herrich Schaffer, 1851

Albulina omphisa Moore, 1875

Aulocera brahminus Blanchard, 1853

Baltia butleri Moore, 1882

Albulina metallica (C. and R. Felder, [1865])

Pseudochazara mniszechii Herrich Schaffer, 1851

Parnassius charltonius Gray [1853]

Parnassius epaphus Oberthür, 1879

Parnassius epaphus Oberthür, 1879

Parnassius hardwickii Gray, 1831

Pieris brassicae (Linnaeus, 1758)

Pieris rapae (Linnaeus, 1758)

Polyommatus eros (Ochsenheimer, 1808)

Pontia chloridice (Hübner, 1813)

Pontia daplidice (Linnaeus, 1758)

Pyrgus cashmirensis Moore, 1874

Pyrgus cashmirensis Moore, 1874

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Chapter 13

INSECTA : LEPIDOPTERA (HAWKMOTHS)

AKHIL NAIR, AVTAR KAUR SIDHU and T. KUBENDRAN

The moth diversity found in Trans-Himalaya is limited due to the extreme climatic conditions of the region and also due to less exploring. So far, 60 moth species belonging to 7 families have been reported from this region. Moths of family Sphingidae and Saturniidae are among important pollinators in the area, as they are able to tolerate the extreme cold. Six species of family Sphingidae viz., *Hemaris ducalis ducalis* (Staudinger), *Hyles gallii* (Rottemburg), *Hyles hippophaes bienerti* (Staudinger), *Hyles nicaea lathyrus* (Walker), *Hyles nervosa* (Rothschild & Jordan) and *Smerinthus kindermanii* Lederer have been reported from the region.

Keywords: Heterocera, Sphingidae, Saturniidae, Trans-Himalaya, Diversity.

INTRODUCTION

Among class Insecta, the order Lepidoptera is known to be the second largest order in terms of number of species. The dominance of the Moth (Heterocera) diversity over the Butterflies could be understood by considering the fact that there are 140 families of Moths comprising 1,38,656 known species worldwide, whereas the Butterflies have been classified into five families and the number of species of known is 18,768 only (van Nieukerken *et al.,* 2011). However, almost all the Moths except few are active only at night, which make them less familiar to humans in comparison with the Butterflies which are mostly diurnal and making them more acquainted to the people. The Moths could be differentiated from the Butterflies by examining the antennae and wings. As all the Butterflies have club shaped antennae and no interlocking mechanism between their forewing and hindwing whereas among moths the antennae may of various types including the club shape, and their wings always possess a hook or bristles called frenulum or retinaculum interlocking the forewing and the hindwing. In India, it is estimated that over 12,000 moth species are present (Chandra and Nema, 2007) however, considering the various zoo-geographical regions present in the country, there is great scope of increase in the species number. The Indian Himalaya being very rich in moth diversity possesses about 4,107 species belonging to 53 various families (Sanyal *et al.,* 2018).

In Trans-Himalaya as well as in the Himalaya, the moth diversity is quite less in comparison with the other regions of the country. So far 60 species belonging to 07 families have been recorded from Trans-Himalaya. The less diversity is due to the harsh climatic conditions, coupled with the limited vegetation found in the region. When compared with the butterflies, from the recorded diversity of moths, it appears that this faunal group is not thoroughly explored in Trans-Himalaya. The first records of moth diversity of Trans-Himalaya have been documented by Hampson (1892, 1894, 1895, 1896) under the series The Fauna of British India including Ceylon and Burma. In subsequent years, the diversity was explored by various workers, the study generally focusing on certain particular families. Tough terrain & climatic conditions, along with the limited availability of resources for conducting proper surveys, only a very few localities has been studied repeatedly so far. This leaves the scope of discovering few more species especially in the gap areas of the regions. The severe cold especially at night in the region promotes the diversity of those moths which are diurnal or crepuscular (active at dawn & dusk) or the moth families which are more tolerant towards severe cold or small sized in which the heat loss is less like those of family Noctuidae and Tortricidae. 12 species from the family Tortricidae and 23 species from the family

High Altitude Regional Centre, Zoological Survey of India, Solan-173 211 (HP)
Email: akhil_2919@yahoo.com; avtarkaur2000@gmail.com

Citation
Nair, A., Sidhu, A.K. and Kubendran, T. 2019. Insecta : Lepidoptera (Hawkmoths). In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 95-101. (Published by the Director, Zool. Surv. India, Kolkata)

Noctuidae has been reported which are significantly more in comparison to other moth families. The diurnal moths such as *Campylotes histrionicus* Westwood of family Zyganidae and *Hemaris ducalis ducalis* (Staudinger) of family Sphingidae, along with five other hawk moth species, are present in the region.

SPHINGIDS-THE HAWKMOTHS

Hawk moths or Sphinx moths are among the swiftest flying insects. These large to medium moths can be easily distinguished from any other insect due to their unique streamlined body and wings, which also aid providing them their hovering capability. The shape and coloration of the wing varies a lot among the different genera. The larvae of sphingids have a single large and stiff horn projecting near the posterior end and can be seen feeding openly over the host plants. The pupation generally occurs in soil or litter inside a cell. The adult solely depend on flower nectar for their energy requirement, which they feed with the help of their long proboscis even from the long tubular flowers without causing any damage to it. They are among the major pollinators of any area and are found in all habitable regions across the world. All over the world, 1,463 species of hawk moths belonging to 206 genera has been reported so far, and in Indian Himalaya the number of hawk moth species is 184 under 54 genera (Sanyal *et al.,* 2018). However, only six species of Hawk moths have been reported from the Trans-Himalayan region.

Hemaris ducalis ducalis (Staudinger, 1887)

Common Name: Pamir Bee Hawkmoth

Host Plant: *Lonicera* spp.

This high altitudinal diurnal moth can be seen hovering around flowers during day time in the region, resembling the bumblebees. This is a medium sized moth, with its forewings covered with brown colored scales and the hind wings with the orange coloured scales along with transparent portions on both the wings. Apart from being reported from Ladakh-India (Smetacek and Kitching, 2012), the species has been reported to be distributed across the Central Asian plateau region near Himalaya from Uzbekistan (Dubatolov, 1999), Kazakhstan (Yakovlev and Doroshkin, 2005; Shovkoon, 2015), Tajikistan (Grum-Grshimailo, 1890; Eitschberger and Lukhtanov, 1996), Kyrgyzstan, Mongolia (Yakovlev and Doroshkin, 2005), Xinjiang Province-China, Afghanistan (Ebert, 1969), Pakistan (Danner, Eitschberger and Surholt, 1998; Rafi *et al.,* 2014), Ladakh-India (Smetacek and Kitching, 2012). The altitude range for the distribution of species is between 2000 m to 4000 m.

Hyles gallii (Rottemburg, 1775)

Common Name: Bedstraw Hawkmoth

Host Plant: *Galium* spp. & *Epilobium* spp.

This large olive coloured hawkmoth is a part of a big genus *Hyles* Hübner, (1819) which includes 42 subspecies and 29 species (Kitching and Caidou, 2000). *Hyles gallii* could be seen active during the dawn time and very much attracted towards the light. This species is widely distributed in the Northen hemisphere in temperate countries from North America in west to China in east and as far as Siberia-Russia in North. It has been recorded from various Central Asian countries. In Indian Trans-Himalaya region the species has been reported from Ladakh of Jammu & Kashmir state upto an altitude of 4360 m (Bell and Scott, 1937; Smetacek and Kitching, 2012; Sidhu *et al.,* 2018). Recently, the species has been reported from the Spiti Valley of Himachal Pradesh in the Indian trans-himalaya region at an altitude of 3673 m (Sidhu *et al.,* 2018).

Hyles hippophaes bienerti (Staudinger, 1874)

Common Name: Seabuckthorn Hawkmoth

Host Plant: *Hippophae rhamnoides* and *Elaeagnus* spp.

The moth has got its name from the host plant *Hippophae rhamnoides* (Sea buckthorn), which widely distributed in cold temperate region of Europe and Asia. *Hyles hippophaes bienerti* can be distinguished from the other species of the same genus with having a more orange coloured hindwing. This large sphingid sub species is found to be distributed in middle east Asia and North West Himalayan region, however the species was last reported from Indian Trans-Himalaya in year 1912 (Smetacek and Kitching, 2012) until recently when the species has been reported again from the region after more than 100 years from the Ladakh and Spiti Valley at an altitude 3048 m to 3673 m (Sidhu *et al.,* 2018).

Hyles nicaea lathyrus (Walker, 1856)

Common Name: Mediterranean Hawkmoth

Host Plant: *Euphorbia* spp.

The large fast flying hawk moth is olive brown in colour and can easily be distinguished from the other speices of the genus with the specific forewing pattern. The subspecies is found in the Himalyan region from Afghanistan (Ebert, 1969), Northern Pakistan (Rafi *et al.,* 2014), Xizang province of China (Walker, 1856) and from Indian Trans-Himalaya locality of Ladakh (Smetacek and Kitching, 2012). This moth is found active during the month of July to September in the region.

Hyles nervosa (Rothschild & Jordan, 1903)

Common Name: Ladakh Hawkmoth

Host Plant: *Euphorbia* spp.

An endemic hawkmoth species of North West Himalaya, which has been reported so far from

Afghanistan (Ebert, 1969), Northern Pakistan (Rafi *et al.,* 2014), Xizang province of China and from Ladakh (Smetacek and Kitching, 2012) with an altitudinal range of 1200 m-3300 m. The species is smaller in size in comparison with the other species of the genus in the region and can be distinguished with the presence of two lateral black spots at abdomen. The moth can be seen active during the months between June to September in the region.

Smerinthus kindermannii Lederer, 1853

Common Name: Southern eyed Hawkmoth

Host Plant: *Populus* spp. and *Salix* spp.

A large hawkmoth with unique dentate forewing shape and pattern, found well distributed across the high altitude regions of Central Palaeartic countries upto North Western Himlayan region. The first reporting for the species from Trans-Himalayan region was done on the basis of fifth instar larva found at Ladakh by Smetacek and Kitching in 2012, however recently several new localities at Spiti Valley as well as at other high altitude regions ranging from 2960 m to 4138 m have been reported on the basis of finding of adult specimens (Sidhu *et al.,* 2018).

Note: The common names and host plants for the species mentioned above are credited to the information published by Kitching and Pittaway.

SATURNIIDS-THE EMPEROR MOTHS

The family Saturniidae includes some of the largest moth species (Atlas moth, *Attacus atlas*) along with species which produces wild silk (Tussar Silk moth, *Antheraea mylitta*) as well. These moths have very large wings in comparison of their body size and both the body and wings are covered with thick wooly hairs. They generally have beautiful coloration and pattern over their wings along with a unique triangular or eye-shaped spot (ocellatus). The male and female communicate from very far with help of pheromones, which is achieved by the well developed quadri-pectinate antennae (feather like). The family Saturniidae has 2349 species in the world under 169 genera whereas the diversity for the same in Indian Himalaya is limited to 37 species under 13 genera. So far, only two species of the family has been reported from the Trans-Himalayan region of Indian Himalaya. The species *Neoris huttoni shadulla* Moore, 1872 was reported by Hampson in year 1892 from the Ladakh region (J&K) at an altiutude 3657 m and *Caligula lindia* Moore, 1865 has been reported recently from the Spiti Valley, Himachal Pradesh at an altitude 3673 m.

ECOLOGICAL IMPORTANCE OF MOTHS IN THE REGION

The large global diversity and number of moths indicates the success they achieved during the course of evolution. They are well adapted for nearly all type of habitats across the world with variety of feeding habits. In Trans-Himalaya, the overall biological diversity is less due to the environmental conditions, however this increases the ecological importance of each species that is present over there. The moth diversity at its prime can be observed during the summer season of the region from July to August months. The moths play a variety of important roles in the ecosystem of the region with different species contributing differently for maintaining the stability. Majorly, the moths act as primary consumers, feeding on the limited vegetation available in the cold desert, especially in their larval stages. Moths of families Erebidae, Tortricidae, Noctuidae etc., feeds on variety of vegetation and are also considered among the pest however, they also keep check on growth of weeds among the crops in the region. Moths from family Sphingidae, Zyganidae, etc. act as important pollinators in the region especially to the flowers which are blooming other than day time. These moths also facilitate pollination of certain unique plants with medicinal properties being endemic to the Trans-Himalaya. Moths also serve as food for various primary consumers like insectivorous birds, reptiles and mammals (bats & rodents), thus passing on the energy conserved by them into the food chain of the region.

RECOMMENDATAIONS

The harsh climate and limited availability of resources restricts the study of moth diversity in the region, however there lies a great scope of finding new species adapted completely for this unique habitat. The isolated areas in the region are completely separate from the nearby region with various geological barriers which could have lead in development of various restricted population, sub-species or species. Exclusive expedition for the study of the diversity needs to be conducted in all habitable seasons especially in the gap areas which are far away from the localities studied earlier. Detailed study about the life cycle of each species reported is required to understand the role played by them in the ecosystem. This could also bring about the various new information regarding the various adaptations they have incorporated in themselves in order to survive in the harsh climate of Trans-Himalaya. The pest problem of the limited crops grown in the region could also be effectively controlled if the complete details regarding the suspected species are available. Though, the climate change, increased tourism, infrastructural development and modern agricultural practices in the region has now started to affect the diversity of the moth fauna, however no conclusive studies for the same has been conducted yet. It is certain that all the above mentioned factors along with increased human

interference will definitely have adverse effect on the moth diversity of the region. The species diversity among the various families of moths will significantly change with the change in climatic conditions and the vegetation found in the region. Therefore, those moths with very limited distributional range in the region needs to be provided with proper conservational status before they completely vanishes. The conservational polices incorporated for the evaluation and protection of biodiversity needed to be constructed providing equal importance to the groups such as moths, whose acquaintance is still far from familiar.

Table 1 : The moth species reported from Trans-Himalayan region of India.

Sl. No.	Family	Species
Order LEPIDOPTERA (moth)		
1.	Tortricidae	*Cylia ponomella* (Linnaeus, 1758)
2.		*Dichrorampha euterpes* Diakonoff, 1971
3.		*Eppihus hippeus* Razowksi, 2005
4.		*Eucosma tetraplana* (Moschler, 1886)
5.		*Lepteucosma oxychrysa* Diakonoff, 1971
6.		*Pelochrista frustata* Razowksi, 2005
7.		*Pelochrista pollinaria* Diakonoff, 1971
8.		*Cnephasia hunzorum* Diakonoff, 1971
9.		*Epelebodina concolorata* Razowksi, 2005
10.		*Eupoecilia dynodesma* (Diakonoff, 1971)
11.		*Meridemis subbathymorpha* Razowksi, 2005
12.		*Neocalyptis chlansignum* Razowksi, 2005
13.		*Neocalyptis ladakhana* Razowksi, 2005
14.	Zygaenidae	*Campylotes histrionicus* Westwood, 1839
15.	Sphingidae	*Hemaris ducalis ducalis* (Staudinger, 1887)
16.		*Hyles gallii* (Rottemburg, 1775)
17.		*Hyles hippophaes bienerti* (Staudinger, 1874)
18.		*Hyles nicaea lathyrus* (Walker, 1856)
19.		*Hyles nervosa* (Rothschild & Jordan), 1903)
20.		*Smerinthus kindermannii* Lederer, 1853
21.	Saturniidae	*Caligula lindia* Moore, 1865
22.		*Neoris huttoni shadulla* Moore, 1872
23.	Erebidae	*Arctia intercalaris* (Eversmann, 1843)
24.		*Arctia thibetica* Fedler, 1874
25.		*Carcinopyga lichenigera* Felder, 1874
26.		*Oroncus ladakensis* O. Bang-Hass, 1927
27.		*Orontobia taglangla* De Freina, 1997
28.		*Spilarctia meianostigma* (Erschoff, 1872)
29.		*Spilosoma melanostigma* Erschoff, 1872

Table 1 contd.

Sl. No.	Family	Species
30.		*Catocala afghana* Swinhoe, 1885
31.		*Catocala amnonfreidbergi* Kravchenko *et al.,* 2008
32.	Erebidae	*Catocala concubia* Walker, 1857
33.		*Bomolocha crassalis* (Fabricius, 1787)
34.		*Bomolocha rhombalis* (Guenée, 1854)
35.		*Hypena tenebralis* (Moore, 1877)
36.		*Lachana ladakensis* Moore, 1888
37.	Euteliidae	*Lophoptera squamigera* Guenée, 1852
38.		*Micardia pulcherrima* (Moore, 1867)
39.		*Acronicta maxima* (Moore, 1881)
40.		*Acronicta rumicis* Linnaeus, 1758
41.		*Amphipyra monolitha* Guenée, 1852
42.		*Amphipyra pyramidea* (Linnaeus, 1758)
43.		*Cryphia albipuncta* Hampson, 1894
44.		*Prospalta galaxia* (Butler, 1883)
45.		*Cucullia verbasci* (Linnaeus, 1758)
46.		*Eupsilia transversa* (Hüfnagel, 1766)
47.		*Hyada grisea* Moore, 1882
48.		*Pyrrhia umbara* (Hüfnagel, 1766)
49.	Noctuidae	*Macdunnoughia confusa* (Stephens, 1850)
50.		*Agrotis cinerea* (Denis and Schiffermüller, 1775)
51.		*Agrotis ipsilon* (Hüfnagel, 1766)
52.		*Aletia vitellina* (Hübner, 1827)
53.		*Cosmia affinis* (Linnaeus, 1767)
54.		*Euxoa agricola* (Boisduval, 1829)
55.		*Euxoa basigramma* (Staudinger, 1870)
56.		*Euxoa nigricans* (Linnaeus, 1761)
57.		*Euxoa temera* (Hübner, 1808)
58.		*Euxoa tibetana* (Moore, 1878)
59.		*Leucania palaestinae* Staudinger, 1897
60.		*Polia mortua* (Staudinger, 1888)

Hyles gallii Rottemburg, 1775

Hyles hippophaes Staudinger, 1874

Hyles livornica Esper, 1780

Hyles nervosa Rothschild and Jordan, 1903

Smerinthulus kindermannii Lederer, 1853

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Chapter 14

INSECTA : DIPTERA : CHIRONOMIDAE

SANJEEV KUMAR

Tans-Himalayan lakes of Ladakh and Spiti valley harbour 67 species of Chironomidae: Insecta. They are major source of food for migratory birds and an important bio-indicator of high altitude wetlands.

Keywords: Chironomidae, Trans-Himalayan wetlands/ Ladakh and Spiti valley, Bio-indicator

INTRODUCTION

A large number of lakes of Trans-Himalaya (Ladakh and Spiti Valley) were investigated way back in 1983-1986 and again under rapid assessment of Fauna in the year 2008. The family Chironomidae was documented from the important high altitude wetlands such as Pangong Tso and stream (4218 m amsl), Tso Moriri (4511 m amsl), Tso Kar (4530 m amsl), Tsigul Tso (4247 m amsl), Marshes of Chusul wetlands, Chandra Tal (4270 m amsl) and numerous wetlands formed along the Indus River in Changthang Valley etc. Chironomidae larvae are the bio-indicators of health of an ecosystem and major food of the aquatic winter migrants of these desolate wetlands.

HISTORICAL RESUME

The Chironomidae of Trans-Himalayan lakes were studied by Hutchinson (1933) who documented chironomid larvae as the only organisms from the Yaya Tso (4680 m amsl) and Pangong Tso (4218 m amsl.) lakes. A checklist of chironomid midges (Diptera: Chironomidae) of the Indian subcontinent have been given by Chaudhuri *et al.* (2001). Arthropod composition including family Chironomidae of High Altitude lakes has been studied by Singh (1987), Kumar (1992), Kumar *et al.* (1989) and Mehta & Kumar (2011). Maheshwari & Maheshwari (2004 a, b) documented more than 50 species of Chironomidae from Ladakh lakes. Bhagat (2014) has also described 38 species from lakes of Jammu, Kashmir and Ladakh Himalaya.

Total Species: A checklist of 67 species, belonging to 40 genera and four subfamilies of one family Chironomidae (Non-Biting Midges) of Order Diptera of Class Insecta are given (Table 1 & 2). The Family Chironomidae is yet not assessed by IUCN/CITES/IWL (P) Act 1972.

Table 1 : Taxonomic Distribution of Family CHIRONOMIDAE

Subfamily	Genus	Species
Chironominae	11	22
Diamesinae	03	03
Orthocladiinae	24	40
Podonominae	02	02

SUMMARY

The Trans-Himalayan (Ladakh & Spiti Valley) lakes are represented by 67 species belonging to 40 genera and 4 sub-families of family Chironomidae. The most dominant sub-family is Orthocladiniinae followed by Chironominae. Tso Moriri harbours the maximum species diversity. Since these pristine high altitude Trans-Himalayan wetlands are remotely located in a most inaccessible rarefied environment much above the tree line, they are the natures true natural living germplasm banks and holds important taxa of chironomids as bio-indicators. Increased accessibility to tourists and related activities is a serious threat to these wetlands in near future. Regular monitoring and minimization of such activities is required to maintain the virgin environment of these wetlands.

Desert Regional Centre, Zoological Survey of India, Jodhpur-342 005(RJ)
Email: dr.kumarsanjeev@gmail.com

Citation
Kumar, S. 2019. Insecta : Diptera : Chironomidae. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 103-106. (Published by the Director, Zool. Surv. India, Kolkata)

Table 2 : Checklist of Chironomidae of Indian Trans-Himalayan Wetlands

Sl. No.	Name of the Species	Chusul Marshes	Tsigul Tso	Tso Moriri	Tso Kar	Pangong Tso & Stream	ChandraTal	Wetlands of River Indus (Changthang Valley)
	Subfamily CHIRONOMINAE							
1.	*Cryptochironomus ladakhiensis* Maheshwari & Maheshwari, 2000			+				
2.	*Dicrotendipes korzokiensis* Maheshwari & Maheshwari, 2000			+				
3.	*Dicrotendipes paraensis* Maheshwari & Maheshwari, 2000			+				
4.	*Dicrotendipes pelduensis* Maheshwari & Maheshwari, 2000			+				
5.	*Dicrotendipes phirsaensis* Maheshwari & Maheshwari, 2000			+				
6.	*Kiefferulus spinai* Maheshwari & Maheshwari, 2000			+				
7.	*Xenochironomus pungaenisis* Maheshwari & Maheshwari, 2000			+				
8.	*Cladotanytarsus changthangi* Maheshwari & Maheshwari, 2000			+				
9.	*Cladotanytarsus scalopi* Maheshwari & Maheshwari, 2000			+				
10.	*Micropsectra himachali* Maheshwari & Maheshwari, 2000	+	+	+	+	+	+	+
11.	*Micropsectra chanderi* Maheshwari & Maheshwari, 2000	+		+	+	+		
12.	*Micropsectra chandratalensis* Maheshwari & Maheshwari, 2000		+	+		+	+	
13.	*Micropsectra glacies* Maheshwari & Maheshwari, 2000			+	+	+		
14.	*Micropsectra hutchinsoni* Maheshwari & Maheshwari, 2000			+		+		
15.	*Micropsectra lahulensis* Maheshwari & Maheshwari, 2000			+	+		+	+
16.	*Micropsectra rupshuensis* Maheshwari & Maheshwari, 2000			+				
17.	*Micropsectra spatulata* Maheshwari & Maheshwari, 2000		+	+	+	+		
18.	*Neostempellina changpasi* Maheshwari & Maheshwari, 2000			+				
19.	*Paratanytarsus spikensis* Maheshwari & Maheshwari, 2000			+				+
20.	*Rheotanytarsus nakpoi* Maheshwari & Maheshwari, 2000			+				
21.	*Stempellina scalpel* Maheshwari & Maheshwari, 2000			+				
22.	*Tanytarsus sinuatus* Goetghebur, 1936			+	+	+		+
	Subfamily DIAMESINAE							
23.	*Pseudodiamesa glaci* Maheshwari, 2001	+					+	+
24.	*Diamesa* sp.		+	+		+		
25.	*Protanypus* sp.	+					+	
	Subfamily ORTHOCLADIINAE							
26.	*Abiskomyia clivus* Maheshwari & Maheshwari, 2000			+				
27.	*Abiskomyia crepide* Maheshwari & Maheshwari, 2000			+		+		
28.	*Bryophaenocladius* sp.			+			+	+
29.	*Chasmatonotus glacioensis* Maheshwari & Maheshwari, 2000			+	+			
30.	*Clinocladius bhatnagari* Maheshwari & Maheshwari, 2000			+	+			
31.	*Corynoneura carinata* Singh & Maheshwari, 1987			+			+	+
32.	*Corynoneura carriana* Edwards, 1924				+		+	

Table 2 contd.

Sl. No.	Name of the Species	Chusul Marshes	Tsigul Tso	Tso Moriri	Tso Kar	Pangong Tso & Stream	ChandraTal	Wetlands of River Indus (Changthang Valley)
33.	*Corynoneura chandertali* Singh & Maheshwari, 1987			+			+	+
34.	*Corynoneura lahuli* Singh & Maheshwari, 1987						+	+
35.	*Corynoneura* sp.			+			+	
36.	*Cricotopus nubrai* Maheshwari & Maheshwari, 2000			+		+		
37.	*Eukiefferiella archanai* Maheshwari & Maheshwari, 2000			+				
38.	*Heterotrissocladius numi* Maheshwari & Maheshwari, 2000			+				
39.	*Himatendipes* sp.			+	+	+	+	
40.	*Krenosmittia labellumi* Maheshwari & Maheshwari, 2000	+		+				
41.	*Krenosmittia lamminansis* Maheshwari & Maheshwari, 2000			+				
42.	*Krenosmittia longulusi* Maheshwari & Maheshwari, 2000	+		+				
43.	*Mariocladius meetai* Maheshwari & Maheshwari, 2000			+		+		
44.	*Metriocnemus yaki* Maheshwari, 2001	+					+	
45.	*Oreadomyia patinaensis* Maheshwari & Maheshwari, 2000			+				
46.	*Orthocladius dolosuri* Maheshwari & Maheshwari, 2000			+		+		
47.	*Oliveridia* sp.			+				
48.	*Paracladius alpicola* (Zetterstedt, 1850)		+	+	+	+		
49.	*Paracladius montivagusi* Maheshwari & Maheshwari, 2000		+	+				
50.	*Paraphenocladius monticoliensis* Maheshwari & Maheshwari, 2000			+				
51.	*Plecopteracoluthus glacialisis* Maheshwari & Maheshwari, 2000			+				
52.	*Psectrocladius hamatilis* Maheshwari & Maheshwari, 2000			+				
53.	*Rheocricotopus montanasi* Maheshwari & Maheshwari, 2000			+		+		
54.	*Smittia spicai* Maheshwari & Maheshwari, 2000			+				
55.	*Smittia spiculumiensis* Maheshwari & Maheshwari, 2000			+				
56.	*Symbiocladius khardongi* Maheshwari & Maheshwari, 2000			+				
57.	*Symbiocladius magnus* Maheshwari & Maheshwari, 2000			+	+			
58.	*Symbiocladius modius* Maheshwari & Maheshwari, 2000			+				
59.	*Symbiocladius nurlai* Maheshwari & Maheshwari, 2000			+				
60.	*Symbiocladius parabillisi* Maheshwari & Maheshwari, 2000			+				
61.	*Symbiocladius parasiticus* Maheshwari & Maheshwari, 2000			+				
62.	*Symbiocladius shayaki* Maheshwari & Maheshwari, 2000			+		+		
63.	*Symbiocladius zanskari* Maheshwari & Maheshwari, 2000			+				
64.	*Thienemanniella hallexi* Maheshwari & Maheshwari, 2000			+				
65.	*Zalutschia hemisi* Maheshwari & Maheshwari, 2000			+				
	Subfamily PODONOMINAE							
66.	*Paraboreochlus tsomorariensis* Maheshwari & Maheshwari, 2000			+	+			
67.	*Podonomus* sp.			+				

Chironomidae

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Chapter 15

MOLLUSCA

BASUDEV TRIPATHY, S.K. SAJAN and AVTA KAUR SIDHU*

The life on a rugged mountains, harsh climatic condition and alpine-arid pastures vegetation act as a challenging task for adaptation of the flora and fauna in the Trans-Himalaya biogeographic zone. In this chapter we provide an updated checklist of land and freshwater molluscan fauna of Trans-Himalaya. The compilation of this study was based on the available literature, previous collection present in NZC and field surveys. A total of 74 species and subspecies of land and freshwater Mollusca were identified from Trans-Himalaya, of which 12 species are endemic to this region.

Keywords: Gastropoda, Bivalvia, Diversity, Distribution, Endemism, Trans-Himalaya, India

INTRODUCTION

The information on landscape specific biodiversity, particularly of the lesser known invertebrate received little attention in India, although invertebrates known to dominate in any given ecosystem, be it the marine, freshwater, terrestrial or even the high altitude. Moreover, the poor knowledge on lesser known invertebrate fauna is needed to be exploring, as they are equally important component for conservation and well-being of the ecosystem. The Trans-Himalaya biogeography zone in India with unique cold climate, vegetation type and fragile mountainous system are divided into the three biogeographic provinces. The phylum Mollusca is the most diverse and ancient group of animal kingdom, and considered as the second largest group in animal phyla in terms of the species occurrence and description (Fedonkin and Waggoner 1997, Lydeard *et al.* 2004, Hohagen and Jackson 2013). It represents 6% of the total described species in the world (Lydeard *et al.,* 2004). Being a most diverse and a ubiquitous component of ecosystem, it is found in all the possible habitats *viz.* terrestrial ecosystem, mountainous ecosystem, freshwater ecosystem, fragmented forests, agriculture field, human habitation, and marine ecosystem (Bouchet 1992, Barker 2002, Lydeard *et al.,* 2004). Despite of huge ecological importance, molluscs act as most essential component of the ecosystem in terms of their contribution to the ecosystem services, maintaining various life processes, components in the food web and food chain; prey-predator interaction and climate change (Parisi and Gandolfi 1974, Fortunato 2015, Vaughn 2017, Smith *et al.,* 2018).

For better understanding of the molluscan diversity, distribution and species assemblage, compilation and collation of information was done from published literature, reports, and personal observation and faunistic surveys by ZSI. The unique climatic condition, vegetation type and river systems of Trans-Himalaya represent 74 species of molluscs (5.28% of total non-marine Mollusca fauna), which includes 46 land and 28 freshwaters (Dey and Mitra 2000, Ramakrishna *et al.,* 2010, Tripathy *et al.,* 2018). The families Ariophantidae, Enidae and Valloniidae are the most dominant assemblage among land snails; whereas among the freshwater 22 species of Gastropoda and 6 species of Bivalvia have been recorded. The families Lymnaeidae (n=8) and Planorbidae (n=6) are dominant assemblage in gastropods, and Sphaeriidae (n=4) is the dominant family in Bivalvia.

HISTORICAL RESUME

The documentation of malacofauna of India was started in the beginning of 19th century by British malacologist W.H. Benson (1828-1870). In the Trans-Himalaya, the first mollusca collection reported to be by Dr. Ferdinand

Zoological Survey of India, M-Block, New Alipore, Kolkata-700 053(WB)
*High Altitude Regional Centre, Zoological Survey of India, Solan, (HP)-173 211
Email: tripathyb@gmail.com

Citation
Tripathy, B., Sajan, S.K. and Sidhu, A.K. 2019. Mollusca. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 107-113. (Published by the Director, Zool. Surv. India, Kolkata)

Stoliczka from Ladakh, Kashmir, and neighbourhood of Yark and territory (Nevill 1878). Based on the Stoliczka's collection, later Nevill (1878) published the systematic account of 27 species of molluscs from Kashmir and Neighbourhood of Mari (Murree) in the Punjab region. Similarly, Theobald (1878) listed 64 species of land and freshwater molluscs from Mari to Srinagar and thence *ria*, the Mohu pass to Jammu in Kashmir. Contemporarily, Godwin-Austen (1899) prepared a list of 42 species belongs to 17 genera of molluscs from south of the PirPanjal, and Kajnag ranges including the Murree hills and Hazara of Kashmir. In the early 20th century, Gude (1914) included 22 species from 11 genera and six families, in non-operculate land snails in '*Fauna of British India*'. During the post-independence India period, Rajagopal and Subba Rao (1972) studied the entire land molluscan fauna of Kashmir and presented 13 species from four families and which one new record for Kashmir. Tripathy *et al.* (2018) published the checklist of mollusca from Indian Himalayan landscape; of which 422 species of non-marine molluscs (379 land and 43 species of freshwater) has been listed.

SPECIES DIVERSITY AND ENDEMISM

A total of 1347 species of non-marine molluscs; of which 1131 species of land snails and 216 species of freshwater form recorded so far from India (Ramakrishna *et al.,* 2010; Mukhopadhaya *et al.,* 2017; Tripathy *et al.* 2018; Aravind & Páll-Gergely 2018; Sajan *et al.,* 2019a,b). Of these, 422 species of land and freshwater molluscs have been recorded from the Indian Himalayan landscape and constitute of 31.39% of the total Indian land and freshwater molluscan fauna (Tripathy *et al.,* 2018). In trans-Himalaya, 74 species of non-marine molluscs, of which 46 species of land snails belong to 16 families, 11 subfamilies and 23 genera; however, the freshwater molluscs include 10 families, 9 subfamilies and 21 genera have been recorded (Blanford and Godwin-Austen 1908; Gude 1914, 1921; Ramakrishna and Dey 2007; Sharma *et al.,* 2010; Sharma *et al.,* 2013; Ramakrishna *et al.,* 2010; Tripathy *et al.,* 2018). The trans-Himalaya constitutes about 5.28% of the total non-marine malacofauna of the country. Moreover, in terms of species distribution, a total of 3.81% of land snails and 12.96% of freshwater molluscs of the country are found in this region. The *Macrochlamys* (n=10) and *Pseudonapaeus* (n=9) are the dominant genera of land snails found in this region whereas, among freshwater forms, *Radix* (n=5) is the dominant genera recorded. Two families of land snails *viz.* Ariophantidae (n=14) and Enidae (n=10) are dominant in the assemblage, whereas Lymnaeidae (n=8) and Planorbidae (n=6) are the dominant families among freshwater mollusca. The species *viz. Pupilla muscorum* (Linnaeus, 1758), *Glessula huegeli* (L. Pfeiffer, 1842), *Khasiella kashmirensis* (Nevill, 1878), *K. sonamurgensis* (Nevill, 1878), *Cathica malaianensis* (Nevill, 1878), *C. phaeozona* von Martens, 1874 and *Anadenus jerdoni* Godwin-Austen, 1882 are endemic to trans-Himalayan region. In freshwater ecosystem of Trans-Himalaya, *Bithynia kashmirense* Nevill, 1885, *Gyraulus ladacensis* (Nevill, 1878), *Gyraulus pankongensis* (von Martens, 1882), *Euglesa casertana* (Poli, 1791), *Pisidium mitchelli* Prashad, 1925, and *Corbicula cashmiriensis* Deshayes, 1854 are endemic.

Table 1 : The systematic list of freshwater mollusca of Trans-Himalaya (the classification and nomenclature followed by Bouchet *et al.,* 2017, Bank. 2017, Ramakrishna and Dey, 2007)

Class	Family	Subfamily	Genus, author (s) and year	Species
Gastropoda	Viviparidae Gray, 1847	Bellamyinae Rohrbach, 1937	*Filopaludina* Habe, 1964	*Filopaludina bengalensis* (Lamarck, 1822)
			Valvata O.F. Müller, 1773	*Valva tapiscinalis* (Mueller, 1784)
	Bithyniidae Gray, 1857		*Bithynia* Leach, 1818	*Bithynia kashmirense* Nevill, 1885
				Bithynia troscheli (Paasch, 1842)
	Thiaridae Gill, 1871 (1823)	Thiarinae Gill, 1871 (1823)	*Tarebia* H. Adams & A. Adams, 1854	*Tarebia granifera* (Lamarck, 1816)
			Melanoides Olivier, 1804	*Melanoides tuberculata* (O.F. Müller, 1774)
	Lymnaeidae Rafinesque, 1815	Amphipepleinae Pini, 1877	*Cerasina* Kobelt, 1881	*Cerasina luteola* (Lamarck, 1822)
			Radix Montfort, 1810	*Radix rufescens* (Gray, 1822)
				Radix persica (Issel, 1865)
				Radix auricularia (Linnaeus, 1758)
				Radix brevicauda (G.B. Sowerby II, 1872)
				Radix labiata (Rossmässler, 1835)
		Lymnaeinae Rafinesque, 1815	*Galba* Schrank, 1803	*Galba truncatula* (O.F. Müller, 1774)
			Lymnaea Lamarck, 1799	*Lymnaea stagnalis* (Linnaeus, 1758)

Table 1 contd.

Class	Family	Subfamily	Genus, author (s) and year	Species
Gastropoda	Physidae Fitzinger, 1833	Physinae Fitzinger, 1833	*Physella* Haldeman, 1843	*Physella acuta* (Draparnaud, 1805)
	Bulinidae P. Fischer & Crosse, 1880	Bulininae P. Fischer & Crosse, 1880	*Indoplanorbis* Annandale & Prashad, 1921	*Indoplanorbis exustus* (Deshayes, 1834)
	Planorbidae Rafinesque, 1815	Planorbinae Rafinesque, 1815	*Culmenella* Clench, 1927	*Culmenella subspinosa* (Annandale & Prashad, 1920
			Hippeutis Charpentier, 1837	*Hippeutis complanatus* (Linnaeus, 1758)
			Planorbis O.F. Müller, 1773	*Planorbis planorbis tangitarensis* Germain, 1918
				Planorbis rotundatus Poiret, 1801
			Gyraulus Charpentier, 1837	*Gyraulus ladacensis* (Nevill, 1878)
				Gyraulus pankongensis (von Martens, 1882)
Bivalvia	Unionidae Rafinesque, 1820	Parreysiinae Henderson, 1935	*Lamellidens* Simpson, 1900	*Lamellidens corrianus* (I. Lea, 1834)
	Cyrenidae Gray, 1840		*Corbicula* Megerle von Mühlfeld, 1811	*Corbicula cashmiriensis* Deshayes, 1854
	Sphaeriidae Deshayes, 1855 (1820)	Sphaeriinae Deshayes, 1855 (1820)	*Musculium* Link, 1807	*Musculium indicum* (Deshayes, 1854)
			Sphaerium Scopoli, 1777	*Sphaerium kashmirensis* Prashad, 1937
			Euglesa Jenyns, 1832	*Euglesa casertana* (Poli, 1791)
			Pisidium C. Pfeiffer, 1821	*Pisidium mitchelli* Prashad, 1925

Table 2 : The systematic list of land mollusca of Trans-Himalaya (the classification and nomenclature followed by Bouchet *et al.,* 2017, Bank. 2017, Ramakrishna *et al.,* 2010)

Order	Family	Subfamily	Genus, author (s) and year	Species
Stylommatophora A. Schmidt, 1855	Pupillidae W. Turton, 1831	Pupillinae W. Turton, 1831	*Pupilla* J. Fleming, 1828	*Pupilla muscorum* (Linnaeus, 1758)
	Valloniidae Morse, 1864	Valloniinae Morse, 1864	*Vallonia* Risso, 1826	*Vallonia costata* (Mueller, 1774)
				Vallonia ladakensis (Nevill, 1878)
				Vallonia pulchella (O. F. Müller, 1774)
	Gastrocoptidae Pilsbry, 1918	Gastrocoptinae Pilsbry, 1918	*Gastrocopta* Wollaston, 1878	*Gastrocopta huttoniana* (Benson, 1849)
	Orculidae Pilsbry, 1918		*Orcula* Held, 1838	*Orculu himalayanum* (Benson, 1863)
	Enidae B. B. Woodward, 1903 (1880)	Eninae B.B. Woodward, 1903 (1880)	*Mirus* Albers, 1850	*Mirus smithei* (Benson, 1865)
			Pseudonapaeus Westerlund, 1887	*Pseudonapaeus arcuata* (Kuester, 1845)
				Pseudonapaeus candelaris (Pfeiffer, 1846)
				Pseudonapaeus coelebs (Pfeiffer, 1846)
				Pseudonapaeus domina (Benson, 1857)
				Pseudonapaeus linterae (Kobelt, 1899)
				Pseudonapaeus mainwaringiana (Nevill, 1878)
				Pseudonapaeus pretiosa (Reeve, 1849)
				Pseudonapaeus rufistrigata (Reeve, 1849)
				Pseudonapaeus sindica (Reeve, 1848)

Table 2 contd.

Order	Family	Subfamily	Genus, author (s) and year	Species
Stylommatophora A. Schmidt, 1855	Cerastidae Wenz, 1923		*Cerastua* Strand, 1928	*Cerastua segregatus* (Reeve, 1849)
	Ferussaciidae Bourguignat, 1883		*Geostilbia* Crosse, 1867	*Geostilbia balanus* (Reeve, 1850)
			Coilostele Benson, 1864	*Coilostele scalaris* Benson, 1864
	Achatinidae Swainson, 1840	Glessulinae Godwin-Austin, 1920	*Glessula* E. von Martens, 1860	*Glessula huegeli* (L. Pfeiffer, 1842)
		Subulininae P. Fischer & Crosse, 1877	*Zootecus* Westerlund, 1887	*Zootecus insularis* (Ehrenberg, 1831)
			Lissachatina Bequaert, 1950	*Lissachatina fulica* (Férussac, 1821)
	Streptaxidae Gray, 1860	Enneinae Bourguignat, 1883	*Gulella* L. Pfeiffer, 1856	*Gulella bicolor* (Hutton, 1834)
	Chronidae Thiele, 1931		*Kaliella* W.T. Blanford, 1863	*Kaliella barrakporensis* (L. Pfeiffer, 1852)
	Ariophantidae Godwin-Austen, 1888	Macrochlamydinae Godwin-Austen, 1888	*Macrochlamys* Gray, 1847	*Macrochlamys indica* Godwin-Austen, 1883
				Macrochlamys cassida (Hutton, 1838)
				Macrochlamys monticola (Pfeiffer, 1848)
				Macrochlamys theobaldi (Godwin-Austen, 1888)
				Macrochlamys altivaga (Godwin-Austen, 1888)
				Macrochlamys austeniana (Nevill, 1878)
				Macrochlamys jacquemonti (von Martens, 1869)
				Macrochlamys mainwaringi (Godwin-Austen, 1882)
				Macrochlamys theobaldiana (Godwin-Austen, 1888)
				Macrochlamys wynnii (Blanford, 1880)
			Syama W.T. Blanford & Godwin-Austen, 1908	*Syama splendens* (Hutton, 1838)
		Ariophantinae Godwin-Austen, 1888	*Khasiella* Godwin-Austen, 1899	*Khasiella hyba* (Benson, 1861)
				Khasiella kashmirensis (Nevill, 1878)
				Khasiella sonamurgensis (Nevill, 1878)
	Camaenidae Pilsbry, 1895	Bradybaeninae Pilsbry, 1934 (1898)	*Landouria* Godwin-Austen, 1918	*Landouria huttoni* (L. Pfeiffer, 1842)
			Cathaica Möllendorff, 1884	*Cathaica malaianensis* (Nevill, 1878)
				Cathaica phaeozona von Martens, 1874
	Pyramidellidae Gray, 1840		*Pyramidella* Lamarck, 1799	*Pyramidella humilis* Preston, 1905
	Ellobiidae Pfeiffer, 1854 (1822)	Carychiinae Jeffreys, 1830	Carychium O.F. Müller, 1773	*Carychium indicum Benson, 1849*
	Alycaeidae W.T. Blanford, 1864		*Dicharax* Kobelt & Möllendorff, 1900	*Dicharax strangulatus* (L. Pfeiffer, 1846)
	Anadenidae Pilsbry, 1948		*Anadenus* Heynemann, 1863	*Anadenus altivagus* (Theobald, 1862)
				Anadenus jerdoni Godwin-Austen, 1882

DISCUSSION AND CONCLUSION

The heterogeneous mountain ecosystem and the cold desert of the trans-Himalayas provide unique habitats for the lesser dispersal taxon *viz*. mollusca. Tripathy *et al.* (2018) documented 71 species of non-marine molluscs inhibiting in the Trans-Himalayan Biogeographical Zone, comprises about 5.28% of the total non-marine malacofauna of India, whereas, we have added three more species of land snails collected from recent surveyed and its finally 74. There are 12 species identified as endemic to the Trans-Himalaya namely *Pupilla muscorum* (Linnaeus, 1758), *Glessula huegeli* (L. Pfeiffer, 1842), *Khasiella kashmirensis* (Nevill, 1878), *K. sonamurgensis* (Nevill, 1878), *Cathica malaianensis* (Nevill, 1878), *C. phaeozona* von Martens, 1874 and *Anadenus jerdoni* Godwin-Austen, 1882, which have restricted distribution in region, whereas, in freshwater form *Bithynia kashmirense* Nevill, 1885, *Gyraulus ladacensis* (Nevill, 1878), *Gyraulus pankongensis* (von Martens, 1882), *Pisidiummitchelli* Prashad, 1925, and *Corbicula cashmiriensis* Deshayes, 1854 are confined distribution to particular high-altitude wetlandsof Trans-Himalaya. According to the IUCN red list assessment, most of the species have been categorised as Least Concern (LC) while many have not been evaluated yet. Nevertheless, most of the endemic species are placed in data deficient categories should be evaluated to known the population trends especially of the endemic land and freshwater molluscs.

The current compilation of the molluscan fauna indicate that, the unique diverse habitats of cold desert and climatic variability as well as transforms the species to adaptive in this biogeographical zone and diverse endemism. However, the gap in malacofaunal research, lack of the malacological interest and inadequate research fund on land snails are challenges to carrying out systematic research for their conservation.

Being a ubiquitous components of ecosystem, immense ecological importance and their contribution towards food web, freshwater and land mollusca are remarkable indicator of a healthy ecosystem. However, it is believe that globally the population of nonmarine molluscs has been declining drastically (Lydeard *et al.*, 2004) and therefore, conducting systematic research on ecology, habitat requirements and impact of climate change on molluscan population are priority areas to evaluate the status and suitable management strategies for conservation of the nonmarinemollusca of Himalayan region.

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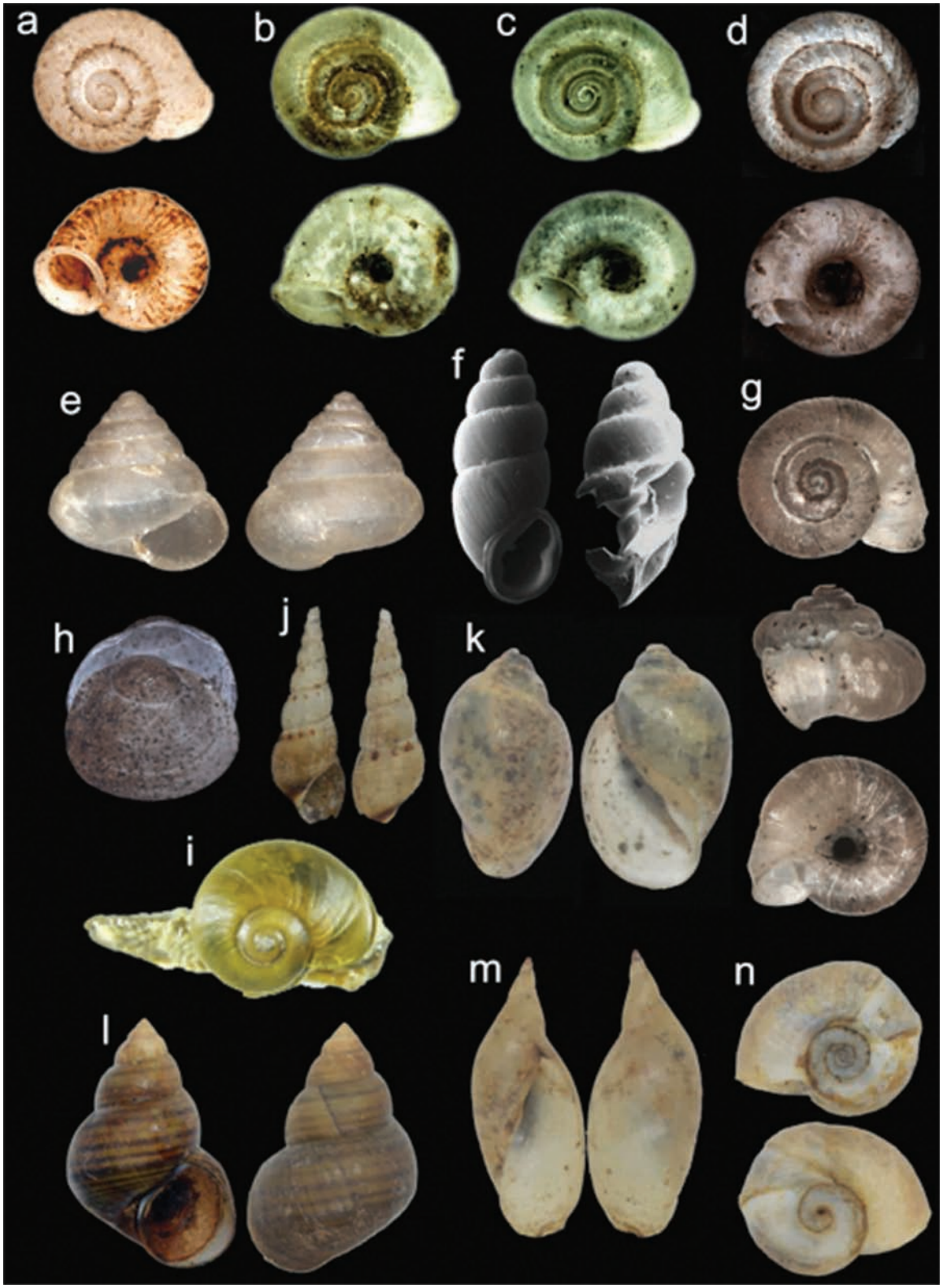


Photographs of few rare and common species (a-g, i) land snails, a. *Vallonia costata* (O.F. Müller, 1774), b. *Vallonia pulchella* (O.F. Müller, 1774), c. *Vallonia ladakensis* (Nevill, 1878), d. *Pyramidella humilis* Preston, 1905, e. *Kaliella barrakporensis* (L. Pfeiffer, 1852), f. *Carychium indicum* Benson, 1849, g. *Dicharax strangulatus* (L. Pfeiffer, 1846), h. *Musculium indicum* (Deshayes, 1854), i. *Macrochlamys cassida* (Hutton, 1838); (h, j-n) freshwater molluscs, j. *Melanoides tuberculata* (O.F. Müller, 1774), k. *Physella acuta* (Draparnaud, 1805), l. *Filopaludina bengalensis* (Lamarck, 1822), m. *Radix rufescens* (Gray, 1822), n. *Indoplanorbis exustus* (Deshayes, 1834).

Chapter 16

PISCES

INDU SHARMA

100 species belonging to 59 genera, 15 families and 07 orders have been documented in this chapter from the Trans-Himalaya. It constitutes 32% of the total Himalayan Fish Diversity of India. Cold desert of Ladakh and Himachal Pradesh encompasses 19 species belonging to families Cyprinidae, Nemachelidae and Sisoridae. Schizothorcinae fishes found here are important native fauna and commercially important. Loaches fishes are small in size but ecologically significant. Fishes have been categorized as 01 Critical endangered, 01 Endangered, 09 near threatened, 02 Vulnerable, 50 Least Concern, 31 Not Evaluated, 02 Data deficient as per IUCN. 03 species have been introduced in the cold water bodies of the high altitudes. Local people of the area do not eat the fish due to religious sentiment but the outside labour exploit the fishes in huge for food purpose and is threat to the native fauna of the area. Thus, right kind of the awareness among the people can go a long way for the conservation of the valuable, indigenous fish fauna of the area.

Keywords: Indigenous, cold desert, religious, conservation, native

INTRODUCTION

Cold water fishery constitutes an important component of the freshwater fishery of India. It is helpful to fulfill the nutrition requirement of the poor economy of mountainous populace. The nutritional value of fish meal is higher than the meat of any other cattle. Fish contains proteins, minerals (calcium, iodine, phosphorus etc.), vitamins A, D, E and low fat content. It plays a vital role in the prevention of heart attack, diabetes, ulcerative colitis, osteoporosis, anemia etc.

The cold water natural resources encompasses nearly 8243 km long streams and rivers, 20500 ha natural lakes, 50,0000 ha of reservoirs both natural & man-made and 2500 ha brackish water lakes at high altitude (Singh and Akhtar 2015). The Trans-Himalayan Ecosystem in India is drained by several tributaries of Indus drainage system in Ladkah (J & K) and Spiti River in Spiti Valley (H.P.). The Chandertal Lake is a freshwater high altitude lake in the district of Lahaul & Spiti. Pangong Tso, Tso Morari, Tso Kar, Khyagar are brackish water lakes and Tsugal Tso, Chisul are freshwater sources in Ladakh. These water drainages and lakes freeze during winter months and fishes survive at the bottom layer to tide over the harsh climatic conditions.

HISTORICAL RESUME

Fishes comprise highest diversity among the entire vertebrate group. There are 34,362 fishes found in India which contributes 9.70% of the global fish diversity. 316 fish species belonging to 118 genera, 38 families and 13 orders from the Himalaya. Himalayan fish diversity represents about 30.8% of the total species (1027) of fresh water fishes of India (Gopi *et al.,* 2018). Nautiyal (2005) recorded 363 species belonging to 36 families and 11 orders in the highlands of Himalaya (India, Nepal and Bhutan) as per the survey of the published literature. Further, Sehgal (1991) and Menon (1962) recorded 241 and 218 species respectively from the Himalayas. Trans-Himalayan fish fauna has been worked out by Day 1876, 1878; Hora 1922, 1936; Mukerji 1936; Das *et al.,* 1964; Das 1965; Talwar 1978; Tilak 1987; Menon 1987; Tilak, 1990; Shivakumar 2008; Sharma and Mehta 2011 from Ladakh Ecosystem and Mehta and Sharma 2008; Sharma and Dhanze 2013 from Spiti Valley, district Lahaul and Spiti.

Desert Regional Centre, Zoological Survey of India, Jodhpur-342005 (Rajasthan)
*Zoological Survey of India, M-Block, New Alipore, Kolkata,–700 053, (WB)
Email: induzsi@gmail.com; kailash616@gmail.com

Citation
Sharma, I. 2019. Pisces. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 115-128. (Published by the Director, Zool. Surv. India, Kolkata)

DIVERSITY

The fish diversity of the Trans-Himalaya Ecosystem consists of valuable, rare and endemic cold water fishes. It contributes about 32% of the total Himalayan fish diversity of India (Gopi *et al.,* 2018). 19 species belonging to two orders and three families have been reported from the Ladakh Ecosystem. The fishes of the region are mainly dominated by palaearctic fauna (Sharma and Mehta, 2009). The present list of fishes from the Trans-Himalayan Ecosystem has been provided on the basis of literature surveys, mainly from the fish diversity of Himalaya (Gopi *et al.,* 2018) and on the basis of various surveys undertaken in the Ladakh and Spiti Valley by the HARC, Solan. 100 species belonging to 59 genera, 15 families and 07 orders have been documented. The Cypriniformes is the largest order (75 species) followed by Siluriformes (12 species) and Perciformes (06 species). Among Cyprinformes family Cyprinidae comprises maximum 59 species followed by Nemachelidae with 16 species. Schizothoracinae fishes (13 species) of family Cyprinidae and loaches fishes (11 species) of family Noemachelidae are distributed in Ladakh, Kashmir and Himachal Pradesh (Table-1). These high altitude Trans-Himalayan fishes are mainly represented by Schizothoricids, Loaches, Exotic Carps and Trouts. Schizothoricids are commercially important fishes. Schizothoracinae are the specialized group of fishes due to tiled rows of enlarged scales along the anal flap, reduction of scales, barbels and herbivorous feeding habit (Tilak, 1987). Among the Schizothoracinae, only *Lepidopygopsis typus* is restricted to Western Ghats while the remaining ones are available from the Himalayas. *Ptycobarbus conirostris*, *Schizopygopsis stoliczkai*, *Diptychus maculatus* are endemic to the area. *Schizothorax richardsonii* (Snow trout) has wide distribution throughout Himalayas. Ali and Pandey (2016) stated that this fish alone contributes to 60-70% of the total fish catch from upland riverine systems. Loaches Fishes of the genus *Triplophysa* are small in size and not much commercially important but ecologically and zoo geographically very significant. *Triplophysa* (Loaches) fishes are characterized by elongated body, compressed or whip like tail and scales are totally absent. Genus *Triplophysa* is represented by 10 species in India. Out of 10 species, five (*T. stoliczkai*, *T. microps, T. tenucauda, T. ladacensis, T. drassensis*) are endemic to the Trans-Himalayan Ecosystem of Ladakh and Spiti Valley. Exotic Carps and Trouts are the commercially important fauna. Trout fishes are exploited for food, sport and recreation. The brackish water lakes like Pangango Tso, Tso moririe in Ladakh (J & K) and freshwater lake in Chandertal lake in Spiti Valley have been stocked by Brown trout by Himachal Pradesh, Department of Fisheries but in these water bodies the fishes could not be sustained (personal observation).

The high altitude streams are characterized by low temperature, alkaline pH, high transparency, rich in oxygen, total dissolved solid, alkalinity, hardness and low carbon dioxide quantity. Singh and Akhtar (2015) reported the species distribution in the higher reaches of the water bodies where water has a torrential flow, and is different from the mid and lower reaches of the stream where flow is moderate and water current is low. *T. microps* (Steindachner) and *T. stoliczkai* (Steindachner) are the highest-dwelling fishes in the freshwater habitats of the Indian Himalaya. They live in the streamlets formed by the glacial melts of the upper Indus drainage in the Indian Trans-Himalayan region of Ladakh at elevations of nearly 5,000 m asl (Steindachner, 1866). In Ladakh region the rivers freeze during winter months and the temperature plunges to -70°C. The fishes survive at the bottom layer and deep burrows to tide over the harsh freezing conditions. It has been found that the *P. conirostrus* prefers to congregate near hot springs (30-40°C) of Chungtang near Nyoma along the Indus River. The occurrence of extraordinary large sized specimen of *Diptychus maculates* and *Schizopygopsis stoliczkae* >5Kg in the marshes of Tsogul Tso is an interesting feature (Sharma and Mehta, 2009). Thus, diverse natural resources of the region with cold climate, low temperature, high oxygen and water velocity are conducive to conserve the rare, threatened and endemic fish fauna.

ADAPTATIONS IN THE HIGH ALTITUDE FISHES

The cold water fishes have several adaptations to cope up with the environmental aggravation. The lotic water bodies of the Trans-Himalayan Ecosystem with continue fluctuation in its water parameters is very harsh. The Schizothoracinae fishes have stream lined and cylindrical body which make them to withstand against the torrent current of water. The snout is pointed to move against the fast current of water. In *Schizothorax* spp., the jaws are covered with horny covering and are helpful to scrap the food from the stones. The scales in the hills stream fishes are embedded in the skin or absent. The reduction of scales mainly occurs in the ventral side of the body which directly comes in contact with the bedrock (Tilak, 1987). Externally, head, body of loaches fishes is flattened and thus body is cylindrical. The paired fins *i.e.* pectoral and pelvic fins are horizontally positioned, which are helpful for adhesion to stones. A continuous broadening of the fins and an increase in the number of rays has made them to hold up in the fast current of water in *Triplophysa* fishes (Loaches). The outer fin rays are thick and strong and number of inner rays increased. Thus, the skin forms a cushion like pad ventrally. Turkestan Cat

fish (*Glyptosternon reticulatum*) has ridges, grooves and striated structures between the pectoral fins and helpful for adhesion. A long, narrow, whip like caudal peduncle in Loaches is helpful to resist in strong water current of hill streams. The barbels are short and thick. The Eyes are small in size and placed upwards. Due to highly oxygenated water of the high altitude streams, the gills of cold water fish are greatly reduced and the gill opening being smaller in size is the main adaptation (Menon, 1987; Khanna, 1989).

WAY FORWARD

(i) The major threats to the coldwater fisheries are loss of river or stream impoundments, rapid environmental degradation, excessive and destructive method of fishing. It is creating enormous pressure on resources in general and fish stocks in particular. Therefore, due to their declining trend in different rivers and streams of Himalayas, IUCN has declared snow trout as a vulnerable species (Ali and Pandey, 2016). Further, it has been observed that most of the Trans-Himalayan fishes from Ladakh have not been assessed and thus it requires studies in the cold water fish fauna.

(ii) The growth of indigenous cold water fishes is slow and thus profit of commercial fishery is less. *Schizothorax* spp., *Schizopygopsis stoliczkai*, *Diptychus maculates* and *Ptychobarbus conirostris* are commercially important indigenous fishes of the region but the growth of these fishes is less and thus without research cannot be exploited as a candidate species for the aquaculture practices. The Government of Jammu and Kashmir has established several rainbow trout farms in Ladakh *viz.* Diskit in Nubra Valley, Sindhu Ghat in Leh, Wakha, Khachan, Damsna in Kargil sector while Khunda and Khandiyal in Drass sector to prompt the aquaculture practices in the region. Locals of Khunda at the foothills of Tololing range in Drass sector are taking up trout farming. The low water temperature throughout the region is ideal for rainbow trout production (Haldar *et al.,* 2016). Dissemination of fish farming technology and environmental education program should be conducted to train the fishermen and to make aware about the importance/conservation of rare cold water fishes.

(iii) The coldwater fishes are important ecological indicators for climate change as they are very sensitive to changes in water temperature. The impact of temperature shift due to climate change on aquatic organisms will affect their biological functions, as they are poikilothermic in nature. The ecological models demonstrate that there would be significant losses of fish species as climate change may lead to a reduction of fish habitat and diversity (Mohseni *et al.,* 2003). Thus, the studies should be conducted at priority level in the Trans-Himalayan ecosystem to work out the consequences of the climate change.

(iv) In Ladakh and Spiti Valley, the Buddhist religion is dominating and fish eating is prohibited. But it has been observed during the survey in July, 2014 of the Spiti Valley that outside labor exploit the small loaches fishes in huge for food purposes. Thus, over fishing will disturb the ecology of the Trans-Himalayan Rivers. Ali and Pandey, 2016 stated that the upland regions are fragile in nature therefore it requires conservation besides utilization on a sustainable basis. The fish diversity along with distribution & conservation status is given in Table 1.

Table 1 : Diversity, distribution and conservation status of fishes of Indian Trans-Himalaya

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
Order OSTEOGLOSSIFORMES L.S. Berg, 1940 Family NOTOPTERIDAE Bleeker, 1851					
1.	*Chitala chitala* (Hamilton, 1822)	Humped featherback	*India:* Himachal Pradesh, Manipur, Uttarakhand, West Bengal, Assam, Tripura, Uttar Pradesh, and Bihar; *Elsewhere:* Pakistan, Bangladesh, Nepal and Myanmar, Indonesia, Cambodia, Malaysia and Thailand	NT	1C
Order CYPRINIFORMES Bleeker, 1859 Family CYPRINIDAE Rafinesque, 1815					
2.	*Amblypharyngodon mola* (Hamilton, 1822)	Mola carpet	*India:* Throughout country except Kerela; *Elsewhere*: Indus plain, Bangladesh, Burma	LC	1C

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
3.	*Bangana dero* (Hamilton, 1822)	Kalabans	*India*: Jammu and Kashmir, Punjab, Haryana, Delhi, Assam, Bihar, Rajasthan, Uttar Pradesh, West Bengal and Himachal Pradesh; *Elsewhere*: Bangladesh, China, Pakistan and Sri Lanka	LC	1A, 1C
4.	*Bangana diplostoma* (Heckel, 1838)	-	*India*: Kashmir (Jammu and Kashmir); *Elsewhere*: Pakistan	LC	1A
5.	*Barilius bendelisis* (Hamilton, 1807)	Hamilton's barila	*India:* Jammu & Kashmir, Assam, Meghalaya, Bihar, Haryana, Karnataka, Kerala, Orissa, Punjab, Rajasthan, Sikkam, Tamil Nadu, Uttar Pradesh, West Bengal, Maharashtra and Himachal Pradesh; *Elsewhere*: Pakistan, Nepal, Bangladesh and Sri Lanka	LC	1A, 1C
6.	*Barilius shacra* (Hamilton, 1822)	Shacra baril, Bola	*India*: Assam, Bihar, Jammu and Kashmir, Orissa, Punjab, Uttar Pradesh, West Bengal and Himachal Pradesh; *Elsewhere*: Pakistan, Nepal and Bangladesh	LC	1C
7.	*Barilius vagra* (Hamilton, 1822)	Patha, Chal, Chilwa and Lahani	*India*: Assam, Bihar, Delhi, Jammu and Kashmir, Punjab, Sikkim, Uttar Pradesh, West Bengal and Himachal Pradesh; *Elsewhere*: Bangladesh, Pakistan, Sri Lanka and Nepal	LC	1A, 1C
8.	*Cabdio jaya* (Hamilton, 1822)	Jaya	*India:* Gangetic provinces, Assam; *Elsewhere:* Nepal and Bangladesh	LC	1C
9.	*Cabdio morar* (Hamilton, 1822)	Kenwachi, Bayi	*India:* Northern India; *Elsewhere:* Iran, Pakistan, Nepal, Bangladesh, Burma and Thailand	LC	1A
10.	*Carassius auratus* (Linnaeus, 1758)	Goldfish, Golden carp	*India:* Introduced throughout Indian subcontinent; *Elsewhere*: China and Japan	LC	1C
11.	*Carassius carassius* (Linnaeus, 1758)	Crucian carp	*India:* Introduced throughout Indian Subcontinent; *Elsewhere*: China, Korea, Japan, Taiwan, Europe, East Asia, Siberia and South to North Vietnam	LC	1B
12.	*Chagunius chagunio* (Hamilton, 1822)	Chaguni	*India:* Throughout Indian Sub Continent along the Himalayan foothills and Himachal Pradesh; *Elsewhere:* Bangladesh, Nepal, Myanmar and Thailand.	LC	1C
13.	*Chela cachius* (Hamilton, 1822)	Silver hatchet chela	*India:* Assam, West Bengal, Bihar, Orissa, Maharashtra; *Elsewhere:* Bangladesh, Pakistan and Myanmar	LC	1A

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
14.	*Cirrhinus mrigala* (Hamilton, 1822)	Mrigal	*India*: Northern India *Elsewhere*: Nepal, Bangladesh and Pakistan	LC	1A, 1C
15.	*Ctenopharyngodon idella* (Valenciennes, 1844)	Grass carp	*India*: Introduced ; *Elsewhere*: Siberia, Machuria, North to South China and Lower reaches of River Amur	-	1C
16.	*Cyprinus carpio* Linnaeus, 1758	Common carp	*India*: Introduced throughout; *Elsewhere*: America, China, Europe, Japan, Korea and Taiwan	-	1A, 1B, 1C
17.	*Danio rerio* (Hamilton, 1822)	Zebra fish, Zebra danio	*India*: Uttar Pradesh, Andhra Pradesh, Bihar, Karnataka, Orissa, Punjab, Sikkim, Tamil Nadu, West Bengal and Himachal Pradesh; *Elsewhere*: Bangladesh, Nepal, Pakistan and Burma	LC	1C
18.	*Devario aequipinnatus* (McClelland, 1839)	Giant danio	*India*: Assam; *Elsewhere*: Nepal, Sri Lanka	LC	1C
19.	*Esomus danricus* (Hamilton, 1822)	Flying barb	*India*: Jammu and Kashmir, Punjab, Uttar Pradesh, Assam, Bihar, Delhi, Goa, Daman and Diu, Gujarat, Madhya Pradesh, Orissa, Tamil Nadu, West Bengal and Himachal Pradesh; *Elsewhere*: Bangladesh, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand	LC	1A
20.	*Garra annandalei* Hora, 1921	Annandale garra	*India*: Assam, Bihar, Nagaland, West Bengal; *Elsewhere*: Bangladesh, Myanmar, Nagaland, Nepal	LC	1C
21.	*Garra gotyla* (Gray, 1830)	Gotyla	*India*: Jammu and Kashmir, Assam, Bihar, Delhi, Manipur, Nagaland, Punjab, Rajasthan, Sikkim, Uttar Pradesh, Madhya Pradesh, West Bengal, Manipur, Himachal Pradesh; *Elsewhere*: Bangladesh, Burma, Nepal and Pakistan	LC	1C
22.	*Garra lamta* (Hamilton, 1822)	Lamta gara	*India:* Assam, Sikkim, Darjeeling, Kumaon Himalayas, Himachal Pradesh; *Elsewhere*: Sri Lanka and Myanmar	LC	1C
23.	*Garra nasuta* (McClelland, 1838)	Khasi garra	*India*: Assam, Meghalaya, Arunachal Pradesh; *Elsewhere*: Burma, South China, Vietnam	LC	1C
24.	*Gibelion catla* (Hamilton, 1822)	Catla	*India*: Throughout India; *Elsewhere*: Pakistan, Bangladesh, Thailand, Burma, Sri Lanka and Siam	LC	1C

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
25.	*Hypophthalmichthys molitrix* (Valenciennes, 1844)	Silver Carp	*India:* Introduced throughout Indian subcontinent; *Elsewhere*: China, Japan, Nepal, Pakistan, Bangladesh, Burma and Sri Lanka	-	1C
26.	*Labeo bata* (Hamilton, 1822)	Bata labeo	*India*: Uttar Pradesh, Madhya Pradesh, Bihar, Orrisa, West Bengal, Maharashtra, Andhra Pradesh, Himachal Pradesh; *Elsewhere*: Bangladesh and Nepal	LC	1A
27.	*Labeo dyocheilus* (McClelland, 1839)	Brahmaputra labeo	*India:* Jammu and Kashmir, Punjab, Uttar Pradesh, Assam, Sikkim, Himachal Pradesh; *Elsewhere*: Pakistan, Nagaland, Bangladesh and Nepal	LC	1A, 1C
28.	*Labeo rohita* (Hamilton, 1822)	Rohu	*India*: Punjab, Delhi, Uttar Pradesh, Assam, Bihar, Gujarat, Madhya Pradesh, Maharashtra, Orissa, West Bengal, Himachal Pradesh; *Elsewhere*: Pakistan, Bangladesh and Burma	LC	1C
29.	*Neolissochilus hexagonolepis* (McClelland, 1839)	Katli	*India*: Assam, Eastern Himalaya, Himachal Pradesh; *Elsewhere*: Nepal, Burma, Thailand, Malaysia, Sumatra and China	NT	1C
30.	*Neolissochilus hexastichus* (McClelland, 1839)	McClelland's bokar	*India*: Assam, Kashmir, Sikkim; *Elsewhere*: Nepal, Burma	NT	1C
31.	*Neolissochilus spinulosus* (McClelland, 1845)	-	*India*: Sikkim	DD	1C
32.	*Opsarius barna* (Hamilton, 1822)	Barna baril	*India*: Uttarakhand, Assam, Bihar, West Bengal, Karnataka, Meghalaya, Orissa, Rajasthan, Sikkim, Burma, Himachal Pradesh; *Elsewhere*: Nepal, Bangladesh and Burma.	LC	1C
33.	*Pethia conchonius* (Hamilton, 1822)	Red Barb, Rosy barb	*India:* Through Indian Subcontinent; *Elsewhere*: Pakistan and Bangladesh	LC	1C
34.	*Pethia ticto* (Hamilton, 1822)	Two-spot barb	*India*: Through Indian Subcontinent; *Elsewhere*: Pakistan, Sri Lanka, Thailand, Bangladesh, Thailand	LC	1A, 1B, 1C
35.	*Puntius sophore* (Hamilton, 1822)	Spot fin swamp Barb	*India*: Through Indian Subcontinent; *Elsewhere*: Pakistan, China, Nepal, Bangladesh and Burma	LC	1A, 1B, 1C
36.	*Poropuntius clavatus* (McClelland, 1845)	Stedman barb	*India*: Assam, Manipur, Sikkim, West Bengal; *Elsewhere:* Bangladesh, Nepal	NT	1C

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
37.	*Ptycobarbus conirostris* Steindachner, 1866	Indus snow trout	*India*: Ladakh, Kashmir (Jammu and Kashmir); *Elsewhere:* Pakistan, China Tibet	NE	1A
38.	*Diptychus maculatus* Steindachner, 1866	Scaly osman	*India*: Ladakh (Jammu and Kashmir), Chandra Bhaga River, district Lahaul & Spiti (Himachal Pradesh); *Elsewhere:* Pakistan, Nepal, China, Tibet	NE	1A
39.	*Schizopyge niger* (Heckel, 1838)	Alghad snowtrout	*India*: Kashmir Valley (Jammu and Kashmir)	NE	1A
40.	*Schizopygopsis stoliczkai* Steindachner, 1866	False osman	*India*: Ladakh (Jammu and Kashmir), Kinnaur (Himachal Pradesh); *Elsewhere*: Afghanistan, Pakistan, Afghanistan, Iran, and Tibet	NE	1A
41.	*Schizothorax curvifrons* Heckel, 1838	Sattar snowtrout	*Distribution:* Ladakh, Kashmir (Jammu and Kashmir); *Elsewhere:* Afghanistan, Pakistan, Nepal China, Tibet, Iran, Uzbekistan, Kazakhstan and Kyrgyzstan	NE	1A
42.	*Schizothorax esocinus* Heckel, 1838	Chirruh snowtrout	*India*: Ladakh (Jammu and Kashmir); *Elsewhere*: Afghanistan, Pakistan, Nepal, China, Tibet	NE	1A
43.	*Schizothorax huegelii* Heckel, 1838	Grot snowtrout	*India*: Kashmir Valley (Jammu and Kashmir)	NE	1A
44.	*Schizothorax labiatus* (McClelland 1842)	Kunar snowtrout	*India:* Indus River (Ladakh), Kashmir (Jammu and Kashmir); *Elsewhere*: Afghanistan, Pakistan, Nepal, Tibet, China	NE	1A
45.	*Schizothorax microcephalus* Day, 1877	-	*India*: Panja (Panjah), waters going to oxus	NE	1A
46.	*Schizothorax nasus* Heckel, 1838	Dongu snowtrout	*India*: Kashmir (Jammu and Kashmir)	NE	1A
47.	*Schizothorax plagiostomus* Heckel, 1838	-	*Elsewhere*: Afghanistan, Pakistan, Tibet	NE	1A
48.	*Schizothorax progastus* (McClelland, 1839)	Dinnawah snowtrout	*India*: Kashmir (Jammu and Kashmir), Ganga river in Uttar Pradesh, Brahmaputra river in Assam	NE	1A, 1C
49.	*Schizothorax richardsonii* (Gray, 1832)	Snowtrout	*India*: Jammu and Kashmir, Punjab, Uttar Pradesh, Assam, Sikkim, Himachal Pradesh; *Elsewhere*: Pakistan, Nepal, Bhutan and Afghanistan	VU	1C
50.	*Semiplotus semiplotus* (McClelland, 1839)	Assamese kingfish	*India*: Arunachal Pradesh, Assam, Darjeeling, Sikkim *Elsewhere*: Bhutan, Nepal	VU	1C

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
51.	*Systomus sarana* (Hamilton, 1822)	Olive barb	*India*: Through Indian Subcontinent; *Elsewhere*: Pakistan, Bangladesh, Bhutan, Burma, China, Nepal, Sri Lanka and Thailand	LC	1A, 1C
52.	*Tariqilabeo diplochilus* (Heckel, 1838)	Kashmir latia	*India*: Kashmir (Jammu and Kashmir); *Elsewhere*: Iran, Afghanistan, Pakistan	NE	1A
53.	*Tariqilabeo latius* (Hamilton, 1822)	Gangetic latia	*India*: Northern states along the Himalayas; *Elsewhere*: Bangladesh, Nepal and Pakistan	LC	1C
54.	*Tor mosal* (Hamilton, 1822)	Mosal mahseer	*India*: Ramganaga River (Uttar Pradesh)	NE	1C
55.	*Tor putitora* (Hamilton, 1822)	Putitor mahseer	*India*: Throughout Northern States (All along Himalayas); *Elsewhere*: Pakistan, Nepal and Bangladesh	EN	1A, 1C
56.	*Botia birdi* Chaudhuri, 1910	Birdi loach	*India*: Jammu and Kashmir, Punjab; *Elsewhere*: Pakistan	NE	1A
57.	*Botia lohachata* Chaudhuri, 1912	Y- Loach	*India:* Uttarakhand, Bihar, Delhi, Rajasthan and Himachal Pradesh; *Elsewhere*: Pakistan, Bangladesh and Nepal.	NE	1B
58.	*Canthophrys gongota* (Hamilton, 1822)	Gongota loach	*India*: Arunachal Pradesh, Assam, Bihar, Darjeeling, Manipur, Meghalaya, Nagaland, Sikkim, Uttar Pradesh, West Bengal; *Elsewhere*: Bangladesh Nepal	LC	1C
59.	*Lepidocephalichthys guntea* (Hamilton, 1822)	Guntea loach	*India*: Throughout northern States; *Elsewhere*: Pakistan, Sri Lanka, Nepal and Bangladesh	LC	1B
60.	*Pangio pangia* (Hamilton, 1822)	Pangia coolir-loach	*India*: Assam, Manipur, Meghalaya, West Bengal; *Elsewhere*: Bangladesh, Myanmar	LC	1C
Family NEMACHEILIDAE Regan, 1911					
61.	*Aborichthys elongatus* Hora, 1921	-	*India*: Darjeeling, North Bengal, Arunachal Pradesh	LC	1C
62.	*Schistura devdevi* (Hora, 1935)	-	*India*: Assam, Darjeeling, Sikkim, Arunachal Pradesh, West Bengal; *Elsewhere*: Nepal	NT	1C
63.	*Schistura himachalensis* (Menon, 1987)	-	*India*: Himachal Pradesh	NE	1B
64.	*Schistura multifasciata* (Day, 1878)	-	*India*: Assam, Bihar, Darjeeling, Sikkim, Uttar Pradesh; *Elsewhere*: Nepal	LC	1C

Table 1 contd.

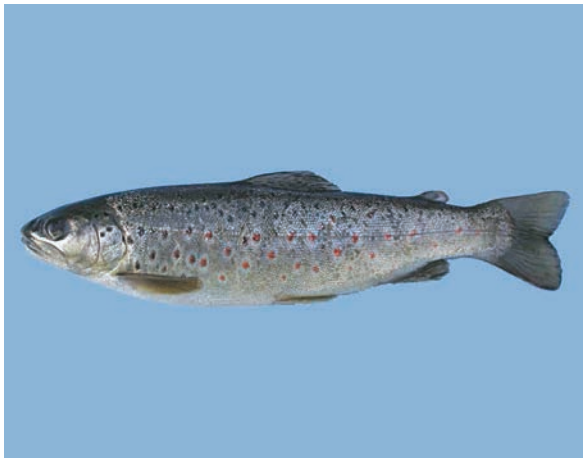
Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
65.	*Schistura rupecula* McClelland, 1838	Hill loach	*India*: Jammu and Kashmir, Uttarakhand, Uttar Pradesh, Himachal Pradesh; *Elsewhere*: Pakistan.	LC	1A, 1C
66.	*Triplophysa yasinensis* (Alcock, 1898)	-	*India*: Ladakh, Kashmir (Jammu and Kashmir); *Elsewhere*: Afghanistan, Pakistan, China	NE	1A,1B
67.	*Triplophysa drassensis* (Tilak, 1990)	Loach	*India*: Drass, Ladakh (Jammu and Kashmir); *Elsewhere:* Afghanistan, Pakistan, China	NE	1A
68.	*Triplophysa gracilis* (Day, 1877)	Gracilis triplophysa loach	Ladakh (Jammu and Kashmir); *Elsewhere*: Afghanistan, Pakistan, China	NE	1A, 1C
69.	*Triplophysa kashmirensis* (Hora, 1922)	Loach	*India*: River Jhelum, Kashmir Valley (Jammu and Kashmir)	NE	1A
70.	*Triplophysa ladacensis* (Günther, 1868)	Ladakh triplophysa loach	*India*: Ladakh (Jammu and Kashmir); *Elsewhere*: Afghanistan, Pakistan, Tibet	NE	1A
71.	*Triplophysa marmorata* (Heckel, 1838)	Kashmir triplophysa loach	*India*: Kashmir (Jammu and Kashmir)	NE	1A
72.	*Triplophysa microps* (Steindachner, 1866	Leh triplophysa loach	Ladakh (Jammu and Kashmir), Himachal Pradesh; *Elsewhere:* Afghanistan, Pakistan, China	NE	1A, 1B
73.	*Triplophysa shehensis* Menon, 1987	Tilak triplophysa loach	*India*: Ladakh (Jammu and Kashmir); *Elsewhere*: Afghanistan, Pakistan, China	NE	1A
74.	*Triplophysa stewarti* (Hora, 1922)	Loach	*India*: Jammu and Kashmir; *Elsewhere*: Tibet, China	LC	1A
75.	*Triplophysa stolickai* (Steindachner, 1866)	Stoliczka triplophysa Loach	*India*: Ladakh, Kashmir (Jammu and Kashmir), Spiti River, ditrict Lahaul & Spiti (Himachal Pradesh); *Elsewhere*: Afghanistan, Pakistan, China, Tibet, Bhutan, Uzbekistan	NE	1A
76.	*Triplophysa tenuicauda* (Steindachner, 1866)	Tibetan Stone Loach	*India*: Ladakh (Jammu and Kashmir); *Elsewhere*: Afghanistan, Pakistan, Tibet	NE	1A
Order SILURIFORMES Family SISORIDAE Bleeker, 1858					
77.	*Bagarius bagarius* (Hamilton, 1822)	Gangetic goonch	*India*: Throughout India and Himachal Pradesh; *Elsewhere*: Pakistan, China, Bangladesh, Burma, Malaya and Thailand	NT	1C

Table 1 contd.

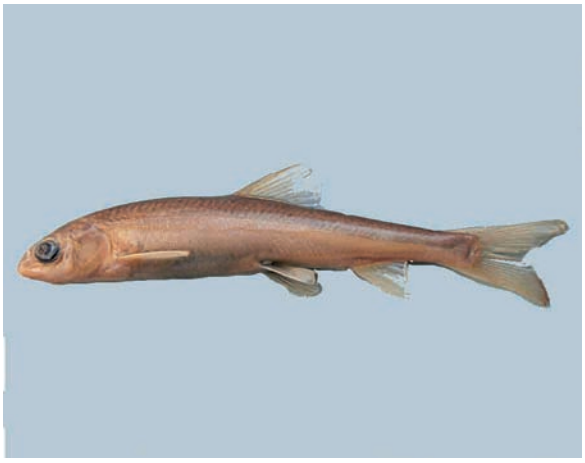
Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
78.	*Glyptosternon maculatum* (Regan, 1905)	-	*India*: Brahmaputra drainages in Sikkim, Arunachal Pradesh; *Elsewhere*: Tibet	LC	1C
79.	*Glyptosternon reticulatum* McClelland, 1842	Turkestan catfish	*India*: Ladakh, Jammu and Kashmir, Himachal Pradesh; *Elsewhere*: Pakistan and Afghanistan	NE	1A, 1B
80.	*Glyptothorax gracilis* (Günther, 1864)	-	*India*: Himachal Pradesh, Sikkim; *Elsewhere*: Nepal	DD	1C
81.	*Glyptothorax kashmirensis* Hora, 1923	-	*India*: Kashmir Valley (Jammu and Kashmir); *Elsewhere*: Pakistan	CR	1A
82.	*Glyptothorax punjabensis* Mirza and Kashmiri, 1971	-	*India*: Punjab; *Elsewhere*: Pakistan	NE	1A
83.	*Glyptothorax striatus* (McClelland, 1842)	-	*India*: Khasi and Garo Hills (Meghalaya), Sikkim	NT	1C
84.	*Parachiloglanis hodgarti* (Hora, 1923)	Torrent catfish	*India*: Ganga and Brahmaputra River drainages; *Elsewhere*: Bangladesh, China, Nepal, Tibet	LC	1C
85.	*Pseudecheneis sulcata* (McClelland, 1842)	Sulcatus catfish	*India*: Uttarakhand, North Bengal, Meghalaya, Himachal Pradesh; *Elsewhere*: Nepal and Bangladesh	LC	1C
Family ERETHISTIDAE Bleeker, 1862					
86.	*Pseudolaguvia shawi* (Hora, 1921)	-	*India*: Arunachal Pradesh, Darjeeling, Mizoram, Sikkim, West Bengal; *Elsewhere*: Bangladesh	LC	1C
Family SILURIDAE Rafinesque, 1815					
87.	*Ompok bimaculatus* (Bloch, 1794)	Butter catfish	*India*: Throughout; *Elsewhere:* Bangladesh, Pakistan, Sri Lanka, Myanmar	NT	1A
Family BAGRIDAE Bleeker, 1858					
88.	*Olyra longicaudata* McClelland, 1842	-	*India*: Assam, Darjeeling, Meghalaya; *Elsewhere*: Myanmar, Thailand	LC	1C
Order SAMONIFORMES Bleeker, 1859 Family SALMONIDAE Cuvier, 1816					
89.	*Salmo trutta* Linnaeus, 1758	Brown trutta	*India*: Jammu and Kashmir, Uttarakhand, Himachal Pradesh; *Elsewhere*: Western Europe, North America (Introduced), New Zealand, Japan and Pakistan	LC	1A, 1C
90.	*Oncorhynchus mykiss* (Walbaum, 1792)	Rainbow trout	*India*: Jammu and Kashmir, Uttarakhand, Himachal Pradesh; *Elsewhere*: Atlantic coast of North America, Introduced world widely	NE	1A, 1C

Table 1 contd.

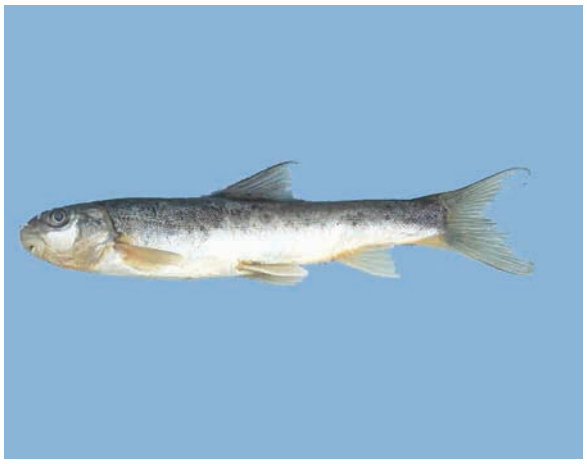
Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
Order CYPRINODONTIFORMES Berg, 1940 Family POECILIIDAE Bonaparte, 1831					
91.	*Gambusia affinis* (Baird and Girard, 1853)	Western mosquito fish	*India*: Introduced; *Elsewhere*: United States of America	LC	1A, 1B
92.	*Poecilia reticulata* Peters 1859	Guppy	*India*: Introduced; *Elsewhere*: The Netherland Antilles, the Venezuelan Islands, Trinidad and British Guiana	NE	1C
Order SYNBRANCHIFORMES Family SYNBRANCHIDAE Bonaparte, 1835					
93.	*Ophisternon bengalense* McClelland, 1844	Bengal eel	*India*: Eastern Coast; *Elsewhere*: Sri Lanka, Indo-Malayan region, Phillippines, South China Sea, New Guinea, Australia	LC	1C
Family MASTACEMBELIDAE Swainson, 1839					
94.	*Mastacembelus armatus* (Lacepède, 1800)	Tire-track spiny eel	*India:* Throughout Indian Subcontinent; *Elsewhere*: Pakistan, Sri Lanka, Nepal, Burma and Southern China.	LC	1A, 1B, 1C
Order PERCIFORMES Rafinesque, 1810 Family AMBASSIDAE Klunzinger, 1870					
95.	*Parambassis baculis* (Hamilton, 1822)	Himalayan glassy perchlet	*India*: Bihar, Uttar Pradesh, Punjab, West Bengal, Orissa, Madhya Pradesh, Maharashtra, and Himachal Pradesh; *Elsewhere*: Pakistan, Bangladesh, Burma and Thailand	LC	1C
96.	*Parambassis ranga* (Hamilton, 1822)	Indian glassfish	*India*: Bihar, Jharkhand, Madhya Pradesh, Maharashtra; *Elsewhere*: Malaysia, Myanmar, Nepal, Pakistan	LC	1C
Family BADIDAE Barlow, Liem and Wickler, 1968					
97.	*Badis badis* (Hamilton, 1822)	Dwarf Chameleon Fish	*India*: Throughout India; *Elsewhere*: Bangladesh, Pakistan, Nepal and Myanmar	LC	1C
Family OSPHRONEMIDAE Van der Hoeven, 1832					
98.	*Ctenops nobilis* McClelland, 1845		*India*: Bengal, Bihar, Assam, Sikkim; *Elsewhere*: Bangladesh	NT	1C
99.	*Trichogaster chuna* (Hamilton, 1822)		*India*: Assam, Manipur, West Bengal; *Elsewhere*: Bangladesh, Nepal	LC	1C
Family CHANNIDAE Fowler, 1934					
100.	*Channa punctata* (Bloch, 1793)	Spotted Snake Head	*India*: Throughout India; *Elsewhere*: Pakistan, Nepal, Afghanistan, Bangladesh, Myanmar, Sri Lanka, Malayssia and China	LC	1C



Salmo trutta fario Linnaeus, 1758



Schizopygopsis stoliczkai Steindachner, 1866



Schizothorax richardsonii Gray, 1832

Triplophysa stoliczkae Steindachner, 1866

Ventral view of *Schizothorax richardsonii* Gray 1832

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Chapter 17

HERPETOFAUNA

IINDU SHARMA

In the present chapter, 24 species of Herpetofauna consisting of 08 species of amphibians of order Anura belonging to 03 families, 06 genera, and 16 species of the reptiles of order Squmata referable to 06 families, 11 genera have been recorded from the Trans-Himalayan Ecosystem. Family Dicroglossidae and Agamidae are the dominating families of Amphibians and reptiles respectively in the region. Herpetofauna is poorly worked out from the area. However, present studies will provide the base line data for the further studies.

Keywords: Herpetofauna, reptile, amphibian, ecosystem

INTRODUCTION

Amphibians and Reptiles collectively known as *Herpers* and constitute the two important classes of the Vertebrate group. They are cold blooded (poikilothermic) animals. Amphibians and Reptiles are important components of ecosystems serving as predators and as key food sources for many species (Gibbons *et al.,* 2000). Herpetofauna play an important role in the ecosystem as links in food web as predators and prey, biomonitors in controlling insect pests and also as excellent ecological indicators owing to their high degree of sensitivity to even a slight change in the environment (Lips, 1998; Daniels, 2003).

HISTORICAL RESUME

Amphibians are mainly characterized by moist, smooth or rough, glandular skin, four limbs and absence of scales except in cancelainas-limbless. They have dual mode of life *i.e.* both terrestrial and aquatic. There are 315 species of amphibians have been updated from India (Dinesh *et al.,* 2015). Amphibians diversity from the different Himalayan zones have been worked out by various workers from time to time (Jerdon, 1870; Boulenger, 1905, 1907; Waltner, 1974; Annandale, 1906, 1907, 1908, 1908a; Tilak and Ray, 1985; Chanda, 1986; Dasgupta, 1983, 1990, 1992; Deuti and Hegde, 2007; Mahony *et al.,* 2013; Sharma and Deuti, 2014; Deuti *et al.,* 2017. Recently, Deuti 2018 updated a list of 80 species comprising of 6 species of toads, 70 speceis of frogs, 2 species of salamanders and 2 species of caecilians has been updated from the different areas of the Indian Himalaya. Studies on the Trans-Himalayan ecosystem are scanty. Gruber (1981) studied the amphibians of Kashmir and Ladakh. Verma *et al.* (1995) studied the amphibians of Jammu and Kashmir including that of Ladakh.

Reptiles are characterized by dry and cornified skin usually covered with epidermal scales or scutes. They usually have two pairs of pentadactyl limbs which end in clawed digits (absent in snakes and limbless lizards). Limbs are paddle like in marine turtles and reduced in some lizards (Vardharaju, 2018). 10544 species belonging to 1194 genera, 85 families and 4 orders have been recorded worldwide of which about 603 species belonging to 170 genera, 30 families and 3 orders are recorded from the Indian subcontinent (Uetz *et al.,* 2017). The work undertaken from the Himalayan Ecosystem includes of Waltner, 1974; Hussain and Ray, 1995; Dutta, 1999; Sanyal and Gayen, 2006; Saikia *et al.,* 2007; Ramakrishna and Alfred 2007; Agarwal *et al.,* 2010; Bahuguna, 2010. 200 species belonging to 85 genera, 20 families and 3 orders from the Indian Himalaya have been reported (Vardhraju and Deepak, 2018).

DIVERSITY

Amphibians

The present study a comprehensive checklist of Amphibians and Reptilians were found in the Trans-

Desert Regional Centre, Zoological Survey of India, Jodhpur-342005 (Rajasthan)
*Zoological Survey of India, New Alipore, Kolkata,–700 053, (WB)
Email: induzsi@gmail.com; kailash616@gmail.com

Citation
Sharma, I. 2019. Herpetofauna. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 129-134. (Published by the Director, Zool. Surv. India, Kolkata)

Himalaya based on the published literature and as per the surveys undertaken on the Trans-Himalayan ecosystem of Ladakh and Spiti by HARC, ZSI, Solan (Table 1 & 2). Amphibians are represented by three orders *i.e.* Anura (frogs and toads), Urodela (salamanders) and Gymnophiona (caecilians). Among which they are represented by Order Anura belonging to 03 families, 06 genera and 08 species from the Trans-Himalayan ecosystem. Family Bufonidae (Toad) - *Bufotes latastii* (Boulenger, 1882) is found in the Ladakh and Spiti Valley and two species of the *Duttaphrynus* are found throughout the Himalaya. Three species *viz. Allopaa hazarensis* (Dubois and Khan, 1989), *Allopaa barmoachensis* (Khan and Tasnim, 1989), *Chrysopaa sternosignata* (Murray, 1885) of Family Dicroglossidae (Aquatic frogs) are found in the Ladakh and Kashmir. *Euphlyctis cyanophlyctis* (Schneider, 1799) is common all over the Himalaya**.** *Scutiger nyingchiensis* Fei, 1977 of family Megophryidae (Stream frog) is represented by a single species and is found in high altitudes of Ladakh.

Reptiles

The reptile fauna is represented by three orders *viz.* Testudines (Turtles and tortoises), Squamata (Lizards and snakes) and Crocodylia (crocodiles and gharials) from Indian Himalaya. Among which only Order Squamata (Lizards and snakes) belonging to 06 families, 11 genera and 16 species has been recorded from the Trans-Himalayan Ecosystem (Table-2). Family Agamidae (Agma) is represented by six species, among which three *viz. Laudakia tuberculata* (Gray, 1827), *Paralaudakia himalayana* (Steindachner, 1867) and *Phrynocephalus theobaldi* Blyth, 1863 are found in the Ladakh, Kashmir and Spiti valley and three species have wide distribution in Himalaya. Family Gekkonidae (Geckos)-*Altiphylax stoliczkai* (Steindachner, 1867) a single species has been recorded from the Ladakh and Kashmir. Family Scincidae (Skinks) is represented by two species *viz. Asymblepharus ladacensis* (Günther, 1864) and *Asymblepharus himalayanus* (Gunther, 1864) are endemic to Ladakh, Kashmir and Spiti Valley. Serpents (Snakes) are represented by three families belonging to seven species and have a wide distribution in the Himalayas.

THREATS

- The pertinent studies/ review of literature depict that diversity, ecology, behavior and biology of the amphibians and reptiles have not been worked out appropriately in the Trans-Himalayan region. Deuti, 2018 reported that many remote areas of Arunachal Pradesh, Sikkim, Himachal Pradesh and Ladakh have not been properly explored. The spatial and altitudinal distribution patterns of most species are unknown. Biological studies on the life history of most amphibian species have not been initiated, their taxonomy itself is poorly known.
- Among vertebrates, the amphibians and reptiles are particular concern because they are poorly known and are highly threatened (Rodrigues *et al.,* 2010). As these causes are still present it is said that herpetofauna is getting lost even before it gets recorded. However, most people have come to recognize the value of both reptiles and amphibians as an integral part of natural ecosystems and as heralds of environment quality (Gibbons *et al.,* 2000).
- It has been observed that most of the reptilian fauna has not assessed by IUCN. Vasudevan *et al.* (2006) reported it is unfortunate that conservation strategies are mostly for glamorous taxa such as birds and mammals, which may neglect smaller and less conspicuous vertebrates such as Herpetofauna.

Table 1 : Amphibian diversity along with distribution and conservation status

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Order ANURA Fischer von Waldheim, 1813 Family BUFONIDAE Gray, 1825				
1.	*Bufotes latastii* (Boulenger, 1882)	Ladakh Toad	*India*: Himachal Pradesh: Kinnaur (Kalpa), Lahaul & Spiti (Spiti-Tabo, Shago & Pin valley N.P.); Jammu and Kashmir: (Srinagar, Ladakh, Drass, Kargil); *Elsewhere:* North Africa, Western & Central Asia, Mongolia, Tibet, Europe, East to Kazakhstan and Altai mountains in Central Asia, extreme Western China.	LC	1A, 1B

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
2	*Duttaphrynus himalayanus* (Gunther, 1864)	Himalayan Toad	*India*: Himachal Pradesh, Sikkim, Meghalaya, Arunachal Pradesh and West Bengal; *Elsewhere*: Pakistan, China and Nepal.	LC	1A, 1B
3	*Duttaphrynus melanostictus* (Schneider, 1799)	Common Indian Toad	*India:* Throughout; *Elsewhere*: Myanmar, Sri Lanka, China, Sumatra, Java, Borneo, Bali, Malaysia, Indonesia, Philippines	LC	1A, 1B
	Family DICROGLOSSIDAE Anderson, 1871				
4	*Allopaa hazarensis* (Dubois and Khan, 1989)	Kashmir paafrog	*India:* Kashmir (Jammu and Kashmir); *Elsewhere*: Pakistan	LC	1A
5	*Allopaa barmoachensis* (Khan and Tasnim, 1989)	Barmoachen frog	*India:* Kashmir (Jammu and Kashmir); *Elsewhere*: Pakistan	-	1A
6	*Chrysopaa sternosignata* (Murray, 1885)	Murray's high altitude frog	*India:* Jammu and Kashmir; *Elsewhere*: Pakistan	LC	1A, 1B
7	*Euphlyctis cyanophlyctis* (Schneider, 1799)	Skittering Frog	*India*: Throughout; *Elsewhere*: Sri Lanka, Nepal, Iran, Nepal, Pakistan, Vietnam and Malaysia	LC	1A, 1B
	Family MEGOPHRYIDAE Bonaparte, 1850				
8	*Scutiger nyingchiensis* Fei, 1977	Ladakh high altitude Toad	*India*: Ladakh (Jammu and Kashmir), Arunachal Pradesh; *Elsewhere*: China, Nepal, Pakistan	LC	1A, 1B

Table 2 : Reptile diversity along with distribution and conservation status

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Order SQUAMATA Linnaeus, 1758 Suborder SAURIA Macartney, 1802 Infraorder IGUANIA Rafinesque, 1815 Family AGAMIDAE Gray, 1827 Subfamily AGAMINAE Gray, 1827				
1.	*Laudakia dayana* (Stoliczka, 1871)	Haridwar agama	*India*: Ladakh, Kashmir (Jammu and Kashmir), Lahaul and Spiti, Kinnaur (Himachal Pradesh), Uttarakhand	-	1B
2.	*Laudakia pakistanica* (Baig, 1989)	Pakistani agama	*India*: North West Indian Himalaya; *Elsewhere*: Pakistan	-	1A
3.	*Laudakia tuberculata* (Gray, 1827)	Kashmir rock agama	*India*: Ladakh, Kashmir (Jammu and Kashmir), Lahaul and Spiti, Kinnaur (Himachal Pradesh); *Elsewhere*: Pakistan, Nepal, Afghanistan	-	1A
4.	*Paralaudakia himalayana* (Steindachner, 1867)	Himalayan agama	*India*: Ladakh, Kashmir, Himachal Pradesh; *Elsewhere*: Afghanistan, Pakistan, Turkmenistan, Tajikistan	-	1A, 1B
5.	*Phrynocephalus theobaldi* Blyth, 1863	Theobald's toad headed agama	*India*: Ladakh, Kashmir (Jammu and Kashmir); *Elsewhere*: Eastern Turkestan, Nepal, China	LC	1A, 1B

Table 2 contd.

Sl. No.	Genus/Species	Common Name	Distribution	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Subfamily DRACONINAE Cuvier, 1829				
6.	*Japalura major* (Jerdon, 1870)	Large mountain lizard, Greater forest agama	*India*: Himachal Pradesh, Uttarakhand; *Elsewhere*: Nepal	-	1A
	Infra order GEKKOTA Cuvier, 1817 Family GEKKONIDAE Cuvier, 1817				
7.	*Altiphylax stoliczkai* (Steindachner, 1867)	Frontier Bow-fingered Gecko	*India*: Ladakh, Kashmir (Jammu and Kashmir); *Elsewhere*: China	LC	1A, 1B
	Family SCINCIDAE Gray, 1825 Subfamily LYGOSOMINAE Mittleman, 1952				
8.	*Asymblepharus ladacensis* (Günther, 1864)	Mountain ground skink	*India:* Ladakh, Kashmir (Jammu and Kashmir); Lahaul and Spiti (Himachal Pradesh); *Elsewhere*: Nepal, China, Pakistan	-	1A, 1B
9.	*Asymblepharus himalayanus* (Gunther, 1864)	Himalayan ground skink	*India*: Kashmir (Jammu and Kashmir); Lahaul and Spiti (Himachal Pradesh); *Elsewhere*: Nepal, Pakistan	-	1B
	Family COLUBRIDAE Cope 1893				
10.	*Elaphe hodgsoni* (Gunther, 1860)	Himalayan trinket snake	*India:* Sikkim, Assam, Kashmir, Ladakh, (Jammu and Kashmir); Himachal Pradesh; *Elsewhere*: Nepal, China	-	1A
11.	*Platyceps ladacensis* (Anderson, 1871)	Braid snake	*India:* Jammu and Kashmir; *Elsewhere*: Iran, Afghanistan, Tajikistan, Turkmenistan, Uzbekistan, Pakistan	-	1A, 1B
12.	*Platyceps rhodorachis* (Jain, 1865)	Common cliff racer	*India:* Jammu, Ladakh (Jammu and Kashmir); *Elsewhere*: Afghanistan, Tajikistan, Pakistan	-	1A
13.	*Ptyas mucosa* (Linnaeus, 1758)	Indian Rat snake	*India:* Kargil, Ladakh (Jammu and Kashmir); *Elsewhere*: Afghanistan, Bangldesh, Burma,China, Sri Lanka, Indonesia, Nepal, Myanmar, Pakistan	-	1A
	Family LAMPROPHIIDAE Fitzinger,1826 Subfamily PSAMMOPHIINAE Dowling,1967				
14.	*Psammophis leithii* Gunther, 1869	Pakistani ribbon snake	*India:* Himachal Pradesh, Kashmir, Jammu (Jammu and Kashmir); Rajasthan, Uttar Pradesh, Punjab, Madhya Pradesh, Maharashtra, Andhra Pradesh; *Elsewhere*: Afghanistan, Pakistan	-	1A
15.	*Psammophis schokari* (Forskal, 1775)	Schokari sand racer	*India:* Kashmir, Rajasthan, Punjab; *Elsewhere:* Pakistan, Iraq, Iran	-	1A
	Family ELAPIDAE F. Boie, 1827				
16.	*Naja oxiana* (Eichwald, 1831)	Central Asian cobra	*India:* Kashmir, Himachal Pradesh; *Elsewhere*: Afghanistan, NE Iran, Tajikistan, Kyrgzstan, Turkmeinstan, Pakistan	DD	1A

Asymblepharus himalayanus Gunther, 1864

Asymblepharus ladacensis Günther, 1864

Laudakia tuberculata Gray, 1827

Pseudepidalea latastii Boulenger, 1882 in Spiti

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Chapter 18

AVES

KAMAL SAINI, INDU SHARMA*, AVTAR KAUR SIDHU and B.S. RANA**

349 species belonging to 183 genera, 64 families and 17 orders have been documented from the Trans-Himalayan Ecosystem. Marshy lands along the Wetlands of Ladakh serve as good breeding habitats of various migratory birds viz. Bar-headed Goose (*Anser indicus*), Brown-headed Gull (*Larus brunnicephalus*) and Black-necked Crane (*Grus nigricollis*) etc. The sightings of the Blacknecked Crane in the area are considered to be good symbol by the locals. Tibetan Snowcock (*Tetraogallus thibetanus*), Tibetan Partridge (*Perdix hodgsoniae*), Tibetan Sandgrouse (*Syrrhaptes thibetanus*), Golden Eagle (*Aquila chrysaetos*) and Lammergeier (*Gypaetus barbatus* are the important resident birds. Tourism, habitat destruction and climate change are some of the main threats in the high altitudes. Thus, there is urgent need for the conservation of the magnificent bird diversity of the area.

Keywords: Threat, conservation, magnificent, tourism

INTRODUCTION

Birds of the Trans-Himalaya are well adapted to the harsh climatic conditions (low oxygen contents and temperature etc.) of the region. High altitude especially aerial birds are habituated through physiological adjustments. The physiology of birds that fly at high altitudes differs from that of lowland birds in various ways. It has been found out from the study that Bar-headed goose (*Anser indicus*) can tolerate severe hypoxia (Black and Tenney 1980) and fly over the Himalaya about of 9000 m between South and Central Asia during its migration (Swan, 1970). A single non-stop flight of Bar-headed geese have been traced at 5000-7750 m elevation while crossing the Himalayan peaks (Koppen *et al*., 2010; Hawkes *et al*., 2011). The characteristics of birds which maintain flight at high altitudes have enhanced gaseous exchange efficiency, increase oxygen diffusion in muscle fibers owing to increase in capillary fiber ratio in a lofty elevation with hypoxic environment. High altitude birds also have larger wings than their lowland relatives thereby reducing the energetic costs of flight in low density air (Essays, 2013).

These are acquired by an enhanced hypoxic ventilator response includes an effective breathing pattern, larger lungs, expansion of oxygen diffusion capacity in the periphery and multiple adjustment in the metabolic properties of cardiac and skeletal muscle. They maintain high metabolic rate of metabolism required for flight at high elevation. These unique specializations improve the uptake, circulation and efficient utilization of oxygen during high altitude hypoxia. The respiratory system of high altitude birds therefore seems capable of loading more oxygen into the blood during hypoxia than that of lowland birds. However, high altitude environments cause various hazards to animal life. The physical environment changes severely on gradient, with declines in oxygen availability, temperature, air density and humidity. Despite various challenges, they live successfully in the high altitudes. Further, understanding of the physiological basis of altitudinal range limits will be helpful to know that how they are being shifted in response to climate change (Scott, 2011). The Trans-Himalayan region especially Ladakh harbours birds from the Palaearctic as well as the Indo-Malayan zoogeographic zones and thus typical bird species are found in this region. In addition, characteristic

High Altitude Regional Centre, Zoological Survey of India, Solan- 173 211 (HP)
* Desert Regional Centre, Zoological Survey of India, Jodhpur-342005 (Rajasthan)
**Forest Training Institute, Chail-173 217 (HP)
Email: zsikamal@gmail.com

Citation
Saini, K., Sharma, I., Sidhu, A.K. and Rana, B.S. 2019. Aves. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 135-158. (Published by the Director, Zool. Surv. India, Kolkata)

Tibetan birds extend their home ranges into eastern Ladakh. The occurrence of birds in Trans-Himalaya has been divided into four groups. Resident birds consist of those species which are adapted to high altitudes. They breed in summer at very high elevations and come back to the bottom valley of lower part during the harsh winter. Summer visiting birds constitutes the significant diversity and population in the region. They came from the South Asian plains and Tibetan plateau during April to May and breeds in and around high altitude steppe, wetlands, meadow valleys and return back to their warmer wintering areas during August and lasting till November. Wintering birds comprises small population and comes in Ladakh during October and up to early-December from Northern breeding ground. They live mainly along the low valley bottoms near the Indus boarders and return back during April-May to their breeding grounds. Migrants comprise the largest and divers group. They arrive in the region from late-March to May (spring) and end- August to November (autumn). These birds live in the area for a short period of time. Comparatively, during winter the arrival of birds are less as Lakes and frozen during this period. Further, the migratory bird diversity is more in the central and eastern regions of Ladakh (Pfister 2004).

HISTORICAL RESUME

Several works on avian fauna from the cold deserts have been undertaken from time to time. The bibliography compilation of published literature (Chaudhury *et al.,* 2016) depicts that there are 252 publications from Jammu and Kashmir (mostly in the Ladakh region) from 1833 to 2016 of two centuries. Some of the contributions from the Trans-Himalayan Ecosystem are of LaPearson, 1928 a, b; Meinertzhagen, 1927; Ali, 2002; Islam and Rahmani, 2004; Pfister, 2004; Sanga and Naoroji, 2005; Namgail, 2005; Chandan *et al.,* 2008; Tak *et al.,* 2008; Mandal *et al.,* 2018 etc. The avian diversity of India is represented by 1,340 species (Chandra *et al.,* 2016). 940 species belonging to 401 genera from 94 families under 23 orders from the Indian Himalaya have been reported. 349 species are found in the Trans-Himalaya (Biogeographic Zone-1) as given in checklist below (Mandal *et al.,* 2018) and among which 41 species are restricted to the Region. Ladakh region provides habitat for more than 25% of the Indian bird diversity (310 out of 1240 species) and preferred breeding ground to more than one-third bird species (106 species) of the area. The avian community of this area is dominated by the passage migrants (135 out of 310 species), followed by the summer visitors (89), residents (31), winter visitors (11), and the altitudinal or local migrants (08) (Tak *et al.,* 2008). The high altitude wetlands are the breeding habitats of the migratory waterfowl *viz.* Bar-headed Goose (*Anser indicus*), Brown-headed Gull (*Larus brunnicephalus*) and Black-necked Crane (*Grus nigricollis*). Prominent resident birds include the Tibetan Snowcock (*Tetraogallus thibetanus*), Tibetan Partridge (*Perdix hodgsoniae*), Tibetan Sandgrouse (*Syrrhaptes thibetanus*), Golden Eagle (*Aquila chrysaetos*) and Lammergeier/ bearded Vulture (*Gypaetus barbatus*) (Misra *et al.,* 2010)

THREATS AND CONSERVATION

Habitat destruction, breeding ground devastation, tourism, climate change etc. are some of the challenges for the survival of the high altitudes birds. Three species

Black necked crane (*Grus nigricollis* Prjevalsky, 1876) near Nyoma in Ladakh

viz. Siberian Crane (*Grus leucogeranus*), Yellow eyed pigeon (*Columba eversmanni*) and Tytler's Leaf-Warbler (*Phylloscopus tytleri*) have not been recorded after 1960 (Pfister, 2004). Several birds of the Trans-Himalaya *viz.* Oriental Honey-Buzzard (*Pernis ptilorhynchus*), Black-shouldered Kite (*Elanus caeruleus*), Pallas's Fish-Eagle (*Haliaeetus leucoryphus*), Bearded Vulture (*Gypaetus barbatus*), Eurasian Marsh-Harrier (*Circus aeruginosus*), Pallid Harrier (*Circus macrourus*), Montagu's Harrier (*Circus pygargus*), Eurasian Sparrowhawk (*Accipiter nisus*), Northern Goshawk (*Accipiter gentilis*), Long-legged Buzzard (*Buteo rufinus*), Upland Buzzard (*Buteo hemilasius*), Steppe Eagle (*Aquila nipalensis*), Golden Eagle (*Aquila chrysaetos*), Booted Eagle (*Hieraaetus pennatus*), Osprey (*Pandion haliaetus*), Tibetan Snowcock (*Tetraogallus tibetanus*), Black-necked Crane (*Grus nigricollis*) are under Schedule-1 of Indian Wild life (Protection) Act 1972. The Black necked crane is the only species which is found in remote high altitudes of Ladakh. It is the state bird of the Jammu and Kashmir and sighting of this bird in the region is considered as the symbol of good fortune by the locals. However, the status of the bird is under real threat. It has been observed that feral dogs, usually destroys the eggs as well as chicks of the bird. Dogs are causing the main threat for the successful reproduction of cranes in Ladakh. The extension of the agricultural activities near the marshy wetland is devastating the amiable habitat of the bird (Pfister, 2004). The excessive grazing near the wetlands is leading to the degradation of the important breeding grounds of the rare and endangered migratory birds. Trans-Himalaya, like any other high altitude desert in the world, has a very fragile ecosystem and due to unplanned, unregulated developmental and tourism activities, is under threat. This is causing more damage as the peak period of biological activity in Trans-Himalaya coincides with the peak tourism season (Chandan, *et al.,* 2008). There is an urgent need for the conservation of this fragile ecosystem. The local people required to be educated through special conservation awareness programmes. Since the younger generations, especially the school children, are the future potential stewards of the wild animals, they should be the prime focus of environmental education programs (Namgail, 2009).

Table 1 : Diversity of Birds species in Indian Trans-Himalaya

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Order ANSERIFORMES Wagler, 1831				
1.	Anatidae Leach, 1820 (Ducks, Geese, Swans)	*Anas acuta* Linnaeus, 1758	Northern Pintail	LC	1A, 1B
2.	-	*Anas crecca* Linnaeus, 1758	Common Teal	LC	1A, 1B
3.	-	*Anser indicus* (Latham, 1790)	Bar-headed Goose	LC	1A, 1B
4	-	*Aythya baeri* (Radde, 1863)	Baer's pochard	CR	1C
5.	-	*Aythya ferina* (Linnaeus, 1758)	Common Pochard	VU	1A, 1B
6.	-	*Aythya fuligula* (Linnaeus, 1758)	Tufted Pochard	LC	1A, 1B
7.	-	*Aythya marila* (Linnaeus, 1761)	Greater Scaup	LC	1A
8.	-	*Aythya nyroca* (Güldenstädt, 1770)	Ferruginous Pochard	NT	1A, 1B, 1C
9.	-	*Cygnus olor* (Gmelin, 1789)	Mute swan	LC	1A
10.	-	*Marmaronetta angustirostris* (Menetries, 1832)	Marbled Duck	VU	1A, 1B
11.	-	*Mergus merganser* Linnaeus, 1758	Common Merganser	LC	1A, 1B
12.	-	*Oxyura leucocephala* (Scopoli, 1769)	White Headed Duck	EN	1A, 1B
13.	-	*Spatula clypeata* (Linnaeus, 1758)	Northern Shoveler	LC	1A, 1B, 1C

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
14.	-	*Ta-rna ferruginea* (Pallas, 1764):	Ruddy shelduck	LC	1A, 1B
	Order GALLIFORMES Temminck, 1820				
15.	Phasianidae Horsfield, 1821 (Partridges, Pheasants, Grouse)	*Alectoris chukar* (Gray, 1830)	Chukor	LC	1A, 1B
16.	-	*Arborophila torqueola* (Valenciennes, 1825)	Simla Hill-Partridge	LC	1C
17.	-	*Coturnix coturnix* (Linnaeus, 1758):	Common Quail	LC	1A
18.	-	*Ithaginis cruentus* (Hardwicke, 1821)	Blood Pheasant	LC	1C
19.	-	*Lerwa lerwa* (Hodgson, 1833)	Snow Partridge	LC	1A, 1B, 1C
20.	-	*Lophophorus impejanus* (Latham, 1790)	Himalayan Monal	LC	1A
21.	-	*Perdix hodgsonia*e (Hodgson, 1857)	Tibetan partridge	LC	1B, 1C
22.	-	*Pucrasia macrolopha* (Lesson, 1829)	Koklass Pheasant	LC	1A
23.	-	*Tetraogallus himalayensis* Gray, 1843	Himalayan Snow Cock	LC	1A, 1B
24.	-	*Tetraogallus tibetanus* Gould, 1854	Tibetan Snow Cock	LC	1B. 1C
	Order PODICIPEDIFORMES Fürbringer, 1888				
25.	Podicipedidae Bonaparte, 1831 (Grebes)	*Podiceps cristatus* (Linnaeus, 1758)	Great Crested Grebe	LC	1A
26.	-	*Podiceps nigricollis* Brehm, 1831	Black-necked Grebe	LC	1A
	Order COLUMBIFORMES Latham, 1790				
27.	Columbidae Leach, 1820 (Pigeons)	*Columba eversmanni* Bonaparte, 1856	Yellow eyed pigeon	VU	1B
28.	-	*Columba hodgsonii* Vigors, 1832	Speckled Wood-Pigeon	LC	1A
29.	-	*Columba leuconota* Vigors, 1831	Snow Pigeon	LC	1A, 1B, 1C
30.	-	*Columba livia* Gmelin, 1789	Blue Rock Pigeon	LC	1A
31.	-	*Columba rupestris* Pallas, 1811	Hill Pegion	LC	1A, 1B, 1C
32.	-	*Streptopelia decaocto* (Frivaldszky, 1838)	Eurasian Collared dove	LC	1A, 1B
33.	-	*Streptopelia orientalis* (Latham, 1790)	Oriental Turtal dove	LC	1A, 1B, 1C
34.	-	*Streptopelia senegalensis* (Linnaeus, 1766)	Laughing dove	LC	1A
35.	-	*Streptopelia turtur* (Linnaeus, 1758):	European turtle dove	VU	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Order PTEROCLIDIFORMES Huxley, 1868				
36.	Pteroclididae Bonaparte, 1831 (Sandgrouse)	*Syrrhaptes tibetanus* Gould, 1850	Tibetan Sandgrouse	LC	1B, 1C
	Order APODIFORMES Peters, 1940				
37.	Apodidae Hartert, 1897 (Swifts)	*Apus affinis* (J.E. Gray, 1830)	House Swift	LC	1A
38.	-	*Apus pacificus* (Latham, 1801)	Pacific Swift	LC	1A, 1B, 1C
39.	-	*Hirundapus caudacutus* (Latham, 1801)	Asian spine tailed Swift	LC	1A, 1B, 1C
	Order CUCULIFORMES Wagler, 1830				
40.	Cuculidae Horsfield, 1823 (Cuckoos)	*Cuculus canorus* Linnaeus, 1758	Common Cuckoo	LC	1A, 1B, 1C
	Order GRUIFORMES Bonaparte, 1854				
41.	Gruidae Vigors, 1825 (Cranes)	*Grus nigricollis* Prjevalsky, 1876	Black Necked Crane	VU	1A
42.	Rallidae Rafinesque, 1815 (Rails, Coots)	*Gallinula chloropus* (Linnaeus, 1758):	Common Moorhen	LC	1A, 1B
43.	-	*Fulica atra* Linnaeus, 1758	Common Coot	LC	1A, 1B
44.	-	*Rallus aquaticus* Linnaeus, 1758	European Water Rail	LC	1A, 1B
45.	-	*Zapornia bicolor* (Walden, 1872)	Black tailed Crake	LC	1C
46.	-	*Zapornia parva* Scopoli, 1769	Little Crake	LC	1A
	Order OTIDIFORMES Wagler, 1830				
47.	Otididae Rafinesque, 1815 (Bustards)	*Tetrax tetrax* (Linnaeus, 1758)	Little Bustard	NT	1A
	Order PELECANIFORMES Sharpe, 1891				
48.	Ardeidae Leach, 1820 (Herons)	*Ardea alba* Linnaeus, 1758	Great White Egret	LC	1A, 1B, 1C
49.	-	*Botaurus stellaris* (Linnaeus, 1758)	Common Bittern	LC	1A
50.	-	*Egretta garzetta* (Linnaeus, 1766)	Little Eagret	LC	1B, 1C
51.	-	*Ixobrychus Minutes* (Linnaeus,1766)	Little Bittern	LC	1A
52.	-	*Nycticorax nycticorax* (Linnaeus,1758)	Black-crowned Night Heron	LC	1A
53.	Pelecanidae Rafinesque, 1815 (Pelicans)	*Pelecanus crispus* Bruch, 1832	Dalmatian Pelican	NT	1A
54.	Threskiornithidae Richmond, 1917 (Ibises)	*Platalea leucorodia* Linnaeus, 1758	Eurasian Spoonbill	LC	1A
	Order CHARADRIIFORMES Huxley, 1867				
55.	Charadriidae Leach, 1820 (Plovers, Lapwings)	*Charadrius mongolus* Pallas, 1776	Lesser Sand Plover	LC	1A, 1B, 1C
56.	-	*Pluvialis fulva* (Gmelin, 1789)	Pacific Golden Plover	LC	1A, 1B

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
57.	-	*Pluvialis squatarola* (Linnaeus, 1758)	Black bellied Plover	LC	1A, 2B
58.	-	*Glareola maldivarum* Forster, 1795	Oriental Pratincole	LC	1C
59.	Glareolidae Brehm, 1831 (Coursers, Pratincoles)	*Glareola pratincola* (Linnaeus, 1766)	Collared Pratincole	LC	1B
60.	Haematopodidae Bonaparte, 1838 (Oystercatchers, Ibisbills)	*Ibidorhyncha struthersii* Vigors, 1832	IbiSbill	LC	1A, 1B, 1C
61.	Jacanidae Stejneger, 1885 (Jacanas)	*Hydrophasianus chirurgus* (Scopoli, 1786)	Phaesant-tailed Jacana	LC	1A
62.	Laridae Rafinesque, 1815	*Larus brunnicephalus* Jer-n, 1840	Brown-headed Gull	LC	1A, 1B
63.	-	*Larus ridibundus* Linnaeus, 1766	Black-headed Gull	LC	1A, 1B
64.	-	*Sterna aurantia* Gray, 1831	Indian River tern	NT	1A
65.	-	*Sterna hirundo* Linnaeus, 1758	Common Tern	LC	1A, 1B
66.	Scolopacidae Rafinesque, 1815 (Sandpipers)	*Actitis hypoleucos* (Linnaeus, 1758)	Common Sandpiper	LC	1A
67.	-	*Arenaria interpres* (Linnaeus, 1758)	Ruddy ternstone	LC	1B
68.	-	*Calidris alba* Pallas, 1764	Sanderling	LC	1B
69.	-	*Calidris alpina* (Linnaeus, 1758)	Dunlin	LC	1B
70.	-	*Calidris falcinellus* Pontoppidan, 1763	Broad billed sandpiper	LC	1B
71.	-	*Calidris minuta* (Leisler, 1812)	Little Stint	LC	1B
72.	-	*Calidris temminckii* (Leisler, 1812)	Temminck's Stint	LC	1A,1B
73.	-	*Gallinago gallinago* (Linnaeus 1758)	Common Snipe	LC	1A, 1B
74.	-	*Gallinago solitaria* Hodgson, 1831	Solitary Snipe	LC	1A, 1B, 1C
75.	-	*Gallinago stenura* (Bonaparte, 1831)	Pin-tailed Snipe	LC	1A, 1B
76.	-	*Limosa lapponica* Linnaeus, 1758	Bar-tailed Godwit	NT	1B
77.	-	*Limosa limosa* Linnaeus, 1758	Black-tailed Godwit	NT	1A, 1B
78.	-	*Numenius arquata* (Linnaeus, 1758)	Eurasian Curlew	NT	1A
79.	-	*Numenius phaeopus* (Linnaeus, 1758)	Whimbrel	LC	1A
80.	-	*Phalaropus lobatus* (Linnaeus, 1758)	Red-necked Phalarope	LC	1B

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
81.	-	*Tringa erythropus* (Pallas, 1764)	Spotted Red Shank	LC	1A
82.	-	*Tringa glareola* Linnaeus, 1758	Wood Sandpiper	LC	1A
83.	-	*Tringa nebularia* (Gunnerus, 1767)	Common Greenshank	LC	1B
84.	-	*Tringa stagnatilis* (Bechstein, 1803)	Marsh Sandpiper	LC	1B
85.	-	*Tringa totanus* (Linnaeus, 1758)	Common Redshank	LC	1A, 1B, 1C
86.	-	*Xenus cinereus* (Guldenstadt, 1775)	Terek Sandpiper	LC	1B
87.	Stercorariidae Gray, 1871 (Skuas)	*Stercorarius parasiticus* (Linnaeus, 1758)	Arctic Jaeger	LC	1B
	Order ACCIPITRIFORMES Vieillot, 1816				
88.	Accipitridae Vieillot, 1816 (Kites, Hawks, Eagles)	*Accipiter gentilis* (Linnaeus, 1758)	Eurasian Goshawk	LC	1A, 1B, 1C
89.	-	*Accipiter nisus* (Linnaeus, 1758)	Eurasian Sparrowhawk	LC	1A, 1B
90.	-	*Aegypius monachus* (Linnaeus, 1766)	Black Vulture	NT	1B
91.	-	*Aquila chrysaetos* (Linnaeus, 1758)	Golden Eagle	LC	1A, 1B
92.	-	*Aquila nipalensis* Hodgson, 1833	Steppe Eagle	EN	1B
93.	-	*Buteo hemilasius* Temminck and Schlegel, 1844	Upland Buzzard	LC	1A, 1B, 1C
94.	-	*Buteo refectus* Portenko, 1935	Himalayan Buzzard	LC	1A, 1B
95.	-	*Buteo rufinus* (Cretzschmar, 1829)	Long-legged Buzzard	LC	1A, 1B, 1C
96.	-	*Circaetus gallicus* (Gmelin, 1788)	Short-toed Eagle	LC	1B
97.	-	*Circus aeruginosus* (Linnaeus, 1758)	Eurasian Marsh Harrier	LC	1A, 1B
98.	-	*Circus cyaneus* (Linnaeus, 1766)	Hen Harrier	LC	1A, 1B
99.	-	*Circus macrourus* (Gmelin, 1770)	Pallid Harrier	NT	1A, 1B
100.	-	*Circus pygargus* (Linnaeus, 1758)	Montagu's Harrier	LC	1B
101.	-	*Elanus caeruleus* (Desfontaines, 1789)	Black Shouldered Kite	LC	1B
102.	-	*Gypaetus barbatus* (Linnaeus, 1758)	Bearded Vulture	NT	1A, 1B, 1C
103.	-	*Gyps himalayensis* Hume, 1869	Himalayan Griffon	NT	1A, 1B, 1C

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
104.	-	*Haliaeetus leucoryphus* (Pallas, 1771)	Pallas's Fish Eagle	EN	1B
105.	-	*Hieraaetus pennatus* (Gmelin, 1788)	Booted Eagle	LC	1A,1B
106.	-	*Neophron percnopterus* (Linnaeus, 1758)	Egyptian Eagle	EN	1B
107.	-	*Nisaetus nipalensis* Hodgson, 1836	Mountain Hawk Eagle	LC	1B
108.	-	*Pernis ptilorhynchus* (Temminck, 1821)	Crested Honey Buzzard	LC	1A
109.	Pandionidae Sclater and Salvin, 1873 (Osprey)	*Pandion haliaetus* (Linnaeus, 1758)	Osprey	LC	1B
	Order STRIGIFORMES Wagler, 1830				
110.	Strigidae Leach, 1820 (Owls)	*Aegolius funereus* (Linnaeus, 1758)	Boreal Owl	LC	1A, 1B
111.	-	*Asio flammeus* (Pontoppidan, 1763)	Short eared Owl	LC	1B
112.	-	*Asio otus* (Linnaeus, 1758)	Northern long eared Owl	LC	1A, 1B
113.	-	*Athene noctua* (Scopoli, 1769)	Little Owl	LC	1A, 1B
114.	-	*Bubo bubo* (Linnaeus, 1758)	Eurasian eagle Owl	LC	1A, 1B
115.	-	*Otus scops* (Linnaeus, 1758)	Eurasian Scops Owl	LC	1A
116.	-	*Strix aluco* Linnaeus, 1758	Tawny Owl	LC	1A
	Order PICIFORMES Meyer and Wolf, 1810				
117.	Picidae Leach, 1820 (Woodpeckers)	*Dendrocopos himalayensis* (Jardine and Selby, 1831)	Himalayan Woodpecker	LC	1A
118.	-	*Dendrocopos hyperythrus* (Vigors, 1831)	Rufous bellied Woodpecker	LC	1A
119.	-	*Jynx torquilla* Linnaeus, 1758	Eurasian Wryneck	LC	1A, 1B
120.	-	*Picus squamatus* Vigors, 1831	Scaly bellied Woodpecker	LC	1A
	Order CORACIIFORMES Forbes, 1884				
121.	Alcedinidae Rafinesque, 1817 (Kingfishers)	*Alce- atthis* (Linnaeus, 1758)	Common Kingfisher	LC	1A, 1B
122.	Coraciidae Rafinesque, 1815 (Rollers)	*Coracias garrulus* Linnaeus, 1758	European Roller	LC	1A
123.	Meropidae Rafinesque, 1815 (Bee-eaters)	*Merops apiaster* Linnaeus, 1758	European Bee eater	LC	1A, 1B
124.	-	*Merops persicus* Pallas, 1773	Blue cheeked Bea eater	LC	1A, 1B

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Order FALCONIFORMES Sharpe, 1874				
125.	Falconidae Leach, 1820 (Falcons, Caracaras)	*Falco columbarius* Linnaeus, 1758	Merlin	LC	1A, 1B
126.	-	*Falco subbuteo* Linnaeus, 1758	Eurasian Hobby	LC	1A, 1B
127.	-	*Falco tinnunculus* Linnaeus, 1758	Common Kestrel	LC	1A, 1B
	Order PASSERIFORMES Linnaeus, 1758				
128.	Acrocephalidae Salvin, 1882 (Brush, Reed and Swamp Warblers)	*Acrocephalus agricola* (Jer-n, 1845)	Paddyfield Warbler	LC	1B
129.	-	*Acrocephalus concinens* (Swinhoe, 1870)	Blunt winged Warbler	LC	1A
130.	-	*Iduna caligata* (Lichtenstein, 1823)	Booted Warbler	LC	1A
131.	Aegithalidae Reichenbach, 1850 (Long-tailed Tits)	*Aegithalos leucogenys* (Moore, 1854)	White cheeked Bushtit	LC	1A
132.	-	*Aegithalos niveogularis* (Gould, 1855)	White -throated Bushtit	LC	1A
133.	-	*Leptopoecile sophiae* Severtzov, 1873	White-browed Tit-Warbler	LC	1A
134.	Artamidae Vieillot, 1816 (Woodswallows, Australian magpies and allies)	*Alaudala rufescens* (Vieillot, 1819)	Lesser short-toed Lark	LC	1B
135.	-	*Melanocorypha bimaculata* (Ménétries, 1832)	Bimaculated Lark	LC	1A, 1B
136.	-	*Melanocorypha maxima* Blyth, 1867	Tibetan Lark	LC	1B, 1C
137.	-	*Galerida cristata* (Linnaeus, 1758)	Crested Lark	LC	1A
138.	-	*Alauda arvensis* Linnaeus, 1758	Eurasian Skylark	LC	1A
139.	-	*Alauda gulgula* Franklin, 1831	Oriental Skylark	LC	1A, 1B, 1C
140.	-	*Calandrella brachydactyla* (Leisler, 1814)	Greater short-toed Lark	LC	1A, 1B, 1C
141.	-	*Eremophila alpestris* (Linnaeus, 1758)	Horned Lark	LC	1A, 1B, 1C
142.	Bombycillidae Vieillot, 1808 (Waxwings)	*Bombycilla garrulus* (Linnaeus, 1758)	Bohemian Waxwing	LC	1A
143.	Campephagidae Vigors, 1825 (Minivets, Cuckooshrikes	*Pericrocotus divaricatus* (Raffles, 1822)	Ashy Minivit	LC	1B
144.	-	*Pericrocotus ethologus* Bangs and Phillips, 1914	Long-tailed Minivit	LC	1A
145.	Certhiidae Leach, 1820 (Treecreepers)	*Certhia himalayana* Vigors, 1832	Bar-tailed Tree creeper	LC	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
146.	Cettiidae Alström *et al.*, 2006 (Bush Warblers and allies)	*Cettia brunnifrons* (Hodgson, 1845)	Grey-sided Bush-warbler	LC	1C
147.	-	*Cettia major* (Moore, 1854)	Chestnut crowned bush warbler	LC	1C
148.	-	*Tesia cyaniventer* Hodgson, 1837	Grey bellied Tesia	LC	1C
149.	Cinclidae Sundevall, 1836 (Dippers)	*Cinclus cinclus* (Linnaeus, 1758)	White-throated Dipper	LC	1A, 1C
150.	-	*Cinclus pallasii* Temminck, 1820	Brown Dipper	LC	1A, 1C
151.	Cisticolidae Sundevall, 1872 (Cisticolas)	*Prinia crinigera* Hodgson, 1836	Striated Prinia	LC	1C
152.	Family Corvidae Leach, 1820 (Crows, Jays)	*Corvus corax* Linnaeus, 1758	Common Raven	LC	1A, 1B, 1C
153.	-	*Corvus corone* Linnaeus, 1758	Carrion Crow	LC	1A, 1B
154.	-	*Corvus frugilegus* Linnaeus, 1758	Rook	LC	1A
155.	-	*Corvus monedula* (Linnaeus, 1758)	Eurasian Jackdaw	LC	1A, 1B
156.	-	*Garrulus glandarius* (Linnaeus, 1758)	Eurasian Jay	LC	1C
157.	-	*Nucifraga caryocatactes* (Linnaeus, 1758)	Northern Nutcracker	LC	1C
158.	-	*Pica pica* (Linnaeus, 1758)	Eurasian magpie	LC	1A, 1B
159.	-	*Pyrrhocorax graculus* (Linnaeus, 1766)	Yellow billed chough	LC	1A, 1B, 1C
160.	-	*Pyrrhocorax pyrrhocorax* (Linnaeus, 1758)	Red billed Chough	LC	1A, 1B, 1C
161.	-	*Urocissa flavirostris* (Blyth, 1846)	Gold billed Magpie or Yellow billed blue magpie	LC	1C
162.	Emberizidae Vigors, 1831 (Old World Buntings)	*Emberiza bruniceps* Brandt, 1841	Red headed Bunting	LC	1A, 1B
163.	-	*Emberiza buchanani* Blyth, 1845	Grey necked Bunting	LC	1A
164.	-	*Emberiza cia* Linnaeus, 1766	European Rock Bunting	LC	1A, 1B
165.	-	*Emberiza citrinella* Linnaeus, 1758	Yellow hammer	LC	1B
166.	-	*Emberiza hortulana* Linnaeus, 1758	Ortolan Bunting	LC	1A
167.	-	*Emberiza leucocephalos* Gmelin, 1771	Pine Bunting	LC	1A, 1B

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
168.	-	*Emberiza melanocephala* Scopoli, 1769	Black-headed Bunting	LC	1A
169.	-	*Emberiza pusilla* Pallas, 1776	Little Bunting	LC	1A, 1B
170.	-	*Emberiza rutila* Pallas, 1776	Chestnut Bunting	LC	1C
171.	-	*Emberiza schoeniclus* (Linnaeus, 1758)	Common reed Bunting	LC	1A
172.	-	*Emberiza spodocephala* Pallas, 1776	Black-faced Bunting	LC	1C
173.	-	*Emberiza stewarti* (Blyth, 1854)	Chestnut-breasted Bunting	LC	1A
174.	Fringillidae Leach, 1820 (Finches, Euphonias and Hawaiian Honeycreepers)	*Agraphospiza rubescens* (Blanford, 1872)	Blanford's Rosefinch	LC	1C
175.	-	*Bucanetes mongolicus* (Swinhoe, 1870)	Mongolian Finch	LC	1A, 1B
176.	-	*Callacanthis burtoni* (Gould, 1838)	Spectacled Finch	LC	1A
177.	-	*Carduelis carduelis* (Linnaeus, 1758)	European Goldfinch	LC	1A, 1B
178.	-	*Carpodacus edwardsii* Verreauxii, 1871	Rosefinch	-	1C
179.	-	*Carpodacus erythrinus* (Pallas, 1770)	Common or Scarlet Rosefinch	LC	1A, 1B, 1C
180.	-	*Carpodacus grandis* Blyth, 1849	Blyth's Rosefinch	-	1C
181.	-	*Carpodacus pulcherrimus* (Moore, 1856)	Beautiful Rosefinch	LC	1C
182.	-	*Carpodacus puniceus* (Blyth, 1845)	Red fronted Rosefinch	LC	1A, 1B, 1C
183.	-	*Carpodacus rodochroa* Vigors, 1831	Pink browed Rosefinch	LC	1A, 1B, 1C
184.	-	*Carpodacus rodopeplus* (Vigors, 1831)	Spot Winged rosefinch	LC	1C
185.	-	*Carpodacus rubicilla* (Guldenstadt, 1775)	Great Rosefinch	LC	1A, 1B, 1C
186.	-	*Carpodacus rubicilloides* Przewalski, 1876	Streaked Rosefinch	LC	1A, 1B, 1C
187.	-	*Carpodacus sipahi* (Hodgson, 1836)	Scarlet Finch	LC	1C
188.	-	*Carpodacus subhimachalus* (Hodgson, 1836)	Crimson browed Finch	LC	1C
189.	-	*Carpodacus thura* Bonaparte and Schlegel, 1850	Himalayan White browed Rosefinch	LC	1A, 1C
190.	-	*Fringilla coelebs* Linnaeus, 1758	Common Chaffinch	LC	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
191.	-	*Leucosticte brandti* Bonaparte, 1850	Black headed Mountain Finch	LC	1A, 1B
192.	-	*Leucosticte nemoricola* (Hodgson, 1836)	Plain Mountain Finch	LC	1A, 1B, 1C
193.	-	*Leucosticte sillemi* Roselaar, 1992	Sillem's Mountain Finch	DD	1B
194.	-	*Linaria cannabina* (Linnaeus, 1758)	Common Linnet	LC	1A, 1B
195.	-	*Linaria flavirostris* (Linnaeus, 1758)	Twite	LC	1A, 1B
196.	-	*Loxia curvirostra* Linnaeus, 1758	Common Crossbill	LC	1C
197.	-	*Mycerobas affinis* (Blyth, 1855)	Collared Grosbeak	LC	1C
198.	-	*Mycerobas carnipes* (Hodgson, 1836)	White-winged Grosbeak	LC	1A, 1B, 1C
199.	-	*Mycerobas icterioides* (Vigors, 1830)	Black and yellow Grosbeak	LC	1A
200.	-	*Mycerobas melanozanthos* (Hodgson, 1836)	Spot winged Grosbeak	LC	1C
201.	-	*Procarduelis nipalensis* (Hodgson, 1836)	Dark breasted Rosefinch	LC	1C
202.	-	*Pyrrhula erythrocephala* Vigors, 1832	Red headed Bullfinch	LC	1C
203.	-	*Serinus pusillus* (Pallas, 1811)	Fire fronted Serin	LC	1A, 1B
204.	Hirundinidae Rafinesque, 1815 (Swallows)	*Cecropis daurica* (Laxmann, 1769)	Red rumped Swallow	LC	1A, 1B, 1C
205.	-	*Delichon dasypus* (Bonaparte, 1850)	Asian house Martin	LC	1A
206.	-	*Delichon urbicum* (Linnaeus, 1758)	Northern House Martin	LC	1A, 1B
207.	-	*Hirundo rustica* Linnaeus, 1758	Barn Swallow	LC	1A, 1B
208.	-	*Ptyonoprogne rupestris* (Scopoli, 1769)	Eurasian Crag Martin	LC	1A, 1B, 1C
209.	-	*Riparia diluta* (Sharpe and Wyatt, 1893)	Pale Sand Martin	LC	1B
210.	-	*Riparia paludicola* (Vieillot, 1817)	African pale Martin	LC	1B
211.	Laniidae Rafinesque, 1815 (Shrikes)	*Lanius cristatus* Linnaeus, 1758	Brown Shrike	LC	1B
212.	-	*Lanius excubitor* Linnaeus, 1758	Great Gey Shrike	LC	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
213.	-	*Lanius isabellinus* Hemprich and Ehrenberg, 1833	Isabelline Shrike	LC	1A, 1B
214.	-	*Lanius schach* Linnaeus, 1758	Long-tailed Shrike	LC	1A, 1B
215.	-	*Lanius tephronotus* (Vigors, 1831)	Grey backed Shrike	LC	1A, 1B, 1C
216.	LEIOTHRICHIDAE (Babblers, Laughingthrushes and allies)	*Chrysominla strigula* (Hodgson, 1837)	Bar-throated Minla	LC	1C
217.	-	*Cutia nipalensis* Hodgson, 1837	Himalayan Cutia	LC	1C
218.	-	*Siva cyanouroptera* Hodgson, 1837	Blue-winged Minla	LC	1C
219.	-	*Trochalopteron affine* (Blyth, 1843)	Black faced laughing thrush	LC	1C
220.	-	*Trochalopteron lineatum* (Vigors, 1831)	Streaked laughing thrush	LC	1A
221.	-	*Trochalopteron variegatum* (Vigors, 1831)	Variegated Laughing thrush	LC	1A
222.	Locustellidae Bonaparte, 1854 (Bush warblers)	*Locustella major* (Brooks, 1871)	Long billed Grasshopper Warbler	NT	1A
223.	-	*Locustella naevia* (Boddaert, 1783)	Common Grasshopper Warbler	LC	1A, 1C
224.	Monarchidae Bonaparte, 1853 (Monarch, Paradise-flycatchers)	*Terpsiphone paradisi* (Linnaeus, 1758)	Indian paradise flycatcher	LC	1A
225.	Motacillidae Horsfield, 1821 (Wagtails, Pipits)	*Anthus campestris* (Linnaeus, 1758)	Tawny Pipit	LC	1A
226.	-	*Anthus cervinus* (Pallas, 1811)	Red throated Pipit	LC	1A, 1B
227.	-	*Anthus godlewskii* (Taczanowski, 1876)	Blyth's pipit	LC	1C
228.	-	*Anthus hodgsoni* Richmond, 1907	Olive backer Pipit	LC	1C
229.	-	*Anthus roseatus* Blyth, 1847	Rosy Pipit	LC	1A, 1B, 1C
230.	-	*Anthus spinoletta* (Linnaeus, 1758)	Rock or Water Pipit	LC	1A, 1B
231.	-	*Anthus trivialis* (Linnaeus, 1758)	Tree Pipit	LC	1A, 1B
232.	-	*Dendronanthus indicus* (Gmelin, 1789)	Forest Wagtail	LC	1A, 1B
233.	-	*Motacilla alba* Linnaeus, 1758	White Wagtail	LC	1A, 1B, 1C

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
234.	-	*Motacilla cinerea* Tunstall, 1771	Grey Wagtail	LC	1A, 1B, 1C
235.	-	*Motacilla citreola* Pallas, 1776	Citrine Wagtail	LC	1A, 1B, 1C
236.	-	*Motacilla flava* Linnaeus, 1758	Western Yellow Wagtail	LC	1A, 1B
237.	Muscicapidae Sundevall, 1836 (Chats, Flycatchers)	*Calliope calliope* (Pallas, 1776)	Siberian Rubythroat	LC	1B, 1C
238.	-	*Calliope pectoralis* (Gould, 1837)	Himalayan Rubythroat	LC	1A, 1B, 1C
239.	-	*Enicurus maculatus* Vigors, 1831	Spotted Forktail	LC	1A
240.	-	*Enicurus scouleri* Vigors, 1832	Little Forktail	LC	1A, 1B, 1C
241.	-	*Ficedula erithacus* (Jer-n and Blyth, 1861)	Slaty backed flycatcher	LC	1C
242.	-	*Ficedula hodgsoni* (Moore, 1854)	Pygmy Blue flycatcher	LC	1C
243.	-	*Ficedula hyperythra* (Blyth, 1843)	Snowy browed Flycatcher	LC	1C
244.	-	*Ficedula strophiata* (Hodgson, 1837)	Rufous gorgeted Flycatcher	LC	1C
245.	-	*Ficedula superciliaris* (Jer-n, 1840)	Ultramarine Flycatcher	LC	1A, 1C
246.	-	*Ficedula tricolor* (Hodgson, 1845)	Slaty blue Flycatcher	LC	1A, 1C
247.	-	*Ficedula westermanni* (Sharpe, 1888)	Little Pied Flycatcher	LC	1C
248.	-	*Hodgsonius phaenicuroides* (Gray, 1846)	White bellied Redstart	LC	1A
249.	-	*Larvivora brunnea* Hodgson, 1837	Indian Blue Robin	LC	1A, 1C
250.	-	*Luscinia svecica* (Linnaeus, 1758)	Blue throat	LC	1A, 1B
251.	-	*Monticola cinclorhyncha* (Vigors, 1832)	Blue capped Rock thrush	LC	1A
252.	-	*Monticola saxatilis* (Linnaeus, 1766)	European Rock Thrush	LC	1A
253.	-	*Monticola solitarius* (Linnaeus, 1758)	Blue Rock Thrush	LC	1A, 1B, 1C
254.	-	*Muscicapa ruficauda* Swainson, 1838	Rusty tailed Flycatcher	LC	1A, 1B
255.	-	*Muscicapa sibirica* Gmelin, 1789	Dark-sided Flycatcher	LC	1A, 1B, 1C
256.	-	*Muscicapa striata* (Pallas, 1764)	Spotted Flycatcher	LC	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
257.	-	*Myiomela leucura* (Hodgson, 1845)	White tailed Blue Robin	LC	1C
258.	-	*Myophonus caeruleus* (Scopoli, 1786)	Blue Whistling Thrush	LC	1A, 1C
259.	-	*Niltava sundara* Hodgson, 1837	Rufous bellied Niltava	LC	1A, 1C
260.	-	*Oenanthe deserti* (Temminck, 1825)	Desert Wheatear	LC	1A, 1B
261.	-	*Oenanthe oenanthe* (Linnaeus, 1758)	Northern Wheatear	LC	1A
262.	-	*Oenanthe picata* (Blyth, 1847)	Eastern pied Wheatear	LC	1A, 1B
263.	-	*Oenanthe pleschanka* (Lepechin, 1770)	Pied Wheatear	LC	1A
264.	-	*Phoenicurus erythrogastrus* (Guldenstadt, 1775)	White-winged Redstart	LC	1A
265.	-	*Phoenicurus frontalis* Vigors, 1832	Blue fronted Redstart	LC	1A, 1C
266.	-	*Phoenicurus fuliginosa* (Vigors, 1831)	Plumbeous Water Redstart	LC	1A, 1B, 1C
267.	-	*Phoenicurus hodgsoni* (Moore, 1854)	Hodgson's Redstart	LC	1C
268.	-	*Phoenicurus leucocephalus* (Vigors, 1831)	White capped Redstart	LC	1A, 1C
269.	-	*Phoenicurus ochruros* (Gmelin, 1774)	Black Redstart	LC	1A, 1B, 1C
270.	-	*Phoenicurus schisticeps* (Gray, 1846)	White throated Redstart	LC	1C
271.	-	*Saxicola caprata* (Linnaeus, 1766)	Pied Bushchat	LC	1A
272.	-	*Saxicola ferreus* Gray and G. R. Gray, 1847	Grey Bushchat	LC	1A, 1C
273.	-	*Tarsiger chrysaeus* Hodgson, 1845	Golden bush Robin	LC	1A, 1C
274.	-	*Tarsiger hyperythrus* (Blyth, 1847)	Rufous breasted bush Robin	LC	1C
275.	Nectariniidae Vigors, 1825 (Sunbirds)	*Aethopyga ignicauda* (Hodgson, 1836)	Fire tailed Sunbird	LC	1C
276.	-	*Aethopyga siparaja* (Raffles, 1822)	Crimson Sunbird	LC	1C
277.	Oriolidae Vigors, 1825 (Orioles, Figbirds and allies)	*Oriolus kuno* Sykes, 1832	Indian Golden Oriole	LC	1A, 1B
278.	Paridae Vigors, 1825 (Tits, Chickades)	*Cephalopyrus flammiceps* (Burton, 1836)	Fire capped Tit	LC	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
279.	-	*Cyanistes cyanus* (Pallas, 1770)	Azure Tit	LC	1A
280.	-	*Lophophanes dichrous* (Blyth, 1845)	Grey crested Tit	LC	1C
281.	-	*Parus major* Linnaeus, 1758	Great Tit	LC	1A, 1B
282.	-	*Periparus ater* (Linnaeus, 1758)	Coal Tit	LC	1A, 1C
283.	-	*Periparus rubidiventris* (Blyth, 1847)	Rufous vented Tit	LC	1C
284.	-	*Periparus rufonuchalis* (Blyth, 1849)	Rufous naped Tit	LC	1A
285.	-	*Pseudopodoces humilis* (Hume, 1871)	Ground tit	LC	1B, 1C
286.	-	*Sylviparus modestus* Burton, 1836	Yellow browed tit	LC	1C
287.	Passeridae Rafinesque, 1815 (Sparrows, Snowfinches and allies)	*Montifringilla adamsi* Adams, 1859	Black-winged Snowfinch	LC	1A, 1B
288.	-	*Onychostruthus Taczanowskii* (Prjevalsky, 1876)	White rumped Snowfinch	LC	1B
289.	-	*Passer mesticus* (Linnaeus, 1758)	House Sparrow	LC	1A, 1B
290.	-	*Passer hispaniolensis* (Temminck, 1820)	Spanish Sparrow	LC	1A, 1B
291.	-	*Petronia petronia* (Linnaeus, 1766)	Rock Sparrow	LC	1A
292.	-	*Pyrgilauda blanfordi* (Hume, 1876)	Plain backed Snowfinch	LC	1B, 1C
293.	-	*Pyrgilauda ruficollis* (Blanford, 1871)	Rufous necked snowfinch	LC	1A
294.	Family Phylloscopidae Alstrom *et al.*, 2006 (Old World Leaf Wrablers)	*Phylloscopus affinis* (Tickell, 1833)	Tickell's leaf warbler	LC	1A, 1B, 1C
295.	-	*Phylloscopus cantator* (Tickell, 1833)	Yellow ventened warbler	LC	1C
296.	-	*Phylloscopus chloronotus* (Gray and G. R. Gray, 1847)	Lemon rumped leaf Warbler	LC	1A, 1C
297.	-	*Phylloscopus collybita* (Vieillot, 1817)	Common Chiffchaff	LC	1A
298.	-	*Phylloscopus fuligiventer* (Hodgson, 1845)	Smoky Warbler	LC	1C
299.	-	*Phylloscopus griseolus* Blyth, 1847	Sulphur bellied Warbler	LC	1A, 1B

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
300.	-	*Phylloscopus humei* (Brooks, 1878)	Hume's leaf warbler	LC	1A, 1B
301.	-	*Phylloscopus maculipennis* (Blyth, 1867)	Ashy throated warbler	LC	1C
302.	-	*Phylloscopus occipitalis* (Blyth, 1845)	Western Crowned leaf warbler	LC	1A, 1B
303.	-	*Phylloscopus pulcher* Blyth, 1845	Buff barred Warbler	LC	1C
304.	-	*Phylloscopus sindianus* Brooks, 1880	Mountain Chiffchaff	LC	1A, 1B
305.	-	*Phylloscopus subviridis* (Brooks, 1872)	Brook's leaf warbler	LC	1A
306.	-	*Phylloscopus trochiloides* (Sundevall, 1837)	Greenish Warbler	LC	1A, 1B, 1C
307.	-	*Phylloscopus tytleri* Brooks, 1871	Tytler's leaf Warbler	NT	1A
308.	-	*Seicercus castaniceps* (Hodgson, 1845)	Chestnut crowned Warbler	LC	1C
309.	Prunellidae Richmond, 1908 (Accentors)	*Prunella atrogularis* (Brandt, 1843)	Black throated Accentor	LC	1A, 1B
310.	-	*Prunella collaris* (Scopoli, 1769)	Alpine Accentor	LC	1A, 1B, 1C
311.	-	*Prunella fulvescens* (Severtsov, 1873)	Brown Accentor	LC	1A, 1B
312.	-	*Prunella himalayana* (Blyth, 1842)	Altai Accentor	LC	1A, 1C
313.	-	*Prunella immaculata* (Hodgson, 1845)	Maroon backed Accentor	LC	1C
314.	-	*Prunella rubeculoides* (Moore, 1854)	Robin Accentor	LC	1A, 1B, 1C
315.	-	*Prunella strophiata* (Blyth, 1843)	Rufous breasted Accentor	LC	1A, 1C
316.	Pycnonotidae Gray, 1840 (Bulbuls)	*Hypsipetes leucocephalus* (Gmelin, 1789)	Blacl bulbul	LC	1C
317.	Regulidae Vigors, 1825 (Crests or kinglets)	*Regulus regulus* (Linnaeus, 1758)	Goldcrest	LC	1A
318.	Sittidae Lesson, 1828 (Nuthatches, Spotted Creepers, Wallcreepers)	*Sitta cashmirensis* Brooks, 1871	Kashmir Nuthatch	LC	1A
319.	-	*Sitta leucopsis* Gould, 1850	White cheeked Nuthatch	LC	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
320.	Stenostiridae Beresford, Beresford *et al.*, 2005 (Fairy-flycatchers, Crested-flycatcghers)	*Chelidorhynx hypoxanthus* (Blyth, 1843)	Yellow bellied fairy fantail	LC	1A, 1C
321.	-	*Culicicapa ceylonensis* (Swainson, 1820)	Grey headed Canary flycatcher	LC	1A, 1C
322.	STURNIDAE Rafinesque, 1815 (Starlings)	*Acri-theres tristis* (Linnaeus, 1766)	Common Myna	LC	1A
323.	-	*Pastor roseus* (Linnaeus, 1758)	Rose coloured starling	LC	1A
324.	-	*Sturnus vulgaris* Linnaeus, 1758	Common Starling	LC	1A
325.	Family SYLVIIDAE Leach, 1820 (Sylvia warblers, Parrotbills and allies)	*Sylvia borin* (Boddaert, 1783)	Garden Warbler	LC	1A
326.		*Sylvia communis* Latham, 1787	Common Whitethroat	LC	1A, 1B
327.	TICHODROMIDAE Swainson, 1827	*Tichodroma muraria* (Linnaeus, 1766)	Wallcreeper	LC	1A, 1B, 1C
328.	TIMALIIDAE Vigors and Horsfield, 1827 (Scimitar Babbler and allies)	*Cyanoderma ruficeps* (Blyth, 1847)	Rufous capped Babbler	LC	1C
329.	TROGLODYTIDAE Swainson, 1832 (Wrens)	*Troglodytes troglodytes* (Linnaeus, 1758)	Northern Wren	LC	1A, 1C
330.	TURDIDAE Rafinesque, 1815 (Thrushes)	*Cochoa purpurea* Hodgson, 1836	Purple Cochoa	LC	1C
331.	-	*Cochoa viridis* Hodgson, 1836	GREEN Cochoa	LC	1C
332.	-	*Grandala coelicolor* Hodgson, 1843	Grandala	LC	1A, 1C
333.	-	*Turdus albocinctus* Royle, 1840	White collared black bird	LC	1C
334.	-	*Turdus atrogularis* Jarocki, 1819	Black throated trush	LC	1A, 1B, 1C
335.	-	*Turdus eunomus* Temminck, 1831	Dusky Thrush	LC	1A, 1B
336.	-	*Turdus maximus* (Seebohm, 1881)	Tibetan blackbird	LC	1A, 1B, 1C
337.	-	*Turdus pilaris* Linnaeus, 1758	Fieldfare	LC	1A
338.	-	*Turdus rubrocanus* Gray and G. R. Gray, 1847	Chestnut Thrush	LC	1C
339.	-	*Turdus ruficollis* Pallas, 1776	Red throated Thrush	LC	1C
340.	-	*Turdus unicolor* Tickell, 1833	Tickell's Thrush	LC	1A, 1B
341.	-	*Turdus viscivorus* Linnaeus, 1758	Mistle Thrush	LC	1A

Table 1 contd.

Sl. No.	Family	Genus/species	Common name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
342.	-	*Zoothera dauma* (Latham, 1790)	Eurasian Scaly Thrush	LC	1C
343.	-	*Zoothera dixoni* (Seebohm, 1881)	Long tailed Thrush	LC	1C
344.	-	*Zoothera mollissima* (Blyth, 1842)	Alpine Thrush	LC	1C
345.	-	*Zoothera monticola* Vigors, 1832	Long billed Thrush	LC	1C
346.	Zosteropidae Bonaparte, 1853 (White eye)	*Yuhina flavicollis* Hodgson, 1836	Whiskered Yuhina	LC	1C
347.	-	*Yuhina gularis* Hodgson, 1836	Stripe throated Yuhina	LC	1C
348.	-	*Yuhina occipitalis* Hodgson, 1836	Rufous vented Yuhina	LC	1C
349.	-	*Zosterops palpebrosus* (Temminck, 1824)	Oriental White Eye	LC	1A

Pyrrhocorax graculus (Linnaeus, 1766)

Anser indicus (Latham, 1790)

Pica pica (Linnaeus, 1758)

Grus nigricollis Prjevalsky, 1876

Ta-rna ferruginea (Pallas, 1764)

Upupa epops Linnaeus 1758

Motacilla citreola Pallas, 1776

Gyps himalayensis Hume, 1869

Columba rupestris Pallas, 1811

Tetraogallus himalayensis Gray, 1843

Passer domesticus (Linnaeus, 1758)

Fulica atra Linnaeus, 1758

Columba leuconota Vigors, 1831

Anser indicus (Latham, 1790)

Larus ridibundus Linnaeus, 1766

Alectoris chukar (Gray, 1830)

Pyrrhocorax pyrrhocorax (Linnaeus, 1758)

Carpodacus erythrinus (Pallas, 1770)

Corvus corax Linnaeus, 1758

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Chapter 19

MAMMALS

INDU SHARMA*, AVTAR KAUR SIDHU, B.S. RANA**
and KAMAL SAINI

100 species referable to 56 genera, 18 families and 07 orders of mammals have been documented from the Trans-Himalayan ecosystem during the present studies. Total 33 species comprising of 20 species, 11 genera, 06 families, 05 orders of wild herbivores and 13 species, 09 genera, 04 families, 01 order of wild carnivores have been recorded in Ladakh. The elusive Snow Leopard, one of the most beautiful feline of the world, is widely distributed in the Trans Himalaya. *Equus kiang* (Kiang) known as wild horse is found exclusively in the Ladakh. Large mammals of the area are under threat and come under Schedule 1 of Indian Wildlife (Protection) Act 1972. Developmental activities, Habitat destruction, tourism, poaching, natural resource dependence, climate change etc. are some of the main threat to wild prestigious mammalian diversity of fragile Himalayan Ecosystem.

Keywords: Exclusively, destruction, dependence, prestigious.

INTRODUCTION

The Trans-Himalaya is amongst the least productive of graminoid dominated ecosystems on earth in terms of above ground graminoid biomass (Mishra, 2001). Yet, the Trans-Himalayan range harbours a surprisingly rich diversity of wild (mountain ungulate and carnivore species) mammalian fauna (Mishra *et al.,* 2010). The wild animals inhabiting in such harsh environment with its difficult terrain show various morphological, behavioural and physiological adaptations. The animals undergo several adjustments from their counterpart mammals that occur in the lower altitudes. The mountain sheep and goats of the Trans-Himalaya are larger in size than that of the lower altitudes. In Pallas's cat (*Octocolobus manul*), the fur of throat, chest, belly and thighs is consistently longer than flanks and with such peculiar adaptation the cat sleeps in the snow covered ground. The head is depressed and ears are short and erect in the cat and are helpful for predatory operation at high altitudes. These animals have less number of sweat glands and thus can conserve more water in dry air. The large number, size of red blood cells provide more surface area for oxygen in the higher elevations. The insulation of the Chiru (*Panthlops hodgsonii*) has the finest under-wool to withstand in the severe winter. Yaks, sheep and goats excrete scanty quantity of urine. This is one of the unique physiological adaptations. *Yak* have long, soft hairs of their fur and such hair coat retain body heat and provide heat throughout the rigorous winter. It has long, thick, coarse hair and loose wool is notable adaptation of the animals residing in world's highest altitude. The sense of smell is more in Yaks, which live in the desolate highest mountains. This is the largest wild animal of the region. They do not come down below 4000m altitude even during the harsh climate of the snow bound areas. It is exploited for hairs, horns, hooves and flesh. The skin and hairs are utilized for tents (Sharma, 1999).

Ungulates constitute the significant component of the mammalian fauna in the region. These mountain ungulates are thought to have evolved in sympatry and diverged in their morphology and resource use patterns (Schaller, 1977). The Blue sheep (*Pseudois nayaur*) has an intermediate place between sheep and goat. It inhabits in the climbing difficult cliffs and is found in herds of 40 to 50 and even as many as 200. For escaping from predators, Asiatic ibex (*Capra ibex*) have muscular legs and stocky bodies that help them negotiate steep cliffs. They do not come down in lower valley during the winter, because their dense under wool provide them warmth. Mountains ungulates differ in the use of the terrain *i.e.* Asiatic ibex

*Desert Regional Centre, Zoological Survey of India, Jodhpur-342005 (Rajasthan)
High Altitude Regional Centre, Zoological Survey of India, Solan- 173 211 (HP)
**Forest Training Institute, Chail- 173 217 (HP)
Email: induzsi@gmail.com

Citation
Sharma, I., Sidhu, A.K., Rana, B.S. and Saini, K. 2019. Mammals. In: *Faunal Diversity of Biogeographic Zones*: *Indian Trans-Himalaya*: 159-172. (Published by the Director, Zool. Surv. India, Kolkata)

(*Capra ibex*) occupy very steep and rugged areas; Blue sheep (*Pseudois nayaur*) prefer rolling areas in the vicinity of cliffs. The Tibetan argali (*Ovis ammon*) have longer legs that enable them to escape from the predators (Bhatnagar 1997, Namgail *et al.,* 2004).

The Tibetan gazelle (*Procapra picticaudata*) and kiang (*Equus kiang*) occur on plateaus (Bhatnagar, 1997; Bagehi *et al*., 2004; Namgail *et al*., 2004). Tibetan Wild ass (Kiang) known as wild horse is found exclusively in the Ladakh. It is a graceful mammal of the high altitude of Ladakh. It inhabits high altitude between 3962 and 4860 m. They inhabit in the most difficult terrain of the high altitude. Male and females live in separate herds from 8 to 30. The herds go in snowy, dry, cold deserts in very high plateau region (Tikadhar, 1983). Smaller herbivores of several species of pikas (*Ochotona* spp.) and voles (*Alticola* spp.) also occur in these rangelands and seem to play a role in maintaining vegetation diversity at local scales through soil disturbance (Bagchi *et al*., 2006). The Pikas are the most attractive mammals of the region. They inhabit in the rocky grounds and hide themselves among the rocks and stones. In Ladakh, because of its long ears, they are called mountain donkey. Marmots live in colonies and dig deep burrows, 10 to 14 marmots may dwell in the same burrow.

The animals living above the snow line have lighter coloration of their fur and thus camouflage with the surrounding and helpful for defense of the animal. This makes them to absorb less heat. Further, the base of the hair of these light colored animals (Snow leopard) is dark and provides protection against the high ultra violet radiations at high altitudes. The tail of the snow leopard is long with bushy hair. The elusive Snow Leopard, one of the most beautiful feline of the world, is widely distributed in the Trans-Himalaya. It inhabits in the inaccessible and remote habitats above 3750 m altitude in hostile climate and is secretive and nocturnal in habits. It is solitary animal and travels mostly alone (Sharma, 1999). The Bharal (Blue sheep) is the preferable food of the cat. It has been reported that male ungulate is the desired prey and hunting is carried out in the early morning. It has been reported that during winter, the cat had kill dozens or more sheep in one night (Dang, 1967). It is one of the rare cats and known as 'grey ghost' in the region. The mammalian fauna in world is represented by 5416 species belonging to 154 families and 29 orders (Wilson and Reeder, 2005). Out of which about 427 (8%) species representing 13 orders and 48 families present in India. 280 species representing 36 families and 11 orders of mammals are reported to be present in Indian Himalaya. 72, 56 and 04 species of the mammals have been recorded in the Tibetan Plateau, Ladakh Area and Sikkim respectively as given in the list below (Kamalakannan *et al.,* 2018).

Herd of Sheep in Ladakh

HISTORICAL RESUME

The pertinent literature reveals that work on the various aspects on mammals from the Trans-Himalayan ecosystem has been undertaken by various workers and some recent contributions are of Sharma and Dutta 2016; Mishra *et al.* 2010; Sanyal and De 2009; Shawl *et al.* 2008; Sharma *et al.* 2008; Bhatanagar *et al.* 2006, 2007; Namgail *et al.* 2005; Pfister 2004; Jackson and Rinchen 2004; Mehta and Julka, 2001; Sharma 1999; Joseph *et al.*1991; Mallon 1991; Osborne *et al.* 1983 etc. There are 20 species (7 families) of wild herbivores, 13 species (4 families) of wild carnivores in the Trans-Himalayan ecosystem. They are mainly represented by Snow leopard (*Panthera uncial*), Tibetan Lynx (*Lynx lynx*), Pallas's Cat (*Octocolobus manul*), Tibetan Wolf (*Canis lupus*), Red Fox (*Vulpes vulpes*), Tibetan Sand Fox (*V. ferrilata*), Wild Dog (*Cuon alpines*), Himalayan Brown Bear (*Ursus arctos*), Himalayan Stoat (*Mustela ermine*), Mountain Weasel (*M. altaica*), Siberian Weasel (*M. sibirica*), Stone Marten (*Martes foina*), Eurasian otter (*Luttra lutra*), Kiang (*Equas kiang*), Chiru/ Tibetan Antelope (*Panthlops hodgsonii*), Tibetan Gazelle (*Procorpa picticaudata*), Yak (*Bos grunniens*), Himalayan Ibex (*Capra sibirica*), Blue sheep (*Pseudois nayaur*), Argali (*Ovis ammon*), Ladakh urial (*O. orientalis*), Long-Tailed Marmot (*Marmota caudate*), Himalayan marmot (*M. himalayana*), Mountain Vole (*Alticola roylei*), Silver Mountain Vole (*A. argentatus*), Stoliczka's Mountain Vole (*A. stoliczkanus*), Royle's Pika (*Ochotona roylei*), Ladakh Pika (*O. ladacensis*), Large-eared Pika (*O. macrotis*), Nubra Pika (*O. nubrica*), Plateau Pika (*O. curzoniae*), Cape Hare (*Lepus capensis*), Woolly Hare (*Lepus oiostolus*) (Pfister 2004; Misra *et al.* 2010). A double humps bacterian camels *Camelus bactrianus* (Bacterian Camels) are found in sand dunes of Nubra valley (Ladakh). However, most of these are domesticated animals and used for tourism in Ladakh. Mostly, all large mammals are listed under 'Schedule 1' of Indian Wildlife (Protection) Act 1972. As per IUCN Red List, 2017 most of them are under threat. Among which Wild Dog (*Cuon alpines*) is categorized as Endangered; Pallas's Cat (*Octocolobus manul*), Mountain Weasel (*Mustela altaica*), Argali (*Ovis ammon*), Chiru (*Panthlops hodgsonii*) as Near Threatened; Snow leopard (*Panthera uncial*), Yak (*Bos grunniens*), Ladakh urial (*Ovis orientalis*) as Vulnerable mammals.

THREATS AND CONSERVATION

- Habitat degradation, tourism, development activities, climate change, poaching, human conflicts, natural resource dependence etc. are various threats to the mammalian fauna in this fragile Himalayan ecosystem. The habitat degradation/ loss are due to extraction of medicinal plants, grazing by the domestic cattle, construction of roads in the far flung areas of the cold deserts and influx of tourism in the alpine pastures. In the Trans-Himalaya, the treeless mountain environment with rolling mountains, sandy plains and a few lake basins form one of the largest extents of alpine regions in India and bulk of which are used for livestock grazing by resident and migratory nomadic herders (Rawat *et al.,* 2006). It has been predicted that the climate change would increase this ecosystem's primary production, but the span of shrub-steppe biome will decline (Ni, 2000).
- As in the Trans-Himalayan region most of the wildlife is out of the protective areas, thus there is need to develop the landscape level management with the involvement of local people. This is particularly important in the Trans-Himalayan landscape, where conventional large protected areas are difficult to establish and to manage effectively. Active participation of local communities is inherent to the framework for the management of Trans-Himalayan rangelands, which is essentially a combination of protectionist and sustainable use conservation paradigms (Mishra *et al.,* 2003). Poaching and illegal trade in wildlife parts and products, competitive exclusion by the domestic livestock, faulty land use practices, increased resource dependency and developmental venture are the factors that affect wildlife and their habitats (Gaston *et al.,* 1983; Sathyakumar, 1994; Rawat and Sathyakumar, 2002; Charoo *et al.,* 2009). There are instances of wildlife meat served in local restaurants in towns or villages adjoining wilderness areas (Rawat and Sathyakumar, 2002). Poaching of large carnivores such as the snow leopard for skin and bones, Himalayan brown bear for bile (used in medicine) and Tibetan antelope or *Chiru* for shahtoosh are explioted (Sathyakumar and Bashir, 2010). The range of the Tibetan gazelle in the Ladakh region, over the last 100 years, has diminished from approximately 20,000 km^2 to less than 100 km^2 today (Bhatnagar *et al.,* 2006a).
- The status of snow leopard has been revised from 'Endangered' to 'Vulnerable' category after three year assessment process. As the global population is estimated to number more than 2,500 and fewer than 10,000 mature individuals; there is an estimated and

Pseudois nayaur (Hodgson, 1833)

projected decline of at least 10% over 22.62 years (3 generations) (IUCN Red list, 2017). The animal has been reclassified for the first time in 45 years. Snow leopard qualifies both as a flagship and an umbrella species representing the ecosystem and that its conservation would mean the conservation of the Trans-Himalayan region as a whole (Bhatnagar *et al.*, 2001).

Table 1 : Diversity of Mammals from Indian Trans-Himalaya

Sl. No.	Genus/Species	Common Name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Order PRIMATES Linnaeus, 1758 Family CERCOPITHECIDAE Gray, 1821			
1	*Macaca assamensis* (Mc Clelland, 1840)*	Assam Macaque	NT	1B
2	*Macaca mulatta* (Zimmermann, 1780)*	Rhesus Macaque	LC	1B
3	*Semnopithecus schistaceus* Hodgson, 1840*	Nepal Gray Langur	LC	1B
	Order RODENTIA Bowdich, 1821 Family SCIURIDAE Fischer de Waldheim, 1817			
4	*Eoglaucomys fimbriatus* (Gray, 1837)*	Kashmir Flying Squirrel	LC	1A
5	*Eupetaurus cinereus* Thomas, 1888*	Woolly Flying squirrel	EN	1A
6	*Petaurista elegans* (Muller, 1840)*	Spotted Giant Flying Squirrel	LC	1B
7	*Petaurista magnificus* (Hodgson, 1836)*	Hodgson's Giant flying Squirrel	LC	1B
8	*Tamiop smacclellandii* (Horsfield, 1840)*	Himalayan Striped Squirrel	LC	1B
9	*Marmota caudata* (Geoffroy, 1844)	Long-tailed Marmot	LC	1A, 1B, 1C
10	*Marmota himalayana* (Hodgson, 1841)	Himalayan Marmot	LC	1A, 1B, 1C
	Family CRICETIDAE Fischer, 1817			
11	*Alticola albicaudus* (True, 1894)*	White-tailed Mountain Vole	-	1A, 1B
12	*Alticola argentatus* (Severtzov, 1879)	Silver Mountain Vole	LC	1A
13	*Alticola roylei* Gray, 1842	Mountain Vole	NT	1A, 1B
14	*Alticola montosa* (True, 1894)*	Kashmir Mountain Vole	-	1A
15	*Alticola stoliczkanus* (Blanford, 1875)	Stoliczka's Mountain Vole	LC	1B, 1C
16	*Hyperacrius fertilis* (True, 1894) *	Subalpine Kashmir Vole	NT	1A
17	*Neodon sikimensis* Horsfield, 1841*	Sikkim Mountain Vole	LC	1B
18	*Phaiomys leucurus* Blyth, 1863*	Blyth's Mountain Vole	LC	1A, 1B
19	*Cricetulus alticola* Thomas, 1917*	Ladakh Dwarf Hamster	LC	1B
20	*Cricetulus migratorius* (Pallas, 1773)*	Gray Dwarf Hamster	LC	1A
	Family MURIDAE Illiger, 1811			
21	*Apodemus pallipes* (Barrett-Hamilton, 1900)*	Himalayan Field Mouse	LC	1A
22	*Apodemus rusiges* Miller, 1913*	Kashmir Field Mouse	LC	1A
23	*Apodemus uralensis* (Pallas, 1811)*	Herb Field Mouse	LC	1A
24	*Mus cookie* Ryley, 1914*	Cook's Mouse	LC	1B
25	*Mus musculus* Linnaeus, 1758*	House Mouse	LC	1A, 1B
26	*Mus pahari* Thomas, 1916*	Sikkim Mouse	LC	1B
27	*Niviventer eha* (Wroughton, 1916) *	Smoke-bellied Niviventer	LC	1B
28	*Niviventer fulvescens* (Gray, 1847)*	Chestnut Rat	LC	1B
29	*Rattus andamanensis* (Blyth, 1860)*	Indochinese Forest Rat	LC	1B
30	*Rattus pyctoris* (Hodgson, 1845)*	Himalayan Rat	LC	1A, 1B
31	*Rattus rattus* (Linnaeus, 1758)*	Common House Rat	LC	1B
	Family HYSTRICIDAE Fischer de Waldheim, 1817			
32	*Hystrix indica* Kerr, 1792*	Indian Crested Porcupine	LC	1A

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
	Order LAGOMORPHA Brandt, 1855 Family OCHOTONIDAE Thomas, 1897			
33	*Ochotona curzoniae* (Hodgson, 1858)	Pleteau Pika	LC	1A, 1B
34	*Ochotona ladacensis* (Günther, 1875)	Ladakh Pika	LC	1B
35	*Ochotona macrotis* (Günther, 1875)	Large-eared Pika	LC	1A, 1B
36	*Ochotona nubrica* Thomas, 1922	Nubra Pika	LC	1B
37	*Ochotona roylei* (Ogilby, 1839)	Royle's Pika	LC	1A, 1B
38	*Ochotona thibetana* (Milne-Edwards, 1871)*	Moupin Pika	LC	1B
	Family LEPORIDAE Fischer de Waldheim, 1817			
39	*Lepus capensis* Linnaeus, 1758	Cape Hare	LC	1A
40	*Lepus oiostolus* Hodgson, 1840	Woolly Hare	LC	1B
	Order EULIPOTYPHLA Family SORICIDAE Fischer, 1814			
41	*Crocidura horsfieldii* (Tomes, 1856)*	Horsfield's Shrew	DD	1B
42	*Crocidura pergrisea* Miller, 1913*	Pale Grey Shrew	DD	1A
43	*Crocidura pullata* Miller, 1911*	Kashmir White-toothed Shrew	LC	1A, 1B
44	*Episoriculus caudatus* (Horsefield, 1851)*	Hodgson's Brown-toothed Shrew	LC	1B
45	*Episoriculus leucops* (Horsefield, 1855)*	Long-tailed Brown-toothed Shrew	LC	1B, 1C
46	*Soriculus nigrescens* (Gray, 1842) *	Himalayan Shrew	LC	1B
47	*Sorex minutus* Linnaeus, 1766*	Eurasian Pygmy Shrew	LC	1A, 1B
48	*Sorex planiceps* Miller, 1911*	Kashmir Pygmy Shrew	LC	1A
	Order CHIROPTERA Blumenbach, 1779 Family PTEROPODIDAE Gray, 1821			
49	*Cynopterus sphinx* (Vahl, 1797) *	Greater Short nosed Fruit Bat	LC	1B
50	*Macroglossus sobrinus* Andersen, 1911*	Greater Long nosed Fruit Bat	LC	1B
51	*Sphaerias blanfordi* (Thomas, 1891)*	Blanford's Fruit Bat	LC	1B
	Family RHINOLOPHIDAE Lacépède, 1799			
52	*Rhinolophus ferrumequinum* (Schreber, 1774) *	Greater Horseshoe Bat	LC	1B
53	*Rhinolophu shipposideros* (Bechstein, 1800) *	Lesser Horseshoe Bat	-	1A, 1B
54	*Rhinolophus pearsonii* Horsfield, 1851*	Pearson's Horseshoe Bat	LC	1B
55	*Rhinolophus rouxii* Temminck, 1835*	Rufous Horseshoe Bat	LC	1B
	Family VESPERTILIONIDAE Gray, 1821			
56	*Eptesicus bottae* (Peters, 1869)*	Botta's Serotine	LC	1A
57	*Eptesicus gobiensis* Bobrinskii, 1926*	Gobi Big Brown Bat	LC	1A
58	*Eptesicus serotinus* (Schreber, 1774)*	Common Serotine	LC	1A
59	*Nyctalus noctula* (Schreber, 1774)*	Noctule	LC	1A
60	*Pipistrellus coromandra* (Gray, 1838) *	Indian Pipistrelle	LC	1A
61	*Pipistrellus javanicus* (Gray, 1838) *	Javan Pipistrelle	LC	1B
62	*Pipistrellus pipistrellus* (Schreber, 1774)*	Common Pipistrelle	LC	1A
63	*Pipistrellus tenuis* (Temminck, 1840)*	Least Pipistrelle	LC	1A
64	*Barbastella leucomelas* (Cretzschmar, 1826)*	Eastern Barbastelle	LC	1A
65	*Otonycteris hemprichii* Peters, 1859*	Hemprich's Desert Bat	LC	1A
66	*Plecotus auritus* (Linnaeus, 1758)*	Brown Long eared Bat	LC	1A
67	*Myotis formosus* (Hodgson, 1835)*	Hodgson's Myotis	LC	1B

Table 1 contd.

Sl. No.	Genus/Species	Common Name	Conservation Status (IUCN Red List)	Distribution in Biogeographical region 1 of India
68	*Myotis nipalensis* (Dobson, 1871)*	Nepal Myotis	LC	1A, 1B
69	*Murina cyclotis* Dobson, 1872*	Round eared Tube nosed Bat	LC	1B
70	*Murina huttoni* (Peters, 1872)*	Hutton's Tube nosed Bat	LC	1A
71	Murina tubinaris (Scully, 1881)*	Scully›s Tube nosed Bat	LC	1A, 1B
	Order PHOLIDOTA Weber, 1904 Family MANIDAE Gray, 1821			
72	*Otocolobus manul* Pallas, 1776	Pallas's Cat	NT	1B
73	*Lynx lynx* (Linnaeus, 1758)	Tibetan/Eurasian Lynx	LC	1A, 1B
74	*Prionailurus bengalensis* (Kerr, 1792)*	Leopard Cat	LC	1A, 1B
75	*Panthera pardus* (Linnaeus, 1758) *	Leopard	VU	1B
76	*Panthera uncia* (Schreber, 1775)	Snow Leopard	VU	1A, 1B
	Family VIVERRIDAE Gray, 1821			
77	*Arctictis binturong* (Raffles, 1821)*	Binturong	VU	1B
78	*Paguma larvata* (Smith, 1827)*	Masked Palm Civet	LC	1A, 1B
79	*Paradoxurus hermaphrodites* (Pallas, 1777)*	Asian Palm Civet	LC	1A, 1B
80	*Prionodon pardicolor* Hodgson, 1842*	Spotted Linsang	LC	1B
	Family CANIDAE Fischer de Waldheim, 1817			
81	*Cuon alpinus* (Pallas, 1811)	Wild Dog/Dhole	EN	1B
82	*Vulpes ferrilata* Hodgson, 1842	Tibetan Sand Fox	LC	1B
83	*Vulpes vulpes* (Linnaeus, 1758)	Red Fox	LC	1A, 1B
84	*Canis lupus* Linnaeus, 1758	Tibetan Wolf	LC	1A
	Family URSIDAE Fischer de Waldheim, 1817			
85	*Ursus arctos* Linnaeus, 1758	Himalayan Brown Bear	LC	1A
	Family MUSTELIDAE Fischer de Waldheim, 1817			
86	*Lutra lutra* (Linnaeus, 1758)	Eurasian Otter	LC	1A, 1B
87	*Martes foina* (Erxleben, 1777)	Stone/Beech Marten	LC	1A, 1B
88	*Mustela altaica* Pallas, 1811	Mountain Weasel	NT	1A, 1B
89	*Mustela erminea* Linnaeus, 1758	Himalayan stoat/Ermine	LC	1A, 1B
90	*Mustela sibirica* Pallas, 1773	Siberian Weasel	LC	1A
	Order PERISSODACTYLA Owen, 1848 Family EQUIDAE Gray, 1821			
91	*Equus kiang* Moorcroft, 1841	Kiang	LC	1A, 1B
	Order ARTIODACTYLA Owen, 1848 Family MOSCHIDAE Gray, 1821			
92	*Moschus cupreus* Grubb, 1982*	Kashmir Musk Deer	EN	1A
	Family BOVIDAE Gray, 1821			
93	*Procapra picticaudata* Hodgson, 1846	Tibetan Gazelle	NT	1B
94	*Bos grunniens* Linnaeus,1766	Yak	VU	1B
95	*Capra falconeri* (Wagner, 1839)*	Markhor	NT	1A
96	*Capra sibirica* (Pallas, 1776)	Himalayan/Asiatic/ Siberian Ibex	LC	1B
97	*Ovis ammon* (Linnaeus, 1758)	Argali	NT	1B
98	*Ovis orientalis* Gmelin, 1774	Ladakh Urial	VU	1A, 1B
99	*Pantholops hodgsonii* (Abel, 1826)	Chiru/ Tibetan Antelope	NT	1B
100	*Pseudois nayaur* (Hodgson, 1833)	Blue sheep/ Bharal	LC	1A, 1B

(Species marked with asterisks (*) are as per given by Kamalakannan *et al.* 2018)

Marmota himalayana (Hodgson, 1841)

Equus kiang Moorcroft, 1841

Ovis orientalis Gmelin, 1774

Vulpes vulpes (Linnaeus, 1758)

Panthera uncia (Schreber, 1775) by Devinder Chauhan

Ochotona roylei (Ogilby, 1839)

Mustela altaica Pallas, 1811

Bos grunniens Linnaeus, 1766

Pseudois nayaur (Hodgson, 1833)

Camelus bactrianus Linnaeus, 1758

Lepus oiostolus Hodgson, 1840

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Annexure

Indian Trans-Himalaya includes 1A-Ladakh Mountains; 1B-Tibetan Plateau; 1C-Sikkim. In the cold desert no attempt has been made to checklist the faunal diversity of the extant species reported so far. Therefore the relevant information about the diversity of all available faunal groups that are reportedly occurring in Trans-Himalaya has been collected from the scientific literature as well as from the exploration cum faunal-study data available with the High Altitude Regional Centre, Zoological Survey of India from Trans-Himalaya (Cold Desert). The groups/species which are not represented in the chapters inside are listed below.

Table 1 : Checklist of Himalayan fauna from Biogeographical Region 1 (1A, 1B and 1C) of India

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
	Kingdom PROTOZOA			
1.	Eimeriidae		*Eimeria brasiliensis* Torres and Ramos	1A
	Kingdom ANIMALIA			
	Phylum PLATYHELMINTHES			
1.	Trichurinae		*Moniezia* sp.	1B
2.	Taeniidae		*Echinococcus* sp.	1B
3.	Anoplocephalidae		*Moniezia* sp.	1B
4.	Fasciolidae		*Fasciolagigantica* Cobbold, 1855	1B
5.	Fasciolidae		*Fasciolahepatica* Linnaeus, 1758	1B
6.	Paramphistomidae		*Gastrothylaxcompressus* Brandes, 1883	1B
7.	Paramphistomidae		*Gastrothylaxcrumenifer* (Creplin, 1847)	1B
8.	Paramphistomidae		*Fischoederiuscobboldi* (Poirier, 1883)	1B
9.	Paramphistomidae		*Paramphistomumcervi* (Zeder, 1790)	1B
10.	Paramphistomidae		*Paramphistomumexplanatum* (Creplin, 1847)	1B
11.	Paramphistomidae		*Cotylophoroncotylophorum* (Fischoeder, 1901)	1B
	Phylum ROTIFERA			
1.	Brachionidae		*Brachionus plicatlis* Muller, 1786	1A
2.	Brachionidae		*Brachionus quadridentatus cluniorbicularis* (Skorikov, 1894)	1A
3.	Brachionidae		*Keratella cochlearis* (Gosse, 1851)	1A
4.	Brachionidae		*Keratella procurva* (Thorpe, 1891)	1A
5.	Brachionidae		*Keratella quadrata* (Muller, 1786)	1A
6.	Brachionidae		*Keratella tropica* (Apstein, 1907)	1A
7.	Brachionidae		*Platyias quadricornis* (Ehrenberg, 1832)	1A
8.	Epiphanidae		*Euchlanis dilatata* Ehrenberg, 1832	1A
9.	Epiphanidae		*Mytilina ventralis ventralis* (Ehrenberg, 1832)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
10.	Lepadellidae		*Lepadella ovalis ovalis* (Muller, 1786)	1A
11.	Lepadellidae		*Lepadella patella* (Muller, 1773)	1A
12.	Lepadellidae		*Lepadella triptera* (Ehrenberg, 1832)	1A
13.	Lepadellidae		*Squatinella mutica* (Ehrenberg, 1832)	1A
14.	Lecanidae		*Lecane luna dorsicalis (*Arora, 1965)	1A
15.	Lecanidae		*Lecane luna luna* (Muller, 1776)	1A
16.	Lecanidae		*Lecane papuana* (Murray, 1913)	1A
17.	Lecanidae		*Monostyla bulla* (Gosse, 1851)	1A
18.	Lecanidae		*Monostyla closterocerca* (Schmarda, 1859)	1A
19.	Lecanidae		*Monostyla decipiens* (Murray, 1913)	1A
20.	Lecanidae		*Monostyla lunaris lunaris* (Ehrenberg, 1832)	1A
21.	Notammatidae		*Cephalodella gibba* (Ehrenberg, 1830)	1A
22.	Trichocercidae		*Trichocerca longiseta* (Schrank, 1802*)*	1A
23.	Trichocercidae		*Trichocerca rattus* (Muller, 1776)	1A
24.	Trichocercidae		*Trichocerca weberi* (Jennings, 1903)	1A
25.	Asplanchnidae		*Asplanchna brightwelli* Gosse, 1850	1A
26.	Asplanchnidae		*Ascomorpha saltans* Bartsch, 1870	1A
27.	Testudinellidae		*Pompholyx sulcata* Hudson, 1885	1A
	Phylum GASTROTRICHA			
1.	Chaetonotidae		*Lepidodermella squamata* (Dujardin, 1841)	1B
	Phylum NEMATODA			
1.	Trichuridae	Trichurinae	*Trichuris ovis* (Abildgaard, 1795)	1B
2.	Ancylostomatidae	Bunostominae	*Bunostomum trigonocephalum* (Rud. 1808)	1B
3.	Ancylostomatidae	Chalertiinae	*Chabertia ovina* (Gmelin, 1790)	1B
4.	Ancylostomatidae	Dictyocaulinae	*Dictyocaulus filaria* (Rudolphi, 1809)	1B
5.	Trichostrongylidae	Haemonchinae	*Haemonchus contortus* (Rudolphi 1803)	1B
6.	Oesophagostominae	Oesophagostominae	*Oesophagostomum columbianum* (Curtice, 1890)	1B
7.	Protostrogylidae		*Protostrongylus rufescens* (Leuckart, 1865)	1B
8.	Pharyngodonidae	Oxyuridae	*Skrjabinema ovis* (Skrjabin, 1915)	1B
9.	Rhabdochonidae		*Rhabdocbona minima* Moravec and Daniel, 1976	1B
10.	Tylenchidae	Tylenchinae	*Aglenchus fragariae* Szczygiel, 1969	1B
11.	Tylenchidae	Tylenchinae	*Polenchus shamimi* Baqri, 1991	1B
12.	Tylenchidae	Tylenchinae	*Tylenchus filiformis* Butschli, 1873	1B
13.	Anguinidae		*Nothotylenchus hexaglyphus* Khan and Siddiqi, 1968	1B
14.	Hoplolaimidae	Hoplolaiminae	*Helicotylenchus egyptiensis* Tarjan, 1964	1B
15.	Hoplolaimidae	Hoplolaiminae	*Helicotylenchus erythrine* (Zimmerman, 1904)	1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
16.	Hoplolaimidae	Hoplolaiminae	*Helicotylenchus exallus* Sher, 1966	1B
17.	Hoplolaimidae	Hoplolaiminae	*Hoplolaimus indicus* Sher, 1963	1B
18.	Hoplolaimidae	Hoplolaiminae	*Scutellonema bizanae* Vanden Berg and Heyns, 1973	1B
19.	Hoplolaimidae	Hoplolaiminae	*Scutellonema brachyurus* (Steiner, 1938)	1B
20.	Hoplolaimidae	Rotylenchulinae	*Rotylenchulus reniformis* Linford and Oleiveira, 1940	1B
21.	Pratylenchidae	Pratylenchinae	*Hirschmanniella gracilis* (de Man, 1880)	1B
22.	Pratylenchidae	Pratylenchinae	*Pratylenchus crenatus* Loof, 1960	1B
23.	Pratylenchidae	Pratylenchinae	*Pratylenchus hexincisus* Taylor and Jenkins, 1985	1B
24.	Pratylenchidae	Pratylenchinae	*Pratylenchus loosi* Loof, 1960	1B
25.	Pratylenchidae	Pratylenchinae	*Pratylenchus scribneri* Steiner, 1943	1B
26.	Pratylenchidae	Pratylenchinae	*Pratylenchus thornei* Sher and Allen, 1953	1B
27.	Meloidogyninae	Meloidogyninae	*Meloidogyne graminicola* Goloden and Birchfield, 1965	1B
28.	Belonolaimidae	Telotylenchinae	*Merlinius affinis* (Allen, 1955)	1B
29.	Belonolaimidae	Telotylenchinae	*Quinisulcius capitatus* (Allen, 1955)	1B
30.	Belonolaimidae	Telotylenchinae	*Tylenchorhynchus nudus* Allen, 1955	1B
31.	Criconematoidea	Criconematinae	*Criconemoides informis* (Micoletzky 1922)	1B
32.	Criconematoidea	Criconematinae	*Hemicriconemoides brachyurus* (Loos, 1949)	1B
33.	Criconematoidea	Criconematinae	*Hemicriconemoides cocophilus* (Loos, 1949)	1B
34.	Criconematoidea	Criconematinae	*Macroposthonia ornate* (Raski, 1985)	1B
35.	Aphelenchoididae		Aphelenchoides asterocaudatus Das, 1960	1B
36.	Aphelenchoididae		*Aphelenchoides saprophilus* Franklin, 1957	1B
37.	Aphelenchoididae		*Metaphelenchus golden* Chaturvedi *et al.,* 1979	1B
38.	Dorylaimidae	Laimydorinae	*Laimydorus coomansi* Baqri, 1991	1B
39.	Dorylaimidae	Laimydorinae	*Laimydorus finalis* Thorne, 1975	1B
40.	Dorylaimidae	Laimydorinae	*Laimydorus minimus Baqri, 1991*	1B
41.	Aporcelaimidae	Aporcelaiminae	*Aporcelaimellus atheri* Baqri, 1991	1B
42.	Qudsianematidae	Qudsianematinae	*Eudorylaimus chauhani* (Baqri and Khera, 1975)	1B
43.	Qudsianematidae	Qudsianematinae	*Labroemella hemicaudata* Baqri, 1991	1B
44.	Qudsianematidae	Thornenematinae	*Opisthodorylaimus cavalcantii* (Lordello, 1955)	1B
45.	Qudsianematidae	Thornenematinae	*Sclerolabia salmae* Baqri, 1991	1B
46.	Qudsianematidae	Thornenematinae	*Thornenema cavalcantii* (LordelIo, 1955)	1B
47.	Nordiidae	Actinolaimoidinae	*Acephalodorylaimus attenuates* Ahmad and Jairajpuri, 1983	1B
48.	Nordiidae	Actinolaimoidinae	*Oriverutus lobatus* Siddiqi, 1971	1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
49.	Nordiidae	Actinolaimoidinae	*Oriverutus parangulatus* Baqri, 1991	1B
50.	Nordiidae	Pungentinae	*Oriverutus sundarus* (Williams, 1964)	1B
51.	Nordiidae	Pungentinae	*Saevadorella Intermoides* Baqri, 1991	1B
52.	Longidoridae	Longidorinae	*Longidorus elongates* (De Man, 1876)	1B
53.	Longidoridae	Xiphinematinae	*Axonchium phukani* Rahman, 1975	1B
54.	Xiphlnematidae	Xiphinematinae	*Belondira neortha* Siddiqi, 1964	1B
55.	Xiphlnematidae	Xiphinematinae	*Dorylaimellus indicus* Siddiqi, 1964	1B
56.	Xiphlnematidae	Xiphinematinae	*Dorylaimellus murtazai* Baqri, 1991	1B
57.	Xiphlnematidae	Xiphinematinae	*Xiphinema brevicolle* Lordello and DaCosta, 1961	1B
58.	Xiphlnematidae	Xiphinematinae	*Xiphinema insigne* Loos, 1949	1B
59.	Tylencholaimidae	Mumtaziinae	*Dorylaimoides longiurus* Siddiqi, 1965	1B
60.	Tylencholaimidae	Mumtaziinae	*Dorylaimoides mujtabai* Baqri, 1991	1B
61.	Tylencholaimidae	Tylencholaiminae	*Basirotyleptus caudatus* Jairajpuri, 1966	1B
62.	Tylencholaimidae	Tylencholaiminae	*Basirotyleptus pini* Siddiqi and Khan, 1965	1B
63.	Tylencholaimidae	Tylencholaiminae	*Discomyctus cephalatus* Thorne, 1939	1B
64.	Tylencholaimidae	Tylencholaiminae	*Tylencholaimus micronanus* Yeates, 1979	1B
65.	Tylencholaimidae	Tylencholaiminae	*Tylencholaimus obscurus* Jairajpuri, 1965	1B
66.	Tylencholaimidae	Tylencholaiminae	*Tylencholaimus pakistanensis* Timm, 1964	1B
67.	Tylencholaimidae	Tylencholaiminae	*Tyleptus variabilis* Jairajpuri and Loof, 1966	1B
68.	Mydonomidae	Mydonominae	*Proleptonchus clarus* Timm, 1964	1B
69.	Alaimidae		*Alaimus primitivusde* Man, 1880	1B
70.	Alaimidae		*Etamphidelus japonicas* Andrassy, 1977	1B
71.	Mononchidae	Prionchulinae	*Clarkus elongates* Jairajpuri and Khan, 1977	1B
72.	Mononchidae	Prionchulinae	*Clarkus propapillatus* (Clark, 1960)	1B
73.	Mylonchulidae	Mylonchulinae	*Granonchulus decurrens* (Cobb, 1917)	1B
74.	Mylonchulidae	Mylonchulinae	*Mylonchulus amurus* Khan and Jairajpuri, 1979	1B
75.	Mylonchulidae	Mylonchulinae	*Mylonchulus hawaiiensis* (Cassidy, 1931)	1B
76.	Mylonchulidae	Mylonchulinae	*Mylonchulus minor* (Cobb, 1893)	1B
77.	Mylonchulidae	Mylonchulinae	*Mylonchulus nainitalensis* Jairajpuri, 1970	1B
78.	Mylonchulidae	Mylonchulinae	*Mylonchulus subsimilis* (Cobb, 1917)	1B
79.	Mylonchulidae	Mylonchulinae	*Paramylonchulus mulveyi* (Jairajpuri, 1970)	1B
80.	Iotonchidae	Iotonchinae	*Iotonchus baqrii* Jairajpuri, 1969	1B
81.	Iotonchidae	Iotonchinae	*Iotonchus longicaudatus* Baqri, 1978	1B
82.	Iotonchidae	Iotonchinae	*Iotonchus nayari* Mohandas and Prabhoo, 1979	1B
83.	Iotonchidae	Iotonchinae	*Iotonchus trichurus* (Cobb, 1917)	1B
84.	Trichodoridae	Iotonchinae	*Parahadronchus shakily* (Jairajpuri,1969)	1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
85.	Trichodoridae	Iotonchinae	*Paratrichodorus porosus* (Allen, 1957)	1B
86.	Trichodoridae	Trichodoridae	*Trichodorus primitivus* (de Man, 1880)	1B
87.	Trichodoridae		*Diphtherophora communis* De Man, 1880	1B
88.	Rhabditidae	Mesorhabditinae	*Mesorhabditis cranganorensis* (Khera, 1968)	1B
89.	Cephalobidae	Acrobelinae	*Acrobeles timmi* Chaturvedi and Khera, 1979	1B
90.	Cephalobidae	Acrobelinae	*Acrobeloides buetschlii* (de Man, 1884)	1B
91.	Cephalobidae	Acrobelinae	*Cephalobus persegnis* Bastian, 1865	1B
92.	Panagrolaimidae		*Trilabiatus lignicolus* (Korner, 1954)	1B
93.	Plectidae	Plectinae	*Charonogaster citri* Khan and Nanjappa, 1972	1B
94.	Plectidae	Plectinae	*Chronogaster loofi* Chaturvedi and Khera, 1979	1B
95.	Plectidae	Plectinae	*Euteratocephalus palustris* (de Man, 1880)	1B
96.	Plectidae	Plectinae	*Plectus cirratus* Bastian, 1865	1B
97.	Camacolaimidae		*Paraphanolaimus micoletzkyi* Khera and Chaturvedi, 1977	1B
98.	Monhysteridae	Monhysterinae	*Prismatolaimus andrassyi* Khera and Chaturvedi, 1977	1B
99.	Cytholaimidae		*Achromadora ruricola* (de Man, 1880)	1B
100.	Ironidae	Ironinae	*Cryptonchus abnormis* (Allgen, 1933)	1B
101.	Ironidae	Ironinae	*Ironus longicaudatus* de Man, 1884	1B
102.	Ironidae	Ironinae	*Ironus tunbridgensis* Bastian, 1865	1B
103.	Oncholaimidae		*Tobrilus gracilis* (Bastian, 1865)	1B
104.	Oncholaimidae		*Tripylina arenicola* (de Man, 1880)	1B
	Phylum ACANTHOCEPHALA			
1.	Neoechinorhynchidae	Neoechinorhynchinae	*Neoechinorhynchus hutchinsoni* Datta, 1936	1A
	Phylum ANNELIDA			
1.	Lumbricidae		*Bimastos parvus* (Eisen, 1874)	1A
2.	Lumbricidae		*Dendrodrilus rubidus* (Savigny, 1826)	1A
3.	Megascolecidae		*Amynthas diffringes* (Baird, 1869)	1A
4.	Megascolecidae		*Metaphire posthuma* (Vaillant, 1868)	1A
5.	Piscicolidae		*Piscicola olivacea* Harding, 1920	1A
6.	Lumbricida		*Aporrectodea caliginosa* (Savigny, 1826)	1B
7.	Lumbricida		*Aporrectodea trapezoides* (Dugès, 1828)	1B
8.	Lumbricida		*Bimastos parvus* (Eisen, 1874)	1B
9.	Lumbricida		*Dendrodrilus rubidus* (Savigny, 1826)	1B
10.	Lumbricida		*Octolasion cyaneum* (Savigny, 1826)	1B,1C
11.	Lumbricida		*Octolasion tyrtaeum* (Savigny, 1826)	1B
12.	Octochaetidae		*Lennogaster chittagongensis* (Stephenson, 1917)	1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
13.	Megascolecidae		*Amynthas corticis* (Kinberg, 1867)	1B
	Phylum ARACHNIDA			
1.	Chaerilidae		*Scorpiops dastychi* Kovarik, 2000	1B
2.	Chaerilidae		*Perionyx planata* (Perrier, 1868)	1C
3.	Chaerilidae		*Scorpiops spitiensis* Zambre, 2014	1B
4.	Ixodidae		*Rhipicephalus haemaphysaloides* Supino, 1897	1B, 1C
5.	Ixodidae		*Rhipicephalus sanguineus* (Latrielle, 1306)	1B,1C
6.	Caligonellidae		*Molothrognathus leptostylus* Summers and Schlinger, 1955	1A
7.	Stigmaeidae		*Agistemus fleschneri* Summers, 1960	1A
8.	Anyphaenidae		*Araniella cucurbitina* (Clerck, 1757)	1A
9.	Ixodidae		*Boophilus microplus* (Canestrini, 1887)	1C
10.	Ixodidae		*Kaiseriana davisi* Hoogstraal, Dhanda and Bhat, 1970	1C
11.	Hermanniidae		*Hermannia convexa* (Koch, 1840)	1C
12.	Liodidae		*Neoliodes ocellatus* Pearce, 1906	1C
13.	Belbidae		*Ommatacepheus ocellatus* (Michael, 1882)	1C
14.	Liacaridae		*Liacarus nigrescens* Pearce, 1906	1C
15.	Cymbaeremeidae		*Cymbaeremaeus cymba* (Nicolet, 1855)	1C
16.	Chaunoproctidae		*Chaunoproctus cancellatus* Pearce, 1906	1C
17.	Chaunoproctidae		*Chaunoproctus longisetosus* Dhali and Bhaduri, 1981	1C
18.	Oribatulidae		*Liebstadia similis* (Michael, 1888)	1C
19.	Oribatulidae		*Zygoribatula tibialis* (Nicolet, 1855)	1C
20.	Oribatulidae		*Scheloribates saswati* Dhali and Bhaduri, 1980	1C
21.	Oribatulidae		*Scheloribates sikkimensis* Dhali and Bhaduri, 1980	1C
22.	Pelopidae		*Eupelops acromios* (Hermann, 1804)	1C
23.	Oribatellidae		*Lamellobates bengalensis* Bhaduri and Raychaudhuri, 1968	1C
24.	Anystidae		*Walzia darjeelingensis* Gupta, 1992	1C
25.	Anystidae		*Bdellodes* sp. Gupta and Ghosh, 1980	1C
26.	Cunaxidae		*Cunaxa setirostris* (Hermann), 1804	1C
27.	Cunaxidae		*Cunaxoides croceus* (Koch), 1838	1C
28.	Erythraeidae		*Balaustium murorum* (Hermann) 1804	1C
29.	Eupodidae		*Eupodes sigmodensis* Strandtmann and Goff, 1978	1C
30.	Stigmaeidae		*Agistemus fleschneri* Summers, 1960	1C
31.	Stigmaeidae		*Agistemus terminalis* (Quayle, 1912)	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
32.	Tydeidae		*Pronematus fleschneri* Baker, 1968	1C
33.	Tydeidae		*Tydeus* sp. Somchoudhury and Mukherjee, 1989	1C
34.	Phytoseiidae		*Amblyseius channabasavannai* Gupta and Daniel, 1978	1C
35.	Phytoseiidae		*Amblyseius herbicolus* (Chant) 1959	1C
36.	Phytoseiidae		*Amblyseius neorykei* Gupta, 1977	1C
37.	Phytoseiidae		*Amblyseius paraaerialis* Muma, 1967	1C
38.	Phytoseiidae		*Euseius alstoniae* Gupta, 1975	1C
39.	Phytoseiidae		*Euseius coccineae* Gupta, 1975	1C
40.	Phytoseiidae		*Euseius delhiensis* (Narayanan and Kaur) 1960	1C
41.	Phytoseiidae		*Euseius finlandicus* (Oudemans) 1915	1C
42.	Phytoseiidae		*Euseius ovalis* (Evans, 1953)	1C
43.	Phytoseiidae		*Euseius pruni* Gupta, 1970	1C
44.	Phytoseiidae		*Euseius rhododendronis* Gupta, 1970	1C
45.	Phytoseiidae		*Neoseiulus longispinosus* (Evans, 1952)	1C
46.	Phytoseiidae		*Paraphytoseius multidentatus* (Swirski and Shechter) 1961	1C
47.	Phytoseiidae		*Typhlodromips officinaria* Gupta, 1975	1C
48.	Phytoseiidae		*Typhlodromips suknaensis* Gupta, 1970	1C
49.	Phytoseiidae		*Typhlodromips syzygii* Gupta, 1975	1C
50.	Phytoseiidae		*Indoseiulus ricini* (Ghai and Menon, 1969)	1C
51.	Phytoseiidae		*Paraamblyseius fragariae* Gupta, 1970	1C
52.	Phytoseiidae		*Paraamblyseius mumai* Gupta, 1980	1C
53.	Phytoseiidae		*Phytoseius macropilis* (Banks)1909	1C
54.	Phytoseiidae		*Typhlodromus darjeelingensis* Gupta, 1980	1C
55.	Phytoseiidae		*Typhlodromus pruni* Gupta, 1970	1C
56.	Phytoseiidae		*Euseius insanus* Khan and Chaudhri	1C
57.	Phytoseiidae		*Typhlodromus garrulus* Chaudhri *et al.,* 1974	1C
58.	Phytoseiidae		*Phytoseius corniger* Wainstein, 1959	1C
59.	Phytoseiidae		*Phytoseius mixtus* Chaudhri, 1973	1C
60.	Phytoseiidae		*Phytoseius intermedius* Evans and Macfarlane, 1962	1C
61.	Phytoseiidae		*Phytoseius mixtus* Chaudhri, 1973	1C
62.	Phytoseiidae		*Phytoseius roseus* Gupta, 1969	1C
63.	Phytoseiidae		*Phytoseius rugosus* Denmark, 1966	1C
64.	Phytoseiidae		*Typhlodromus hadii* Chaudhri, 1965	1C
65.	Anyphaenidae		*Araniella cucurbitina* (Clerck, 1757)	1C
66.	Gnaphosidae		*Drassodes carinivulvus* Caporiacco, 1934	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
67.	Gnaphosidae		*Drassodes rubicundulus* Caporiacco, 1934	1A
68.	Gnaphosidae		*Drassodes singulariformis* Roewer, 1951	1A
69.	Gnaphosidae		*Gnaphosa stoliczkai* O. Pickard-Cambridge, 1885	1A
70.	Gnaphosidae		*Zelotes baltoroi* Caporiacco, 1934	1A
71.	Gnaphosidae		*Zelotes pseudopusillus* Caporiacco, 1934	1A
72.	Gnaphosidae		*Zelotes sindi* Caporiacco, 1934	1A
73.	Linyphiidae		*Collinsia crassipalpis* (Caporiacco, 1935)	1A
74.	Linyphiidae		*Collinsia inerrans* (O. Pickard-Cambridge, 1885)	1A
75.	Lycosidae		*Acantholycosa baltoroi* (Caporiacco, 1935)	1A
76.	Lycosidae		*Pardosa alii* Tikader, 1977	1A
77.	Lycosidae		*Pardosa algoides* Schenkel, 1963	1A
78.	Lycosidae		*Pardosa flavisterna* Caporiacco, 1935	1A
79.	Nemesiidae		*Raveniola concolor* Zonstein, 2000	1A
80.	Salticidae		*Chalcoscirtus glacialis* Caporiacco, 1935	1A
81.	Salticidae		*Heliophanus curvidens* (Pickard-Cambridge, 1872)	1A
	Phylum CRUSTACEAE			
1.	Branchinectidae		*Branchinecta ferox* (Milne Edwards, 1840)	1A
2.	Macrothricidae		*Macrothrix laticornis* (Jurine, 1820)	1A
3.	Chydoridae	Aloninae	*Alona guttata* Sars, 1862	1A
4.	Chydoridae	Aloninae	*Coronatella rectangula* (Sars, 1862)	1A
5.	Chydoridae	Chydorinae	*Chydorus sphaericus* (O.F. Müller, 1776)	1A
6.	Chydoridae	Diaptominae	*Arctodiaptomus altissimus*	1A
7.	Chydoridae	Diaptominae	*Arctodiaptomus bacillifer* (Koelbel, 1885)	1A
8.	Chydoridae	Diaptominae	*Arctodiaptomus parvispineus* Kiefer, 1932	1A
9.	Chydoridae	Diaptominae	*Arctodiaptomus stewartianus* (Brehm, 1925)	1A
10.	Cyclopidae	Cyclopinae	*Microcyclops varicans varicans* (Sars,1863)	1A
11.	Cyclopidae	Cyclopinae	*Thermocyclops decipiens* (Kiefer, 1929)	1A
12.	Cyclopidae	Cyclopinae	*Cyclops ladakanus* Kiefer	1A
13.	Cyclopidae	Cyclopinae	*Cyclops vicinus vicinus* Uljanin, 1875	1A
14.	Cyclopidae	Cyclopinae	*Diacyclops alticola* (Kiefer, 1935)	1A
15.	Cyclopidae	Cyclopinae	*Eucyclops productus* Kiefer, 1936)	1A
16.	Cyclopidae	Cyclopinae	*Eucyclops serrulatus serrulatus* (Fischer, 1851)	1A
17.	Cyclopidae	Cyclopinae	*Macrocylops albidus albidus* (Jurine, 1820)	1A
18.	Cyclopidae	Cyclopinae	*Megacyclops viridis (*Jurine, 1820)	1A
19.	Cypridiidae	Cypricercinae	*Eucypris afghanistanensis* Hartmann, 1964	1A
20.	Candonidae	Candoninae	*Candona candida* (Müller, 1776)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
21.	Ilyocyprididae	Ilyocypridinae	*Ilyocypris bradyi* Sars, 1890	1A
22.	Ilyocyprididae	Ilyocypridinae	*Ilyocypris gibba* (Ramdohr, 1808)	1A
	Subphylum HEXAPODA Class COLLEMBOLA			
1.	Entomobryidae		*Lepidosira unguserrata* Salmon, 1970	1C
2.	Hypogastruridae		*Ceratophysella indica* (Salmon, 1956)	1C
3.	Hypogastruridae		*Desoria mazda* (Yosii, 1971)	1C
4.	Hypogastruridae		*Desoria trispinata* (Mac Gillivray, 1896)	1C
5.	Hypogastruridae		*Isotoma plumosa* (Salmon, 1969)	1C
6.	Hypogastruridae		*Procerura transequatoria* (Salmon, 1969)	1C
7.	Neanuridae		*Adbiloba sikkimensis* (Yosii, 1966)	1C
8.	Neanuridae		*Pronura indiana* Salmon, 1969	1C
9.	Odontellidae		*Spinanurida mandibulata* Salmon, 1969	1C
10.	Odontellidae		*Superodontella altitudina* (Salmon, 1969)	1C
11.	Paroneliidae		*Salina sikkimensis* Mitra, 1973	1C
12.	Tullbergidae		*Thalassaphorura clayae* (Salmon, 1958)	1C
13.	Neanuridae		*Himalmeria karmapa* Cassagnau, 1984	1A
14.	Neanuridae		*Paranura coenobita* Cassagnau, 1991	1A
15.	Neanuridae		*Womersleya sikkimensis* Cassagnau, 1984	1A
16.	Tomoceridae		*Tomocerus petalospinus* Salmon, 1969	1B
17.	Tomoceridae		*Tomocerus serratospinus* Salmon, 1941	1B
18.	Arrhopalitidae		*Pygmarrhopalites habei* (Yosii, 1965)	1B
19.	Entomobryidae		*Seira hazrai* Baquero, 2014	1B
20.	Entomobryidae		*Seira nidarensis* Baquero, 2014	1B
	Class INSECTA Order ARCHAEOGNATHA (Thysanura)			
1.	Machilidae		*Machilanus hutchinsoni* Silvestri, 1936	1A
	Order EPHEMEROPTERA			
2.	Ephemeridae	Ephemerinae	*Ephemera consors* Eaton, 1892	
3.	Heptageniidae	Heptageniinae	*Heptagenia traverae* Braasch, 1986	
4.			*Iron papillatus* Braasch, 2006	
5.			*Notacanthurus ladakhensis* Braasch, 1986	
6.			*Rhithrogena rougemonti* Braasch and Soldan, 1987	
	Order ODONATA			
7.	Lestidae		*Indolestescyaneus* (Selys, 1862)	1A
8.			*Lestesbarbarus* (Fabricius, 1798)	1A
9.			*Sympecma paedisca* (Brauer, 1877)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
10.	Chlorocyphidae		*Aristocypha quadrimaculata* Selys, 1853	1A
11.	Euphaeidae		*Epallage fatime* (Charpentier, 1840)	1A
12.	Platycnemididae		*Platycnemis dealbata* Selys in Selys and Hagen, 1850	1A
13.	Coenagrionidae		*Enallagma cyathigerum* (Charpentier, 1840)	1A
14.			*Ischnura aurora* (Brauer, 1865)	1A
15.			*Ischnura forcipata* Morton, 1907	1A
16.			*Ischnura inarmata* Calvert, 1898	1A
17.			*Ischnura pumilio* (Charpentier, 1825)	1A
18.	Aeshnidae		*Aeshna juncea* (Linnaeus, 1758)	1A
19.			*Aeshna mixta* Latreille, 1805	1A
20.			*Anax parthenope* (Selys, 1839)	1A
21.			*Cephalaeschna klapperichi* Schmidt, 1961	1A
22.	Gomphidae		*Anisogomphusbivittatus* Selys, 1854	1A
23.			*Onychogomphus schmidti* Fraser, 1937	1A
24.			*Ophiogomphus reductus* Calvert, 1898	1A
25.	Chlorogomphidae		*Chlorogomphus olympicus* Fraser, 1933	1A
26.	Cordulegastridae		*Cordulegaster brevistigma* (Selys, 1854)	1A, 1B
27.			*Cordulegaster parvistigma* (Selys, 1873)	1B
28.			*Neallogaster schmidti* Asahina, 1982	1A
29.	Libellulidae		*Crocothemis servilia* (Drury, 1770)	1A, 1B
30.			*Diplacodes trivialis* (Rambur, 1842)	1A
31.			*Libellula quadrimaculata* Linnaeus, 1758	1A
32.			*Orthetrum anceps* (Schneider, 1845)	1A
33.			*Orthetrum brunneum* (Fonscolombe, 1837)	1A
34.			*Orthetrum cancellatum* (Linnaeus, 1758)	1A
35.			*Orthetrum glaucum* (Brauer, 1865)	1B
36.			*Orthetrum japonicum* (Uhler, 1858)	1A
37.			*Orthetrum martensi* Asahina, 1978	1A
38.			*Orthetrum pruinosum* (Burmeister, 1839)	1A
39.			*Orthetrum taeniolatum* (Schneider, 1845)	1A
40.			*Orthetrum triangulare* (Selys, 1878)	1A
41.			*Palpopleura sexmaculata* (Fabricius, 1787)	1A
42.			*Pantala flavescens* (Fabricius, 1798)	1A, 1B
43.			*Selysiothemis nigra* (Vander Linden, 1825)	1A
44.			*Sympetrum commixtum* (Selys, 1884)	1A, 1B
45.			*Sympetrum fonscolombii* (Selys, 1840)	1A
46.			*Sympetrum meridionale* (Selys, 1841)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
47.			*Sympetrum speciosum* Oguma, 1915	1A
48.			*Sympetrum striolatum* (Charpentier, 1840)	1A
49.			*Trithemis festiva* (Rambur, 1842)	1A
	Order PHASMIDA			
50.	Pachymorphidae	Pachymorphinae	*Ladakhomorpha longipes* Hennemann and Conle, 1999	1B
	Order EMBIOPTERA			
51.	Embiidae		*Embia rabaulti* Navas, 1934	1B
	Order PLECOPTERA			
52.	Capniidae		*Capnia hingstoni* Kimmins, 1946	1C
53.			*Capnia montana* Kimmins, 1946	1C
54.			*Kyphopteryx dorsalis* Kimmins, 1946	1C
55.	Perlidae	Acroneuriinae	*Brahmana benigna* (Needham, 1909)	1C
56.		Perlinae	*Kamimuria sikkimensis* (Enderlein, 1909)	1C
	Order DERMAPTERA			
57.	Anisolabididae	Isolaboidinae	*Isolaboides burri* (Borelli, 1909)	1A
58.			*Isolaboides immsi* (Burr, 1913)	1A
59.	Labiduridae	Nalinae	*Nala nepalensis* (Burr, 1907)	1A
60.	Forficulidae	Anechurinae	*Oreasiobia fedtschenkoi* (Saussure, 1876)	1A
61.			*Anechura zubovskii* Semenov, 1901	1A, 1B
62.		Forficulinae	*Forficula abbottabadiensis* Bharadwaj and Kapoor, 1968	1A
63.			*Forficula schlagintweiti* (Burr, 1904)	1A
	Order MANTODEA			
64.	Hymenopodidae	Oxypilinae	*Ephestiasula intermedia* Werner, 1930	1A
65.	Ridopterygidae	Nanomantinae	*Parananomantis brevis* Mukherjee, 1995	1A, 1B
66.	Liturgusidae	Liturgusinae	*Humbertiella similis* Giglio-Tos, 1917	1A
67.	Mantidae	Miomantinae	*Deiphobe infuscata* (Saussure, 1871)	1A, 1B
	Order BLATTODEA			
68.	Ectobiidae		*Hemipterisca submarginata* (Walker, 1871)	1A
69.	Blattidae	Blattinae	*Shelfordella lateralis* (Walker, 1868)	1A
70.			*Shelfordella monochroma* (Walker, 1871)	1A
	Order PSOCODEA			
71.	Stenopsocidae		*Stenopsocus uniformis* (Hagen, 1859)	1A
72.	Lachesillidae	Lachesillinae	*Lachesilla falcicula* Badonnel, 1981	1A
73.			*Lachesilla sonamarga* Garcia Aldrete, 1988	1A
74.	Peripsocidae		*Diplopsocus dachigamensis* (Badonnel, 1981)	1A
75.			*Diplopsocus similaris* (Badonnel, 1981)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
76.			*Peripsocus kashmirensis* Badonnel, 1981	1A
77.	Psocidae	Psocinae	*Ptycta schneideri* Badonnel, 1981	1A
	Order PHTHIRAPTERA			
78.	Menoponidae		*Actornithophilus grandiceps* (Piaget, 1880)	1A
79.	Hoplopleuridae		*Hoplopleura captiosa* Johnson, 1960	1A, 1B
80.			*Hoplopleura himalayana* Mishra, Kulkarni and Bhat, 1974	1A, 1B
81.			*Hoplopleura kondana* Mishra, 1981	1A, 1B
82.			*Hoplopleura maniculata* (Neumann, 1909)	1A, 1B
83.			*Hoplopleura pacifica* Ewing, 1924	1A, 1B
84.			*Hoplopleura phaiomydis* Ferris, 1921	1B
85.			*Hoplopleura sicata* Johnson, 1964	1A, 1B
86.			*Hoplopleura silvula* Johnson, 1972	1A, 1B
87.	Linognathidae		*Linognathus ovillus* (Neumann, 1907)	1A, 1B
88.			*Linognathus setosus* (Von Olfers, 1816)	1A, 1B
89.			*Linognathus stenopsis* (Burmeister, 1838)	1B
90.	Pedicinidae		*Pedicinus ancoratus* Ferris, 1934	1A, 1B
91.			*Pedicinus eurygaster* (Burmeister, 1838)	1A, 1B
92.			*Pedicinus obtusus* (Rudow, 1869)	1A, 1B
93.	Polyplacidae		*Pedicinus echinatus* (Neumann, 1909)	1A, 1B
94.			*Pedicinus palearctus* Olsoufiev, 1938	1A, 1B
95.			*Pedicinus petauristae* Ferris, 1923	1A, 1B
96.			*Polyplax asiatica* Ferris, 1923	1A, 1B
97.			*Polyplax indica* Mishra and Kulkarni, 1974	1A, 1B
98.			*Polyplax reclinata* (Nitzsch, 1864)	1A, 1B
99.			*Polyplax serrata* (Burmeister, 1838)	1B
100.			*Polyplax spinulosa* (Burmeister, 1838)	1A, 1B
101.	Philopteridae		*Anaticola anseris* Linne, 1758	1A, 1B
102.	Philopteridae		*Brueelia daumae* (Clay, 1936)	1A, 1B
103.			*Brueelia husaini* Ansari, 1956	1A, 1B
104.			*Brueelia multipunctata* (Clay, 1936)	1A
105.			*Brueelia myiophoneae* (Clay, 1936)	1A
106.			*Brueelia varia* (Burmeister, 1838)	1A
107.			*Brueelia zootherae* (Clay, 1936)	1A, 1B
108.			*Coloceras lativentris* (Uchida, 1916)	1A, 1B
109.			*Degeeriella rufa* (Burmeister, 1838)	1A
110.			*Falcolipeurus quadripustulatus* (Burmeister, 1838)	1A, 1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
111.			*Goniodes cervinicornis* Giebel, 1874	1A, 1B
112.			*Goniodes costatus* (Kéler, 1939)	1A
113.			*Goniodes dispar* Burmeister, 1838	1A
114.			*Goniodes intermedius* Neumann, 1913	1A
115.			*Goniodes ocellatus* (Rudow, 1869)	1A
116.			*Goniodes tragopan* Clay, 1940	1A
117.			*Lipeurus eurycnemis* Taschenberg, 1882	1A, 1B
118.			*Oxylipeurus himalayensis* (Rudow, 1869)	1A
119.			*Philopterus atratus* Nitzsch, 1818	1A
120.			*Philopterus garruli* Boisduval and Lacordaire, 1835	1A
121.			*Philopterus thryptocephalus* (Kellogg and Paine, 1914)	1A
122.			*Quadraceps altoasiaticum* (Timmermann, 1954)	1A, 1B
123.			*Syrrhaptoecus tibetanus* Waterston, 1928	1B
	Order THYSANOPTERA			
124.	Aeolo thripidae		*Aeolothrips collaris* Priesner, 1919	1A
125.			*Aeolothrips distinctus* Bhatti, 1971	1A
126.			*Aeolothrips intermedius* Bagnall, 1934	1B
127.			*Aeolothrips mongolicus* Pelikan, 1985	1A
128.	Thripidae	Dendrothripinae	*Dendrothrips asperses* Bhatti, 1971	1A
129.			*Dendrothrips saltator* Uzel, 1895	1A
130.			*Dendrothrips stannardi* (Ananthakrishnan, 1958)	1A
131.		Panchaetothripinae	*Astrothrips tumiceps* Karny, 1923	1A
132.			*Caliothrips graminicola* (Bagnall and Cameron, 1932)	1A
133.			*Caliothrips indicus* (Bagnall, 1913)	1A
134.			*Helionothrips aino* (Ishida, 1931)	1A
135.			*Monilothrips kempi* Moulton, 1929	1A
136.			*Phibalothrips peringueyi* (Faure, 1925)	1A
137.			*Rhipiphorothrips cruentatus* Hood, 1919	1A
138.			*Selenothrips rubrocintus* (Giard, 1901)	1A
139.		Sericothripinae	*Hydatothrips boerhaaviae* Seshadri and Ananthakrishnan, 1954	1A
140.			*Hydatothrips proximus* Bhatti, 1973	1A
141.			*Neohydatothrips gracilipes* (Hood, 1924)	1A
142.			*Neohydatothrips samayunkur* Kudô, 1995	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
143.		Thripinae	*Abacothrips lotus* Bhatti, 1986	1A
144.			*Anaphothrips obscurus* (Müller, 1776)	1A
145.			*Anaphothrips sudanensis* Trybom, 1911	1A
146.			*Aptinothrips rufus* (Haliday, 1836)	1A
147.			*Ayyaria chaetophora* Karny, 1927	1A
148.			*Bolacothrips striatopennatus* (Schmutz, 1913)	1A
149.			*Caprithrips melanophthalmus* (Bagnall, 1927)	1A
150.			*Chaetanaphothrips orchidii* (Moulton, 1907)	1A
151.			*Chirothrips meridionalis* Bagnall, 1927	1A
152.			*Ctenothrips niger* Kudo, 1977	1A
153.			*Ctenothrips smilax* Bhatti, 1976	1A
154.			*Dendrothripoides innoxius* (Karny, 1914)	1A
155.			*Diarthrothrips nimbus* (Ananthakrishnan, 1965)	1A
156.			*Ernothrips lobatus* (Bhatti, 1967)	1A
157.			*Exothrips jammuensis* Vijay Veer and Srivastava, 1985	1A, 1B
158.			*Exothrips redox* Bhatti, 1975	1A
159.			*Frankliniella schultzei* (Trybom, 1910)	1A
160.			*Kurtomathrips morrilli* Moulton, 1927	1A
161.			*Lefroyothips lefroyi* (Bagnall, 1913)	1A
162.			*Megalurothrips usitatus* (Bagnall, 1913)	1A
163.			*Microcephalothrips abdominalis* (Crawford, 1910)	1A
164.			*Moundinothrips robustus* (Bhatti, 1995)	1A
165.			*Mycterothrips nilgiriensis* (Ananthakrishnan, 1960)	1A
166.			*Oxythrips indicus* Bhatti, 1967	1A, 1B
167.			*Oxythrips kochummani* Ananthakrishnan, 1969	1A
168.			*Parabaliothripstakahashii* Priesner, 1935	1A
169.			*Rhamphothripspardus* (Bhatti, 1967)	1A
170.			*Scirtothrips dorsalis* Hood, 1919	1A
171.			*Scirtothrips kenyensis* Mound, 1968	1A
172.			*Scirtothrips mangiferae* Priesner, 1932	1A
173.			*Smilothrips productus* Bhatti, 1976	1A
174.			*Stenchaetothrips bambusae* (Shumsher, 1946)	1A
175.			*Stenchaetothrips biformis* (Bagnall, 1913)	1A
176.			*Stenchaetothrips faurei* (Bhatti, 1962)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
177.			*Stenchaetothrips spinulae* Tyagi and Kumar, 2008	1A
178.			*Taeniothrips major* Bagnall, 1916	1A
179.			*Tenothrips frici* (Uzel, 1895)	1A
180.			*Thrips alatus* Bhatti, 1980	1A
181.			*Thrips andrewsi* (Bagnall, 1921)	1A
182.			*Thrips apicatus* Priesner, 1934	1A
183.			*Thrips arorai* Bhatti, 1980	1A
184.			*Thrips beharensis* (Ramakrishna and Margabandhu, 1939)	1C
185.			*Thrips carthami* Shumsher, 1946	1A
186.			*Thrips coloratus* Schmutz, 1913	1A, 1C
187.			*Thrips dorax* Bhatti, 1980	1A
188.			*Thrips flavus* Schrank, 1776	1A
189.			*Thrips florum* Schmutz, 1913	1A, 1C
190.			*Thrips hawaiiensis* (Morgan, 1913)	1A, 1C
191.			*Thrips palmi* Karny, 1925	1A, 1C
192.			*Thrips subnudula* (Karny, 1927)	1A
193.			*Thrips tabaci* Lindeman, 1889	1A, 1C
194.			*Thrips trehernei* Priesner, 1927	1A, 1B
195.			*Thrips xenos* Bhatti, 1980	1A
196.			*Tusothrips sumatrensis* (Karny, 1925)	1A, 1B
197.	Phlaeothripidae	Idolothripinae	*Elaphrothrips curvipes* Priesner, 1929	1C
198.			*Elaphrothrips denticollis* (Bagnall, 1909)	1C
199.			*Elaphrothrips procer* (Schmutz, 1913)	1C
200.			*Nesothrips lativentris* (Karny,1913)	1C
201.			*Ophthalmothrips breviceps* (Bagnall, 1914)	1A
202.		Phlaeothripinae	*Azaleothrips bhattii* Vijay Veer and Chauhan, 1990	1A
203.			*Dolichothrips zyziphi* Bagnall, 1923	1A
204.			*Gigantothrips elegans* Zimmerman, 1900	1A
205.			*Haplothrips bagrolis* Bhatti, 1973	1A, 1B
206.			*Haplothrips ganglbaueri* Schmutz, 1913	1A, 1C
207.			*Haplothrips gowdeyi* (Franklin, 1908)	1A
208.			*Haplothrips mangiferae* Priesner, 1930	1B
209.			*Liothrips aberrans* Muraleedharan and Sen, 1978	1C
210.			*Liothrips renukae* Muraleedharan and Sen, 1928	1A
211.			*Plicothrips apicalis* (Bagnall, 1915)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
	Order HEMIPTERA			
212.	Aphididae		*Acutosiphon obliquoris* Basu *et al.*, 1970	1C
213.			*Acyrthosiphon rubi* Narzikulov, 1957	1C
214.			*Acyrthosiphon rubiformosanus* Takahashi, 1971 1C	1C
215.			*Aiceona titabarenis* (Raychaudhuri and Ghosh, 1964) 1C	1C
216.			*Akkaia bengaiensis* Basu, 1967	1C
217.			*Akkaia neopolygoni* Ghosh *et al.*, 19	1C
218.			*Akkaia sikkimensis* Agarwala and Raychaudhuri, 1977	1C
219.			*Aleurodaphis blumeae* Van der Goot, 1917	1C
220.			*Amphorophora bengalensis* Lambers and Basu, 1966	1C
221.			*Anoecia vagans* (Koch 1856)	1C
222.			*Anomalosiphum indigoferae* Ghosh *et al.*, 1971	1C
223.			*Aphis craccivora* Koch, 1854	1C
224.			*Aphis fabae solanella* Theobald, 1914	1C
225.			*Aphis gossypii* Glover, 1877	1C
226.			*Aphis longisetosus* Basu, 1969	1C
227.			*Aphis nasturtii* Kaltenbach, 1843	1C
228.			*Aphis nerii* Fonscolombe, 1841	1C
229.			*Aphis spiraecola* Patch, 1914	1C
230.			*Astegopteryx minuta* (Van der Goot, 1917)	1C
231.			*Aulacorthum circumflexus* (Buckton, 1876)	1C
232.			*Aulacorthum dasi* Ghosh *et al.*, 1970	1C
233.			*Aulacorthum linderae* (Shinji, 1982)	1C
234.			*Aulacorthum magnoliae* (Essig and Kuwana, 1918)	1C
235.			*Aulacorthum nipponicum* (Essig and Kuwana, 1918)	1C
236.			*Aulacorthum primulum* Ghosh *et al.*, 1971	1C
237.			*Aulacorthum primulum* Ghosh *et al.*, 1971	1C
238.			*Aulacorthum solani* (Kaltenbach, 1843)	1C
239.			*Betacallis odaiensis* Takahashi, 1969	1C
240.			*Betacallis querciphaga* Basu *et al.*, 1968	1C
241.			*Betacallis sikkimensis* Basu *et al.*, 1974	1C
242.			*Brevicoryne brassicae* (Linnaeus,1758)	1C
243.			*Capitophorus eleagni* (Del Guerico, 1894)	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
244.			*Capitophorus formosartemisiae* (Takahashi, 1921)	1C
245.			*Capitophorus hippophaes javanicus* Lambers, 1953	1C
246.			*Capitophorus hippophaes mitegoni* Eastop, 1956	1C
247.			*Capitophorus indicus* Ghosh and Raychaudhuri, 1968	1C
248.			*Capitophorus vernoniae* Ghosh and Raychaudhuri, 1968	1C
249.			*Cavariella araliae* Takahashi, 1921	1C
250.			*Ceratoglyphina bambusae bengalensis* Ghosh, 1972	1C
251.			*Ceratovacuna indica* Ghosh *et al.,* 1974	1C
252.			*Ceratovacuna lanigera* Zehntner, 1897	1C
253.			*Ceratovacuna perglandulosa* Basu *et al.,* 1973	1C
254.			*Ceratovacuna silvestrti* (Takahashi, 1927)	1C
255.			*Chaetogeoica graminiphaga* Raychaudhuri, Pal and Ghosh, 1978	1C
256.			*Clethrobius dryobius* Chakrabarti and Raychaudhuri, 1976	1C
257.			*Cinara atrotibialis* David and Rajasingh, 1968	1C
258.			*Cinara cupressi* (Buckton, 1881)	1C
259.			*Cinara tistaensis* Agarwala and Raychaudhuri, 1982	1C
260.			*Cinara tujafilina* (Del Guercio, 1909)	1C
261.			*Cryptosiphum artemisiae* Buckton, 1859	1C
262.			*Elatobium sclerotica* Agarwala *et al.,* 1982	1C
263.			*Epipemphigus imaicus* (Cholodkovsky, 1912)	1C
264.			*Eriosoma lanigerum* (Hausmann, 1802)	1C
265.			*Eumyzus himalayana* Agarwala *et al.,* 1982	1C
266.			*Eutrichosiphum alnicola* (Basu, 1967)	1C
267.			*Eutrichosiphum arunachali* Basu *et al.,* 1972	1C
268.			*Eutrichosiphum betulae* Mondal *et al.,* 1979	1C
269.			*Eutrichosiphum davidi* Raychaudhuri, 1956	1C
270.			*Eutrichosiphum quercifoliae* Raychaudhuri *et al.,* 1973	1C
271.			*Eutrichosiphum sikkimense* Raychaudhuri *et al.,* 1973	1C
272.			*Eutrichosiphum tapatii* Mondal *et al.,* 1979	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
273.			*Greenidea longirostris* Basu, 1969	1C
274.			*Greenidea decaspermi* Takahashi, 1933	1C
275.			*Greenidea ficicola* Takahashi, 1916	1C
276.			*Greenidea longicornis* (Ghosh *et al.*, 1970)	1C
277.			*Greenidea symplocosis* Ghosh *et al.*, 1970	1C
278.			*Greenidea brachyunguis* Chatterjee *et al.*, 1981	1C
279.			*Greenidea bucktonis* Ghosh *et al.*, 1970	1C
280.			*Greenidea formosana heeri* Raychaudhuri *et al.*, 1973	1C
281.			*Greenidea prunicola* Ghosh *et al.*, 1971	1C
282.			*Greenidea sikkimensis* Raychaudhuri *et al.*, 1973	1C
283.			*Greenidea luteum* (Basu, 1969)	1C
284.			*Geoica lucifuga* (Zehntner, 1898)	1C
285.			*Geoica sikkimensis* Raychaudhuri *et al.*, 1978	1C
286.			*Glyphinaphis bambusae* Van der Goot, 1917	1C
287.			*Hysteroneura setariae* (Thomas, 1878)	1C
288.			*Hyalomyzus raoi* Lambers, 1973	1C
289.			*Hyperomyzus carduellinus* (Theobald, 1915)	1C
290.			*Impatientinum impatiens* (Shinji, 1922)	1C
291.			*Impatientinum smilaceti* Agarwala *et al.*, 1982	1C
292.			*Jacksonia conandri* (Takahashi, 1968)	1C
293.			*Jacksonia papillata* Theobald, 1923	1C
294.			*Jacksonia sikkimensis* Ghosh *et al.*, 1977	1C
295.			*Kurisakia indica* Basu, 1967	1C
296.			*Lachnus tropicalis* (Van der Goot, 1916)	1C
297.			*Liosomaphis berberidis* (Kaltenbach, 1843)	1C
298.			*Lipaphis erysimi* (Kaltenbach, 1843)	1C
299.			*Macromyzus maculatus* (Basu, 1969)	1C
300.			*Macrosiphoniella kikusanensis* Moritsu, 1971	1C
301.			*Macrosiphoniella sanborni* (Gillette, 1908)	1C
302.			*Macrosiphoniella sikkimartemisiae* Agarwala and Raychaudhuri, 1977	1C
303.			*Macrosiphoniella yomogifoliae* (Shinji, 1922)	1C
304.			*Macrosiphoniella kikunshana* Takahashi, 1937	1C
305.			*Macrosiphoniella hikosanensis* Moritsu, 1949	1C
306.			*Macrosiphoniella akebiae* (Shinji, 1935)	1C
307.			*Macrosiphoniella gravelii* (Van der Goot, 1917)	1C
308.			*Macrosiphoniella luteum* (Buckton, 1876)	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
309.			*Macrosiphoniella rosaeformis* (Das, 1918)	1C
310.			*Macrosiphoniella sikkimense* (Ghosh and Raychaudhuri, 1968)	1C
311.			*Macrosiphoniella pseudoluteum* Ghosh, 1969	1C
312.			*Macrosiphoniella smilacicola sikkimensis* Ghosh and Raychaudhuri, 1968	1C
313.			*Macrosiphoniella takahashii* (Eastop, 1959)	1C
314.			*Masonaphis capitophoroides* Lambers, 1966	1C
315.			*Metaphorodon polygoni* (Van der Goot, 1965)	1C
316.			*Metopolopium rubifoliae* Raychaudhuri *et al.,* 1975	1C
317.			*Melanaphis pahanensis* (Takahashi, 1950)	1C
318.			*Melanaphis bambusae* (Fullaway, 1910)	1C
319.			*Melanaphis sacchariforma indosacchari* (David, 1897)	1C
320.			*Melanaphis niger* Van der Goot, 1917	1C
321.			*Mollitrichosiphum montnum* (Van der Goot, 1917)	1C
322.			*Mollitrichosiphum nandii* Basu, 1964	1C
323.			*Mollitrichosiphum nigriabdominalis* Agarwala *et al.,* 1982	1C
324.			*Mollitrichosiphum tenuicorpus* Okajima, 1908	1C
325.			*Mollitrichosiphum trilokum* Agarwala and Ghosh, 1993	1C
326.			*Myzakkaia kuwanis* (Ghosh *et al.,* 1970)	1C
327.			*Myzus formosanus* (Basu, 1969)	1C
328.			*Myzus ornatus* Laing, 1932	1C
329.			*Myzus persicae* (Sulzer, 1776)	1C
330.			*Myzus siegesbeckicola* Strand,1929	1C
331.			*Neoacyrthosiphon holsti* (Takahashi, 1935)	1C
332.			*Neomasonaphis anaphalidis* Basu, 1964	1C
333.			*Neomasonaphis inulae* (Ghosh and Raychaudhuri, 1972)	1C
334.			*Nippolachnus querciphaga* Ghosh and Raychaudhuri, 1973	1C
335.			*Pemphigus eastopi* Mondal, 1977	1C
336.			*Pemphigus vulgaria* Raychaudhuri *et al.,* 1978	1C
337.			*Phorodon cannabis* Passerini, 1860	1C
338.			*Protrama longitarsus sclerodensus* Kumar, 1973	1B
339.			*Pseudoastegopteryx himalayensis* Ghosh *et al.,* 1974	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
340.			*Pseudoregma alexanderi* (Takahashi, 1924)	1C
341.			*Pseudoregma bucktoni* Ghosh *et al.*,1893	1C
342.			*Pseudoregma bambusicola* (Takahashi, 1971)	1C
343.			*Pseudoregma orientalis* (Agarwala *et al.*, 1982)	1C
344.			*Pseudoregma panicola* (Takahashi, 1918)	1C
345.			*Pseudoregma subgladulosa* (Lambers and Basu, 1969)	1C
346.			*Pterocomma populifoliae* (Fitch, 1851)	1C
347.			*Rhopalosiphum maidis* (Fitch, 1835)	1C
348.			*Rhopalosiphum nymphaeae* (Linnaeus, 1761)	1C
349.			*Rhopalosiphum padi* (Linnaeus, 1758)	1C
350.			*Rhopalosiphum rufiabdominalis* (Sasaki, 1899)	1C
351.			*Rhopalosiphum yoksumi* Ghosh *et al.*, 1971	1C
352.			*Rhopalosiphum smilacifoliae* (Ghosh and Raychaudhuri, 1968)	1C
353.			*Rhopalosiphum smilacifoliae* Ghosh and Raychaudhuri, 1968	1C
354.			*Schoutedenia alnicola* (Basu, 1967)	1C
355.			*Schoutedenia arunachali* Basu *et al.*, 1972	1C
356.			*Schoutedenia betulae* Mondal *et al.*, 1979	1C
357.			*Schoutedenia quercifoliae* Raychaudhuri *et al.*, 1973	1C
358.			*Schoutedenia raychaudhurii* Ghosh, 1969	1C
359.			*Schoutedenia ralumensis* Riibsaamen, 1905	1C
360.			*Schoutedenia sikkimense* Raychaudhuri *et al.*, 1973	1C
361.			*Schoutedenia tapatii* Mondal *et al.*, 1979	1C
362.			*Schizaphis graminum* (Rondoni, 1852)	1C
363.			*Schizaphis rotundiventris* (Signoret, 1860)	1C
364.			*Semiaphis heraelei* (Takahashi, 1921)	1C
365.			*Shivaphis celti* Das, 1918	1C
366.			*Sinomegoura citricola* (Vander Goot, 1917)	1C
367.			*Sinomegoura photinae* (Takahashi, 1986)	1C
368.			*Sinomegoura rhododendri* (Takahashi, 1937)	1C
369.			*Subovalomyzae leucosceptri* Basu, 1964	1C
370.			*Subovatomyzus leucosceptri* Basu, 1964	1C
371.			*Sumatraphis celti* Takahashi, 1935	1C
372.			*Taiwaoaphis dioeni* Mandal *et al.*, 1973	1C
373.			*Taiwaoaphis dineni* Mondal, *et al.*, 1979	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
374.			*Takecallis arundinariae* (Essig, 1917)	1C
375.			*Taoia indica* (Ghosh and Raychaudhuri, 1969)	1C
376.			*Tinocallis himalayensis* Ghosh *et al.,* 1971	1C
377.			*Tinocalloides montanus* Basu, 1969	1C
378.			*Tetraneura basui* Lambers, 1969	1C
379.			*Tetraneura nigriabdominalis* (Sasaki, 1899)	1C
380.			*Tetraneura sikkimensis* Raychaudhuri, *et al.,* 1978	1C
381.			*Toxoptera aurantii* (Boyer de Fonscolombe, 1841)	1C
382.			*Toxoptera citricidus* (Kirkaldy, 1907)	1C
383.			*Toxoptera odinae* (Van der Goot, 1917)	1C
384.			*Trichosiphonaphis gerberae* Ghosh and Raychaudhuri, 1972	1C
385.			*Trichosiphonaphis polygoni* (Vander Goot, 1917)	1C
386.			*Tuberocephalus sasaki* (Matsumura, 1917)	1C
387.			*Uroleucon formosanus crepidis* (Ghosh *et al.,* 1971)	1C
388.			*Uroleucon sonchi* (Linnaeus, 1767)	1C
389.			*Uroleucon pseudotallaceti* (Verma, 1969)	1C
390.			*Vesiculaphiskuwanis* Ghosh *et al.,* 1971	1C
391.			*Vesiculaphis sikkimensis* Mondal, 1979	1C
392.	Kermesidae		*Pseudopulvinaria sikkimensis* Atkinson, 1889	1C
393.	Cercopidae	Aphrophorinae	*Aphrophora bisignata* Walker, 1858	1C
394.			*Peuceptyleus sigillifer* Walker, 1851	1C
395.			*Philagra dissimilis* Distant, 1908	1C
396.			*Philagra fuciformis* Walker, 1858	1C
397.		Callitettixinae	*Callitattix versicolor* (Fabricius, 1794)	1C
398.			*Clovia bipunctata* Kirby, 1891	1C
399.			*Clovia conifera* (Walker, 1851)	1C
400.			*Clovia puncta* Walker, 1851	1C
401.			*Cosmoscarta balteata* Distant, 1914	1C
402.			*Cosmoscarta bispecularis* (White, 1844)	1C
403.			*Cosmoscarta decisa* Walker, 1858	1C
404.			*Cosmoscarta dimidiata* (Dallas, 1850)	1C
405.			*Cosmoscarta dorsalis* Walker, 1851	1C
406.			*Cosmoscarta dorsimacula* Walker, 1851	1C
407.			*Cosmoscarta egens* Walker, 1858	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
408.			*Cosmoscarta egentior* Lalleman, 1927	1C
409.			*Cosmoscarta innota* Schmidt, 1910	1C
410.			*Cosmoscarta minor* Atkinson, 1889	1C
411.			*Cosmoscarta nigra* Atkinson, 1889	1C
412.			*Cosmoscarta nigrofasciata* Atkins, 1888	1C
413.			*Cosmoscarta septempunctata* Walker, 1851	1C
414.			*Cosmoscarta thoracica* Distant, 1900	1C
415.			*Cosmoscarta trigona* Walker, 1851	1C
416.			*Cosmoscarta trifasciata* Schmidt, 1910	1C
417.			*Leptataspis moorei* Distant, 1878	1C
418.			*Leptataspis fluviceps* (Dallas, 1850)	1C
419.			*Leptataspis fruhstorferi* Schmidt, 1905	1C
420.			*Leptataspis fuscipennis* (Le Peletier and Serville, 1825)	1C
421.			*Leptataspis specialis* Lallemand, 1927	1C
422.			*Opistharsostethus menaca* Distant, 1900	1C
423.			*Opistharsostethus nigrofasciatus* Atkinson, 1889	1C
424.			*Phymatostetha basiclava* Walker, 1858	1C
425.			*Phymatostetha pudens* Walker, 1858	1C
426.			*Phymatostetha stalii* Butler, 1874	1C
427.		Cercopinae	*Abidama producta* (Walker, 1851)	1C
428.			*Paphnutius ostentus* Distant, 1916	1C
429.	Machaerotidae		*Machaerota assamensis* Distant, 1916	1C
430.	Cicadidae	Cicadinae	*Balinta octonotata octonotata* (Westwood, 1842)	1C
431.			*Basa singularis* (Walker, 1858)	1C
432.			*Callogaeana festiva festiva* (Fabricius, 1803)	1C
433.			*Cryptotympana corvus* (Walker, 1850)	1C
434.			*Cryptotympana exalbida* Distant, 1891	1C
435.			*Dundubia intemerata* Walker, 1856	1C
436.			*Dundubia mannifera* (Linn., 1754)	1C
437.			*Dundubia vaginata vaginata* (Fabricius, 1787)	1C
438.			*Gaeana consors* Atkinson, 1884	1C
439.			*Gaeana maculata maculata* (Drury, 1773)	1C
440.			*Gudaba maculata* Distant, 1912	1C
441.			*Haphsa nicomache* (Walker, 1850)	1C
442.			*Hyalessa expansa* (Walker, 1858)	1C
443.			*Leptopsaltria samia* (Walker, 1850)	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
444.			*Leptopsaltria tuberosa* (Signoret, 1847)	1C
445.			*Macrosemia saturata* (Walker, 1858)	1C
446.			*Macrosemia umbrata* (Distant, 1888)	1C
447.			*Meimuna gamameda* (Distant, 1902)	1C
448.			*Meimuna microdon* (Walker, 1850)	1C
449.			*Meimuna tripurasura* (Distant, 1881)	1C
450.			*Mogannia aurea* Fraser, 1942	1C
451.			*Mogannia effecta effecta* Distant, 1892	1C
452.			*Mogannia obliqua* Walker, 1858	1C
453.			*Mogannia venutissima venutissima* Stal, 1865	1C
454.			*Platylomia radha* (Distant, 1881)	1C
455.			*Platylomia saturata* Walker, 1858	1C
456.			*Platylomia similis* (Distant, 1888)	1C
457.			*Paranosia andersoni* (Distant, 1892)	1C
458.			*Polyneura ducalis* Westwood, 1840	1C
459.			*Pycna repanda repanda* (Linneaus, 1758)	1C
460.			*Sulphogaeana sulphurea* (Westwood, 1839)	1C
461.			*Tanna thalia* (Walker, 1850)	1C
462.			*Terpnosia abdullah* Distant, 1904	1C
463.			*Terpnosia clio* (Walker, 1850)	1C
464.			*Terpnosia confusa* Distant, 1905	1C
465.			*Terpnosia lactea* (Distant, 1887)	1C
466.			*Terpnosia psecas* (Walker, 1850)	1C
467.			*Tosena dives* (Westwood, 1842)	1C
468.			*Tosena mearesiana* (Westwood, 1842)	1C
469.			*Tosena melanoptera* (White, 1846)	1C
470.			*Tosena melanopteryx* (Kirkaldy, 1846)	1C
471.		Cicadettinae	*Graptotettix guttatus* Stal, 1866	1C
472.			Huechys phaenicura	1C
473.			*Huechys sanguinea sanguinea* (De Geer, 1773)	1C
474.			*Lycurgus subvittus* (Walker, 1850)	1C
475.			*Scieroptera splendidula cuprea* (Walker, 1870)	1C
476.	Cicadellidae	Aphrodinae	*Gurawa intermediatus* Singh-Pruthi, 1936	1C
477.			*Gurawa vexillum* Distant, 1908	1C
478.		Cicadellinae	*Bothrogonia ferruginea* (Fabricius, 1794)	1C
479.			*Bothrogonia indistincta* (Walker, 1851)	1C
480.			*Cicadella spectra* (Distant, 1853)	1C
481.			*Cofana mimica* (Distant, 1908)	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
482.			*Kolla canida* Distant,1908	1C
483.			*Kolla maculifrons* Schmidt, 1911	1C
484.			*Tettigella rubromaculata* Signoret, 1953	1C
485.			*Tettigella sikkimensis* Distant, 1908	1C
486.			*Tituria acutangulata* (Distant, 1908)	1B
487.		Deltocephalinae	*Balclutha indica* (Pruthi, 1930)	1C
488.			*Cicadula maculata* Singh-Pruthi, 1930	1C
489.			*Deltocephalus nigrifacialis* Distant, 1918	1C
490.			*Dio facialis* Distant, 1918	1C
491.			*Exitianus nanus* (Distant, 1908)	1C
492.			*Exitianus indicus* (Distant, 1908)	1C
493.			*Michalowskiya sikkimensis* Dworakowska, 1993	1C
494.			*Mitjaevia aurea* Dworakowska, 1994	1C
495.			*Mitjaevia elegantula* Dworakowska, 1994	1C
496.			*Mitjaevia sikkimensis* Dworakowska, 1994	1C
497.			*Nephotettix nigropicta* (Stal, 1859)	1C
498.			*Nephotettix virescens* Fabricius, 1803	1C
499.			*Salka elongata* Sohi and Mann, 1994	1C
500.			*Salka jarucha* Sohi and Mann, 1994	1C
501.			*Sandanella crucifera* Dworakowska, 1994	1C
502.			*Sandanella sikkimensis* Dworakowska, 1994	1C
503.			*Sikkimasca annulata* Dworakowska, 1994	1C
504.		Evacanthinae	*Evacanthus extremus* (Walker, 1851)	1C
505.			*Evacanthus repexus* (Distant, 1908)	1C
506.		Hecalinae	*Parabolocratus albomaculatus* (Distant, 1908)	1C
507.		Ledrinae	*Ledra dorsalis* Walker, 1851	1C
508.			*Ledropsis ohligens* Walker, 1858	1C
509.			*Petalocephalus cultellifera* Walker, 1856	1C
510.			*Petalocephalus hearsayi* Distant, 1908	1C
511.			*Petalocephalus latifrons* Walker, 1855	1C
512.		Megophthalminae	*Hepneriana inquiniata* Dworakowska, 1994	1C
513.			*Hepneriana nigrifrons* (Dworakowska, 1994)	1C
514.			*Igerna keyae* Viraktamath, 2011	1C
515.			*Igerna sikkima* Viraktamath, 2011	1C
516.			*Matsumurana nigrum* Dworakowska, 1994	1C
517.		Nirvaninae	*Sobrala clara* Viraktamath and Wesley, 1988	1C
518.			*Yangida basnetti* Dworakowska, 1994	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
519.			*Zyginella mandali* Dworakowska, 1994	1C
520.			*Zyginella nadobna* Dworakowska, 1994	1C
521.		Typhlocybinae	*Agurihana decorata* Dworakowska, 1994	1C
522.			*Agurihana hybrida* Dworakowska, 1994	1C
523.			*Agurihana pteridis* Dworakowska, 1994	1C
524.			*Alberoides elsae* Dworakowska, 1994	1C
525.			*Alberoides gallus* Dworakowska, 1994	1C
526.			*Alberoides irmgardae* Dworakowska, 1994	1C
527.			*Alberoides perplexus* Dworakowska, 1994	1C
528.			*Alberoides victor* Dworakowska, 1994	1C
529.			*Alberoides wesleyi* Dworakowska, 1994	1C
530.			*Alnetoidia defecta* Dworakowska, 1994	1C
531.			*Alnetoidia sikkimensis* Dworakowska, 1994	1C
532.			*Alnetoidia pavo* Dworakowska, 1994	1C
533.			*Alnetoidia triseta* Dworakowska, 1994	1C
534.			*Arboridia gracilis* Dworakowska, 1994	1C
535.			*Arboridia inconspicua* Dworakowska, 1994	1C
536.			*Arboridia salka* Dworakowska, 1994	1C
537.			*Atkinsoniella canidia* Distant, 1908	1C
538.			*Atkinsoniella mungphuensis* (Distant, 1908)	1C
539.			*Atkinsoniella oppnens* (Walker, 1851)	1C
540.			*Atkinsoniella similis* Schmidt, 1911	1C
541.			*Caknesia glarusa* Dworakowska, 1994	1C
542.	Membracidae	Leptocentrini	*Gargara majuscula* Distant, 1908	1C
543.			*Gargara rivulata* Distant, 1908	1C
544.			*Gargara sikhimensis* Distant, 1908	1C
545.			*Telingana canescens* (Buckton, 1903)	1C
546.	Achilidae		*Faventilla pustulata* Walker,1857	1C
547.			*Usana abdominalis* Dlabola, 1906	1C
548.	Cixiidae		*Andes inornata* Distant, 1911	1C
549.			*Andes plagosa* Distant, 1911	1C
550.			*Andes variolosa* Distant, 1911	1C
551.			*Andes strigipennis* Distant, 1911	1C
552.			*Andes suknanicus* Distant, 1911	1C
553.			*Brixia inornata* Distant, 1906	1C
554.			*Brixia plagosa* Distant, 1906	1C
555.			*Brixia variolosa* Distant, 1906	1C
556.			*Oliarus punctipennis* Distant, 1911	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
557.	Dictyopharidae		*Dictyophara nilgiriensis* Distant, 1906	1C
558.	Eurybrachidae		*Loxocephala decora* Walker, 1851	1C
559.	Flatidae		*Cerynia maria* (White, 1846)	1C
560.			*Cisatra serva* Melichar, 1902	1C
561.			*Flatida marginella* (Oliver, 1791)	1C
562.			*Flatida viridula* Atkinson, 1889	1C
563.			*Flatoides servus* Melichar, 1902	1C
564.			*Lawana conspersa* Walker, 1851	1C
565.			*Phromnia marginella* (Olivier, 1791)	1C
566.			*Salurnis marginellus* Guer., 1834	1C
567.	Fulgoridae		*Aphaena amabilis* Hope, 1843	1C
568.			*Aphaena apicata* Distant, 1906	1C
569.			*Aphaena aurantia* Hope, 1840	1C
570.			*Aphaena submaculata* Duncan, 1840	1C
571.			*Fulgora candelaria* Linnaeus, 1746	1C
572.			*Fulgora spinolae* Westwood, 1842	1C
573.			*Penthicodes atkinsoni* Schmidt, 1885	1C
574.			*Penthicodes pulchella* (Guérin-Méneville, 1838)	1C
575.			*Penthicodes variegata* Guerin-Meneville, 1829	1C
576.			*Phenax variegara* (Olivier, 1791)	1C
577.			*Polydictya affinis* Atkinson, 1889	1C
578.			*Pyrops affinis* Westwood, 1838	1C
579.			*Pyrops candelaria* (Linnaeus, 1758)	1C
580.			*Pyrops clavata* (Westwood, 1839)	1C
581.			*Saiva cardinalis* (Butler, 1874)	1C
582.			*Saiva gemmata* (Westwood, 1848)	1C
583.	Iassidae		*Vishnuloka prominula* Distant, 1906	1C
584.	Nogodinidae		*Indogaetulia nigrovenosa* Melichar, 1898	1C
585.	Ricaniidae		*Euricania ocella* Walker, 1851	1C
586.			*Pochazia atkinsoni* Distant, 1906	1C
587.			*Pochazia guttifera* Walker, 1851	1C
588.			*Ricania apicalis* (Walker, 1851)	1C
589.	Tropiduchidae		*Cixiopsis atkinsoni* (Distant, 1906)	1C
590.			*Kallitaxila sinica* Walker, 1851	1C
591.	Miridae	Bryocorinae	*Helopeltis theivora* Waterhouse, 1886	1C
592.			*Pachypeltis dudgeoni* (Kirkaldy, 1902)	1C
593.		Deraeocorinae	*Deraeocoris ornandus* Distant, 1904	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
594.			*Deraeocoris rufus* Distant, 1904	1C
595.		Mirinae	*Allorhinocoris virescens* (Poppius, 1915)	1C
596.			*Compseuta russelii* Livingstone, 1972	1C
597.			*Dolichomiris antennatis* (Distant, 1904)	1C
598.			*Liocapsidea nitidicollis* Poppius, 1915	1C
599.			*Lygus nigricornis* Poppius, 1914	1C
600.			*Lygus sikkimensis* Poppius, 1914	1C
601.			*Peltidolygus puncticollis* (Poppius, 1915)	1C
602.			*Philostephanus elongatus* (Poppius, 1915)	1C
603.			*Vairocanamiris jordiribesi* Yasunaga 2011	1C
604.	Nabidae		*Gorpis humeralis* (Distant, 1904)	1C
605.			*Nabis funebris* Distant, 1904	1C
606.			*Nabis indicus* Stål, 1873	1C
607.			*Nabis corallinus* (Stål, 1873)	1C
608.	Reduviidae	Ectrichodiinae	*Ectrychotes scutellaris* (Breddin, 1903)	1C
609.			*Scadra scutellaris* Distant, 1903	1C
610.		Harpactorinae	*Biasticus nigricollis* (Dallas, 1850)	1C
611.			*Biasticus fuliginosus* Reuter, 1887	1C
612.			*Coranus emodicus* Kintshenko, 1931	1C
613.			*Coranus siva* Kirkaldy, 1891	1C
614.			*Epidaus atrispinus* Distant,1902	1C
615.			*Epidaus famulus* (Stal, 1863)	1C
616.			*Endochus atricapillus* Distant, 1902	1C
617.			*Endochus inornatus* Stal, 1866	1C
618.			*Henricohahnia montana* (Distant, 1903)	1C
619.			*Henricohahnia spinosa* Distant, 1903	1C
620.			*Henricohahnia tinctoria* Miller, 1954	1C
621.			*Henricohahnia typica* Distant, 1903	1C
622.			*Henricohahnia viroopa* Muraleedharan, 1976	1C
623.			*Isyndus reticulates reticulatus* (Stal, 1868)	1C
624.			*Karenocoris inermis* (Distant, 1903)	1C
625.			*Macracanthopsis nodipes* Reuter, 1881	1C
626.			*Paracydnocoris distinctus* Miller, 1953	1C
627.			*Platerus pitcheri* Distant, 1903	1C
628.			*Panthous excellens* Stal, 1863	1C
629.			*Polididus armatissimus* Stal, 1859	1C
630.			*Pristhesancus zetterstedti* Stal, 1859	1C
631.			*Rhynocoris costålis* (Stal, 1866)	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
632.			*Rhynocoris marginellus* (Fabricius, 1803)	1C
633.			*Rhynocoris squalus* (Distant, 1902)	1C
634.			*Rhynocoris tristicolor* (Reuter, 1881)	1C
635.			*Scipinia horrida* (Stal, 1861)	1C
636.			*Sphedanolestes funeralis* Distant, 1903	1C
637.			*Sphedanolestes indicus* Reuter, 1881	1C
638.			*Sphedanolestes pubinotum* Reuter, 1881	1C
639.			*Sphedanolestes pulchriventris* (Stal, 1863)	1C
640.			*Vesbius sanguinosus* Stal, 1874	1C
641.		Reduviinae	*Acanthaspis annulicornis* Stål, 1874	1C
642.			*Acanthaspis apicata* Distant, 1903	1C
643.			*Acanthaspis flavipes* Stal, 1855	1C
644.			*Acanthaspis fulvipes* (Dallas, 1850)	1C
645.			*Acanthaspis lineatipes* Reuter, 1881	1C
646.			*Acanthaspis lutipes* Walker, 1873	1C
647.			*Acanthaspis rama* Distant, 1904	1C
648.			*Acanthaspis sexguttata* (Fabricius, 1775)	1C
649.			*Reduvius delicatula* Distant, 1909	1C
650.			*Reduvius knyvetti* Distant, 1904	1C
651.			*Tapeinus fuscipennis* (Stal, 1874)	1C
652.			*Velitra rubropicta* (Amy. and Serv., 1843)	1C
653.		Stenopodainae	*Canthesancus gula* Stal, 1863	1C
654.			*Oncocephalus micropterus* Horvath, 1889	1C
655.			*Oncocephalus morosus* Distant, 1904	1C
656.			*Pygolampis unicolor* Walker, 1873	1C
657.			*Sastrapada baerensprungi* (Stal, 1859)	1C
658.		Peiratinae	*Ectomocoris atrox* (Stal, 1855)	1C
659.			*Ectomocoris tibialis* Distant, 1904	1C
660.			*Ectomocoris posticus* Walker, 1873	1C
661.			*Peirates flavipes* (Walker, 1873)	1C
662.	Veliidae	Microveliinae	*Microvelia diluta* Distant, 1909	1C
663.		Rhagoveliinae	*Rhagovelia sumatrensis* Lundblad, 1933	1C
664.	Gerridae	Eotrechinae	*Eotrechus brevipes* Andersen, 1982	1C
665.			*Eotrechus terrestris* Andersen, 1982	1C
666.		Gerrinae	*Gerris lepcha* Distant, 1910	1C
667.			*Gerris spinolae* Lethierry and Severin, 1896	1C
668.			*Gerris gracilicornis* (Horvath, 1879)	1C
669.		Halobatinae	*Metrocoris deceptor* Basu, *et al.*, 2016	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
670.			*Metrocoris ståli* (Dohrn, 1860)	1C
671.			*Ptilomera himalayensis* Hungerford and Matsuda, 1858	1C
672.	Hebridae	Hyrcaninae	*Hyracanus capitatus* Distant 1910	1C
673.	Corixidae	Corixinae	*Agraptocorixa hyalinipennis* (Fabricius, 1803)	1C
674.			*Hesperocorixa occulata* (Lundblad, 1929)	1C
675.			*Sigara pruthiana* (Hutchinson, 1940)	1C
676.			*Corixa punctata* (Illiger, 1807)	1C
677.			*Callicorixa gebleri* (Feiber, 1848)	1C
678.	Aphelocheiridae		*Aphelocheirus pradhanae* Zettel, 1998	1C
679.	Notonectidae	Anisopinae	*Anisops balillifrons* Lundblad,1933	1C
680.			*Anisops kuroiwae* Matsumura, 1915	1C
681.	Gelastocoridae	Nerthrinae	*Nerthra asiatica* (Horvath, 1892)	1C
682.			*Nerthra indica* (Atkinson, 1888)	1C
683.			*Nerthra turgidula* (Distant, 1906)	1C
684.	Aradidae		*Brachyrhynchus feanus* Bergroth, 1889	1C
685.			*Brachyrhynchus membranaceus* (Fabricius, 1798)	1C
686.	Alydidae	Alydinae	*Riptortus strenuus* Horváth, 1889	1C
687.	Coreidae	Coreinae	*Acanthocoris anticus* Walker, 1871	1B
688.			*Anoplocnemis compressa* Dallas 1852	1B
689.			*Anoplocnemis phasicana* Fabricius,1781	1C
690.			*Aschistocoris brevicornis* (Dallas, 1852)	1C
691.			*Cloresmus antennatus* Distant, 1908	1B
692.			*Cloresmus khasianus* Distant, 1901	1C
693.			*Cloresmus modestus* Distant, 1901	1C
694.			*Cletus bipunctatus* (Herrich-Schäffer, 1840)	1B
695.			*Cletus punctulatus* (Westwood, 1842)	1B
696.			*Dalader acuticosta* Amyot and Servile, 1843	1C
697.			*Dalader planiventris* (Westwood, 1842)	1C
698.			*Derepteryx feana* Distant, 1902	1C
699.			*Derepteryx grayi* White, 1839	1C
700.			*Haidara producta* Distant, 1908	1C
701.			*Helcomeria spinosa* (Signoret, 1851)	1C
702.			*Homoeocerus albiguttulus* Stal, 1873	1C
703.			*Homoeocerus angulatus* Westwood, 1842	1C
704.			*Homoeocerus biguttatus* Westwood, 1842	1C
705.			*Homoeocerus concisus* Walker, 1871	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
706.			*Homoeocerus fasciolatus* Stal, 1873	1C
707.			*Homoeocerus indus* Distant, 1918	1C
708.			*Homoeocerus montanus* Distant, 1901	1C
709.			*Homoeocerus punctum* Dallas, 1852	1C
710.			*Homoeocerus relatus* Distant, 1908	1C
711.	Heterogastridae		*Dinomachus sikhimensis* Distant, 1904	1C
712.	Lygaeidae	Lygaeinae	*Blachia ducalis* Walker 1867	1C
713.		Orsillinae	*Nysius inconspicuus* Distant, 1904	1C
714.	Rhyparochromidae	Rhyparochrominae	*Atkinsonianus reticulatus* Distant, 1909	1C
715.			*Botocudo picturatus* (Distant, 1893)	1C
716.			*Dieuches alternatus* Horvath, 1889	1C
717.			*Drymus bicolour* Distant, 1901	1C
718.			*Eucosmetus annulicoris* Kiritshenko, 1931	1C
719.			*Hexatrichocoris melleus* Kiritshenko, 1931	1C
720.			*Naudarensia distantii* Kiritshenko, 1931	1C
721.			*Orthaea cephalotes* Kirichenko, 1931	1C
722.	Largidae		*Physopelta quadriguttata* Bergroth, 1894	1C
723.	Pyrrhocoridae		*Antilochus pygmaeus* Distant, 1904	1C
724.			*Dindymus dembickyi* Stehlik, 2006	1C
725.			*Dindymus thunbergi* (Stal, 1855)	1C
726.			*Pyrrhocoris apterus* (Linnaeus, 1758)	1C
727.	Acanthosomatidae	Acanthosomatinae	*Elasmostethus recurvum* (Dallas, 1851)	1C
728.			*Sastragala binotata* Distant, 1887	1C
729.			*Sastragala edessoides* Distant, 1900	1C
730.			*Sastragala parmata* Distant, 1887	1C
731.			*Sastragala rufispina* Distant, 1887	1C
732.	Cydnidae	Cydninae	*Macroscytus expansus* Sign., 1882	1C
733.			*Macroscytus foveolus* (Dallas, 1851)	1C
734.			*Tominotus punctipes* Stal, 1876	1C
735.	Dinidoridae	Dinidorinae	*Coridius chinensis* (Dallas, 1851)	1C
736.			*Coridius nepalensis* Westwood, 1837	1C
737.			*Coridius obscurus* (Fabricius, 1775)	1C
738.			*Coridius siecifolia* Westwood, 1837	1C
739.			*Cyclopelta obscura* (Lepeletier and Serville, 1828)	1C
740.			*Cyclopelta siccifolia* Westwood, 1837	1C
741.			*Aeschrocoris obscurus* Dallas, 1851	1C
742.			*Aeschrocoris tuberculatus* Stal, 1865	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
743.			*Antestiopsis anchora* (Thunberg, 1783)	1C
744.			*Antestiopsis cruciata* (Fabricius, 1775)	1C
745.			*Antestiopsis modificata* Distant, 1902	1C
746.			*Antestiopsis pulchra* (Dallas, 1851)	1C
747.			*Agaeus mimus* Distant, 1893	1C
748.			*Agaeus tessellatus* Dallas, 1851	1C
749.			*Alcimocoris jlavicornis* Distant, 1902	1C
750.			*Alcimocoris parvus* Distant, 1902	1C
751.			*Blachia manifesta* Distant, 1887	1C
752.			*Cazira ulcerata* Burmeister, 1835	1C
753.			*Cazira verrucosa* Westwood, 1834	1C
754.			*Aednus ventralis* Dallas, 1851	1C
755.			*Critheus indicus* (Distant, 1900)	1C
756.			*Dalpada affinis* Dallas, 1851	1C
757.			*Dalpada anandalei* Distant, 1908	1C
758.			*Dalpada jugatoria* (Lethierry, 1891)	1C
759.			*Dalpada oculata* (Fabricius, 1775)	1C
760.			*Dalpada versicolor* (Herrich-Schäffer, 1840)	1C
761.			*Dunnius fulvescens* (Dallas, 1851)	1C
762.			*Dunnius bellus* Distant, 1900	1C
763.			*Dunnius fulvescens* Dallas, 1851	1C
764.			*Erthesina acuminata* Dallas, 1851	1C
765.			*Erthesina robertsi* Distant, 1908	1C
766.			*Eurydema lituriferum* Walker, 1867	1C
767.			*Eurydema pulchrum* (Westwood, 1837)	1C
768.			*Eysarcoris guttiger* (Thunberg, 1783)	1C
769.			*Eysarcoris montivagus* (Distant, 1904)	1C
770.			*Gynenica affinis* Distant, 1880	1C
771.			*Gonopsis coccinea* Walker, 1868	1C
772.			*Gonopsis rubescens* Distant, 1887	1C
773.			*Halyomorpha murrea* Distant, 1887	1C
774.			*Hoplistodera incisa* Distant, 1887	1C
775.			*Hoplistodera virescens* Dallas, 1851	1C
776.			*Hoplistodera atkinsoni* Distant, 1900	1C
777.			*Hoplistodera formosa* Westwood, 1837	1C
778.			*Hoplistodera varipennis* Westwood, 1837	1C
779.			*Nevisanus alternans* (Westwood, 1837)	1C
780.			*Otantestia heterospila* (Walker, 1867)	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
781.			*Otantestia modificata* (Distant, 1887)	1C
782.			*Oncinoproctus griseolus* Breddin, 1904	1C
783.			*Picromerus obtusus* (Walker, 1867)	1C
784.			*Palomena viridissima* (Poda, 1761)	1C
785.			*Piezodorus rubrofasciatus* Fabricius, 1787	1C
786.			*Placosternum taurus* Fabricius, 1781	1C
787.			*Priassus carinatus* (Horvath, 1889)	1C
788.			*Paterculus affinis* Distant, 1900	1C
789.			*Podops serrata* Voll., 1863	1C
790.			*Prionaca nigrescens* Distant, 1911	1C
791.			*Rolstoniellus spinosus* (Distant, 1887)	1C
792.			*Rolstoniellus taurus* (Distant, 1911)	1C
793.			*Rhynchocoris humeralis* (Thunberg, 1783)	1C
794.			*Scylax macrinus* Distant, 1887	1C
795.			*Sciocoris funebris* Distant, 1918	1C
796.			*Sciocoris indicus* Dallas, 1851	1C
797.			*Scylax porrectus* (Distant, 1887)	1C
798.			*Tetroda histeroides* (Fabricius, 1798)	1C
799.			*Zangis beryllus* (Westwood, 1837)	1C
800.			*Zangis dorsalis* (Dohrn., 1860)	1C
801.	Plataspidae	Plataspidinae	*Brachyplatys carolinae* Atkinson, 1889	1C
802.			*Brachyplatys subaeneus* (Westwood, 1837)	1C
803.			*Brachyplatys vahlii* (Fabricius, 1787)	1C
804.			*Coptosoma lebongensis* Distant, 1918	1C
805.			*Coptosoma lethierryi* Montandon, 1892	1C
806.	Scutellaridae	Odontoscelinae	*Arctocoris incisus* Stål, 1873	1C
807.		Scutellerinae	*Brachyaulax oblonga* (Westwood, 1837)	1C
808.			*Chrysocoris fascialis* (White, 1842)	1C
809.			*Chrysocoris grandis* (Thunberg, 1783)	1C
810.			*Chrysocoris stolli* (Wolf, 1801)	1C
811.			*Poecilocoris druraei* (Linnaeus, 1771)	1C
812.			*Poecilocoris hardwicki* (Westwood, 1837)	1C
813.			*Poecilocoris interruptus* (Westwood, 1837)	1C
814.			*Scutellera fasciata* (Panzer, 1797)	1C
815.	Tessarotomidae	Tessaratominae	*Eusthenes cupreus* (Westwood, 1837)	1C
816.			*Pycanum ponderosum* Stål, 1854	1C
817.	Urostylidae	Urostylidinae	*Urochela discrepans* Walker, 1867	1C
818.			*Urochela pulchra* Stal, 1887	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
819.			*Urolabida grayii* (White, 1839)	1C
820.			*Urolabida histrionica* (Westwood, 1837)	1C
821.			*Urostylis fumigata* Walker, 1867	1C
822.			*Urostylis pallida* Dallas, 1851	1C
823.			*Urostylis punctigera* Westwood, 1837	1C
	Order HYMENOPTERA			
824.	Aphelinidae		*Aphelinus gossypii* Timberlake, 1924	1A,1B
825.	Eulophidae		*Elachertus kashmiricus* Narendran, 2011	1A,1B
826.			*Eulophus razaki* Narendran, 2011	1A,1B
827.	Perilampidae		*Perilampus inimicus* Crawford, 1910	1A,1B
828.	Pteromalidae		*Dibrachys microgastri* (Bouché, 1834)	1A,1B
829.	Ichneumonidae		*Ophion dentatus* Smith, 1878	1A,1B
830.	Formicidae		*Prionopelta kraepelini* Forel, 1905	1A,1B
831.			*Chronoxenus dalyi* (Forel, 1895)	1A,1B
832.			*Chronoxenus myops* (Forel, 1895)	1A,1B
833.			*Chronoxenus wroughtonii* (Forel, 1895)	1A,1B
834.			*Dolichoderus thoracicus* (Smith, 1860)	1A,1B
835.			*Tapinoma himalaica* Bharti, Kumar and Dubovikoff, 2013	1A,1B
836.			*Tapinoma melanocephalum* (Fabricius, 1793)	1A,1B
837.			*Tapinoma wroughtonii* Forel, 1904	1A,1B
838.			*Technomyrmex albipes* (Smith, 1861)	1A,1B
839.			*Aenictus aitkenii* Forel, 1901	1A,1B
840.			*Aenictus ceylonicus* (Mayr, 1866)	1A,1B
841.			*Aenictus clavatus* Forel, 1901	1A,1B
842.			*Aenictus doryloides* Wilson, 1964	1A,1B
843.			*Aenictus pachycerus* (Smith, 1858)	1A,1B
844.			*Cerapachys biroi* Forel, 1907	1A,1B
845.			*Cerapachys longitarsus* (Mayr, 1879)	1A,1B
846.			*Dorylus labiatus* Shuckard, 1840	1A,1B
847.			*Dorylusorientalis* Westwood, 1835	1A,1B
848.			*Dorylus orientalis obscuriceps* Santschi, 1920	1A,1B
849.			*Camponotus aethiops cachmiriensis* Emery, 1925	1A,1B
850.			*Camponotus albosparsus* Bingham, 1903	1A,1B
851.			*Camponotus buddhae* Forel, 1892	1A,1B
852.			*Camponotus compressus* (Fabricius, 1787)	1A,1B
853.			*Camponotus himalayanus* Forel, 1893	1A,1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
854.			*Camponotus mitis* (Smith, 1858)	1A,1B
855.			*Camponotus nirvanae* Forel, 1893	1A,1B
856.			*Camponotus opaciventris* Mayr, 1879	1A,1B
857.			*Camponotus parius* Emery, 1889	1A,1B
858.			*Camponotus rufoglaucus* (Jerdon, 1851)	1A,1B
859.			*Camponotus socrates* Forel, 1904	1A,1B
860.			*Camponotus sylvaticus basalis* Smith, 1878	1A,1B
861.			*Camponotus sylvaticus paradichrous* Emery, 1925	1A,1B
862.			*Camponotus wasmanni mutilarius* Emery, 1893	1A,1B
863.			*Cataglyphis cugiai* Menozzi, 1939	1A,1B
864.			*Cataglyphis setipes* (Forel, 1894)	1A,1B
865.			*Formica candida* Smith, 1878	1A,1B
866.			*Formica clara* Forel, 1886	1A,1B
867.			*Formica cunicularia* Latreille, 1798	1A,1B
868.			*Formica fusca* Linnaeus, 1758	1A,1B
869.			*Formica gagates* Latreille, 1798	1A,1B
870.			*Formica gagatoides* Ruzsky, 1904	1A,1B
871.			*Formica kashmirica* Starcke, 1935	1A,1B
872.			*Formica picea* Nylander, 1846	1A,1B
873.			*Formica polyctena* Foerster, 1850	1A,1B
874.			*Formica rufibarbis* Fabricius, 1793	1A,1B
875.			*Formica sanguinea* Latreille, 1798	1A,1B
876.			*Formica truncorum* Fabricius, 1804	1A,1B
877.			*Lasius alienoflavus* Bingham, 1903	1A,1B
878.			*Lasius alienus* (Foerster, 1850)	1A,1B
879.			*Lasius bicornis* (Foerster, 1850)	1A,1B
880.			*Lasius brunneus* (Latreille, 1798)	1A,1B
881.			*Lasius himalayanus* Bingham, 1903	1A,1B
882.			*Lasius lawarai* Seifert, 1992	1A,1B
883.			*Lasius niger* (Linnaeus, 1758)	1A,1B
884.			*Lasius wittmeri* Seifert, 1992	1A,1B
885.			*Lepisiota bipartita* (Smith, 1861)	1A,1B
886.			*Lepisiota capensis* (Mayr, 1862)	1A,1B
887.			*Lepisiota capensis lunaris* (Emery, 1893)	1A,1B
888.			*Lepisiota capensis simplex* (Forel, 1892)	1A,1B
889.			*Lepisiota frauenfeldi integra* (Forel, 1894)	1A,1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
890.			*Lepisiota opaca* (Forel, 1892)	1A,1B
891.			*Lepisiota opaca pulchella* (Forel, 1892)	1A,1B
892.			*Lepisiota sericea* (Forel, 1892)	1B
893.			*Nylanderia bourbonica* (Forel, 1886)	1A,1B
894.			*Nylanderia indica* (Forel, 1894)	1A,1B
895.			*Nylanderia smythiesii* (Forel, 1894)	1A,1B
896.			*Nylanderia taylori* (Forel, 1894)	1A,1B
897.			*Oecophylla smaragdina* (Fabricius, 1775)	1A,1B
898.			*Paraparatrechina aseta* (Forel, 1902)	1A,1B
899.			*Paratrechina longicornis* (Latreille, 1802)	1A,1B
900.			*Plagiolepis balestrierii* Menozzi, 1939	1A
901.			*Plagiolepis dichroa* Forel, 1902	1A,1B
902.			*Plagiolepis jerdonii* Forel, 1894	1A,1B
903.			*Polyrhachis exercita* (Walker, 1859)	1A,1B
904.			*Polyrhachis illaudata* Walker, 1859	1A,1B
905.			*Polyrhachis lacteipennis* Smith, 1858	1A,1B
906.			*Polyrhachis menelas* Forel, 1904	1A,1B
907.			*Polyrhachis punctillata smythiesii* Forel, 1895	1A,1B
908.			*Pseudolasius machhediensis* Bharti, Gul and Sharma, 2012	1A,1B
909.			*Aphaenogaster beesoni* Donisthorpe, 1933	1A,1B
910.			*Aphaenogaster cristata* (Forel, 1902)	1A,1B1A,1B
911.			*Aphaenogaster feae* Emery, 1889	1A,1B
912.			*Aphaenogaster rothneyi* (Forel, 1902)	1A,1B
913.			*Aphaenogaster sagei* (Forel, 1902)	1A,1B
914.			*Aphaenogaster sagei* pachei (Forel, 1906)	1A,1B
915.			*Aphaenogaster smythiesii* (Forel, 1902)	1A,1B
916.			*Aphaenogaster smythiesii prudens* (Forel, 1902)	1A,1B
917.			*Cardiocondyla minutior* Forel, 1899	1A,1B
918.			*Cardiocondyla wroughtonii* (Forel, 1890)	1A,1B
919.			*Carebara affinis* (Jerdon, 1851)	1A,1B
920.			*Carebara dentata* Bharti and Kumar, 2013	1A,1B
921.			*Carebara propomegata* Bharti and Kumar, 2013	1A,1B
922.			*Carebara rectangulata* Bharti and Kumar, 2013	1A,1B
923.			*Carebara spinata* Bharti and Kumar, 2013	1A,1B
924.			*Cataulacus taprobanae* Smith, 1853	1A,1B
925.			*Crematogaster anthracina* Smith, 1857	1A,1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
926.			*Crematogaster binghamii* Forel, 1904	1A,1B
927.			*Crematogaster biroi* Mayr, 1897	1A,1B
928.			*Crematogaster biroi smythiesii* Forel, 1902	1A,1B
929.			*Crematogaster flava* Forel, 1886	1A,1B
930.			*Crematogaster politula* Forel, 1902	1A,1B
931.			*Crematogaster rogenhoferi* Mayr, 1879	1A,1B
932.			*Crematogaster rothneyi* Mayr, 1879	1A,1B
933.			*Crematogaster sagei* Forel, 1902	1A,1B
934.			*Crematogaster subnuda* Mayr, 1879	1A,1B
935.			*Lophomyrmex ambiguus* Rigato, 1994	1A,1B
936.			*Lophomyrmex bedoti* Emery, 1893	1A,1B
937.			*Lophomyrmex quadrispinosus* (Jerdon, 1851)	1A,1B
938.			*Mayriella transfuga* Baroni Urbani, 1977	1A,1B
939.			*Meranoplus bicolor* (Guerin-Meneville, 1844)	1A,1B
940.			*Messor himalayanus* (Forel, 1902)	1A,1B
941.			*Messor instabilis* (Smith, 1858)	1A,1B
942.			*Messor semirufus* (Andre, 1883)	1A,1B
943.			*Monomorium atomum* Forel, 1902	1A,1B
944.			*Monomorium floricola* (Jerdon, 1851)	1A,1B
945.			*Monomorium indicum* Forel, 1902	1A,1B
946.			*Monomorium luisae* Forel, 1904	1A,1B
947.			*Monomorium orientale* Mayr, 1879	1A,1B
948.			*Monomorium pharaonis* (Linnaeus, 1758)	1A,1B
949.			*Monomorium sagei* Forel, 1902	1A,1B
950.			*Myrmica aimonissabaudiae* Menozzi, 1939	1A,1B
951.			*Myrmica cachmiriensis* Forel, 1904	1A,1B
952.			*Myrmica elmesi* Bharti and Sharma, 2011	1A,1B
953.			*Myrmica ereptrix* Bolton, 1988	1A,1B
954.			*Myrmica foreliana* Radchenko and Elmes, 2001	1A,1B
955.			*Myrmica fortior* Forel, 1904	1A,1B
956.			*Myrmica hecate* Weber, 1947	1A,1B
957.			*Myrmica longisculpta* Bharti and Sharma, 2011	1A,1B
958.			*Myrmica nitida* Radchenko and Elmes, 1999	1A,1B
959.			*Myrmica ordinaria* Radchenko and Elmes, 1999	1A,1B
960.			*Myrmica petita* Radchenko and Elmes, 1999	1A,1B
961.			*Myrmica radchenkoi* Bharti and Sharma, 2011	1A,1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
962.			*Myrmica rhytida* Radchenko and Elmes, 1999	1A,1B
963.			*Myrmica rugosa* Mayr, 1865	1A,1B
964.			*Myrmica rupestris* Forel, 1902	1A,1B
965.			*Myrmica smythiesii* Forel, 1902	1A,1B
966.			*Myrmica varisculpta* Radchenko and Elmes, 2009	1A,1B
967.			*Myrmica wardi* Radchenko and Elmes, 1999	1A,1B
968.			*Myrmica williamsi* Radchenko and Elmes, 1999	1A,1B
969.			*Myrmicaria brunnea* Saunders, 1842	1A,1B
970.			*Pheidole binghamii* Forel, 1902	1A,1B
971.			*Pheidole fervens* Smith, 1858	1A,1B
972.			*Pheidole indica* Mayr, 1879	1A,1B
973.			*Pheidole jucunda* Forel, 1885	1A,1B
974.			*Pheidole jucunda* fossulata Forel, 1902	1A,1B
975.			*Pheidole latinoda* Roger, 1863	1A,1B
976.			*Pheidole latinoda angustior* Forel, 1902	1A,1B
977.			*Pheidole latinoda major* Forel, 1885	1A,1B
978.			*Pheidole parva* Mayr, 1865	1A,1B
979.			*Pheidole sagei* Forel, 1902	1A,1B
980.			*Pheidole sharpi* Forel, 1902	1A,1B
981.			*Pheidole singaporensis* Ozdikmen, 2010	1A,1B
982.			*Pheidole smythiesii* Forel, 1902	1A,1B
983.			*Pheidole spathifera* Forel, 1902	1A,1B
984.			*Pheidole spathifera aspatha* Forel, 1902	1A,1B
985.			*Pheidole watsoni* Forel, 1902	1A,1B
986.			*Pheidole woodmasoni* Forel, 1885	1A,1B
987.			*Recurvidris recurvispinosa* (Forel, 1890)	1A,1B
988.			*Solenopsis geminata* (Fabricius, 1804)	1A,1B
989.			*Stenamma kashmirense* Baroni Urbani, 1977	1A,1B
990.			*Strumigenys membranifera* Emery, 1869	1A,1B
991.			*Temnothorax desioi* (Menozzi, 1939)	1A,1B
992.			*Temnothorax desioi melanicus* (Menozzi, 1939)	1A,1B
993.			*Temnothorax fultonii* (Forel, 1902)	1A,1B
994.			*Temnothorax himachalensis* Bharti, Gul and Schulz, 2012	1A,1B
995.			*Temnothorax kashmirensis* Bharti, Gul and Schulz, 2012	1A,1B
996.			*Temnothorax rothneyi* (Forel, 1902)	1A,1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
997.			*Temnothorax wroughtonii* (Forel, 1904)	1A,1B
998.			*Temnothorax elisabethae* Forel, 1904	1A,1B
999.			*Temnothorax lanuginosum* Mayr, 1870	1A,1B
1000.			*Temnothorax simillimum* (Smith, 1851)	1A,1B
1001.			*Temnothorax smithi* Mayr, 1879	1A,1B
1002.			*Temnothorax walshi* (Forel, 1890)	1A,1B
1003.			*Trichomyrmex aberrans* (Forel, 1902)	1A,1B
1004.			*Trichomyrmex destructor* (Jerdon, 1851)	1A,1B
1005.			*Trichomyrmex glaber* (Andre, 1883)	1A,1B
1006.			*Trichomyrmex scabriceps* (Mayr, 1879)	1A,1B
1007.			*Anochetus cryptus* Bharti and Wachkoo, 2013	1A,1B
1008.			*Anochetus graeffei* Mayr, 1870	1A,1B
1009.			*Anochetus madaraszi* Mayr, 1897	1A,1B
1010.			*Anochetus validus* Bharti and Wachkoo, 2013	1A,1B
1011.			*Bothroponera sulcata* (Mayr, 1867)	1A,1B
1012.			*Bothroponera jerdonii* (Forel, 1900)	1A,1B
1013.			*Bothroponera luteipes* (Mayr, 1862)	1A,1B
1014.			*Cryptopone subterranea* Bharti and Wachkoo, 2013	1A,1B
1015.			*Harpegnathos venator* (Smith, 1858)	1A,1B
1016.			*Hypoponera assmuthi* (Forel, 1905)	1A,1B
1017.			*Hypoponera confinis* (Roger, 1860)	1A,1B
1018.			*Hypoponera kashmirensis* Bharti, Akbar, Wachkoo and Singh, 2015	1A,1B
1019.			*Hypoponera ragusai* (Emery, 1894)	1A,1B
1020.			*Leptogenys chinensis* (Mayr, 1870)	1A,1B
1021.			*Leptogenys diminuta* (Smith, 1857)	1A,1B
1022.			*Leptogenys diminuta laeviceps* (Smith, 1857)	1A,1B
1023.			*Myopias shivalikensis* Bharti and Wachkoo, 2012	1A,1B
1024.			*Odontomachus monticola* Emery, 1892	1A,1B
1025.			*Odontomachus rixosus* Smith, 1857	1A,1B
1026.			*Odontoponera denticulata* (Smith, 1858)	1A,1B
1027.			*Platythyrea parallela* (Smith, 1859)	1A,1B
1028.			*Pseudoneoponera bispinosa* Smith, 1858	1A,1B
1029.			*Pseudoneoponera rufipes* (Jerdon, 1851)	1A,1B
1030.			*Tetraponera allaborans* (Walker, 1859)	1A,1B
1031.			*Tetraponera nigra* (Jerdon, 1851)	1A,1B
1032.			*Tetraponera rufonigra* (Jerdon, 1851)	1A,1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
	Order COLEOPTERA			
1033.	Carabidae	Broscinae	*Broscosoma gracile* Andrewes, 1927	1C
1034.			*Broscosoma ribbei* Putzeys, 1877	1C
1035.			*Chaetobroscus anomalus* (Chaudoir, 1878)	1A
1036.			*Chaetobroscus kezukai* Dostal, 1984	1B
1037.		Trechinae	*Bembidion ladas lehense* Miiller-Motzfeld, 1985	1B
1038.			*Bembidion satanas satanas* Andrewes, 1924	1A
1039.			*Bembidion hasurada hasurada* Andrewes, 1924	1A
1040.			*Bembidion himalayanum* Andrewes, 1924	1A
1041.			*Bembidion bracculatum* Bates, 1889	1A
1042.			*Bembidion gilgit gilgit* Andrewes, 1935	1A
1043.			*Bembidion insidiosum luntaka* Andrewes, 1924	1B
1044.			*Bembidion ladakense ladakense* Andrewes, 1924	1A
1045.			*Bembidion obscurellum corporaali* Netolitzky, 1935	1B
1046.		Harpalinae	*Chlaenius atratulus atratulus* Mandl, 1983	1B
1047.			*Cymindis rubriceps* Andrewes, 1934	1B
1048.			*Amara lamia* Andrewes, 1924	1B
1049.			*Amara walterheinzi* Hieke, 1988	1A
1050.			*Amara junkarensis* Hieke, 2012	1A
1051.	Dytiscidae	Agabinae	*Agabus adustus* Guignot, 1954	1B
1052.			*Agabus biguttatus* (Olivier, 1795)	1B
1053.			*Agabus bipustulatus* (Linnaeus, 1767)	1B
1054.		Colymbetinae	*Rhantus suturalis* (Macleay, 1825)	1B
1055.		Hydroporinae	*Hydroglyphus geminus* (Fabricius, 1792)	1B
1056.			*Boreonectes griseostriatus* (De Geer, 1774)	1B
1057.	Helophoridae		*Helophorus yangae* Angus, Fikáček and Jia, 2016	1B
1058.	Silphidae	Silphinae	*Thanatophilus dentiger* (Semenov, 1890)	1B
1059.	Staphylinidae	Omaliinae	*Hygrogeus minor* Coiffait, 1983	1B
1060.			*Lesteva kargilensis* Cameron, 1934	1A
1061.			*Trichodromeus pusillus* (Coiffait, 1983)	1B
1062.			*Omalium eri* Coiffait, 1982	1B
1063.			*Cephalocousya nivicola* (Thomson, 1871)	1B
1064.		Paederinae	*Astenus ladakhensis* Coiffait, 1982	1A
1065.		Staphylininae	*Rabigus ladakhensis* Coiffait, 1982	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1066.			*Quedius franzi najik* (Smetana, 1992)	1C
1067.			*Creophilus maxillosus maxillosus* (Linnaeus, 1758)	1A
1068.			*Leptacinus karakorus* Coiffait, 1975	1A
1069.	Lucanidae	Lucaninae	*Aulacostethus nepalensis* (Hope, 1831)	1C
1070.			*Aulacostethus ratiocinativus* Westwood, 1871	1C
1071.			*Neolucanus baladeva* (Hope, 1842)	1C
1072.			*Neolucanus castanopterus castanopterus* (Hope, 1831)	1C
1073.	Scarabaeidae	Aphodiinae	*Loraphodius kashmirensis* (Sharp, 1878)	1B
1074.			*Rhyssemus falcatus* Petrovitz, 1961	1A
1075.		Scarabaeinae	*Onitis castaneus* Redentenbacher, 1848	1A
1076.			*Caccobius indicus* Harold, 1867	1A
1077.			*Onthophagus taurinus* (White, 1844)	1A
1078.			*Onthophagus mopsus* (Fabricius, 1792)	1A
1079.			*Onthophagus falcifer* Harold, 1880	1C
1080.			*Onthophagus kashmirensis* Balthasar, 1966	1A
1081.		Melolonthinae	*Melolontha furcicauda* Ancey, 1881	1A
1082.			*Chilotrogus lahauli* (Chandra, 1991)	1A
1083.			*Sericania kashmirensis* (Moser, 1919)	1B
1084.		Rutelinae	*Adoretusladakanus ladakanus* Ohaus, 1914	1B
1085.			*Adoretusstoliczkae* Ohaus, 1914	1B
1086.			*Adoretosoma signaticolle* (Nonfried, 1893)	1C
1087.			*Adoretosoma perplexa perplexa* (Hope, 1839)	1C
1088.			*Adoretosoma rufiventris* Redtenbacher, 1844	1C
1089.			*Mimela marginalis* Arrow, 1908	1C
1090.			*Mimela princeps* Hope, 1842	1C
1091.			*Callistopopillia iris* (Candeze, 1869)	1B
1092.			*Popillia cupricollis* Hope, 1831	1C
1093.		Dynastinae	*Alissonotum binodulum* (Fairmaire,1891)	1A
1094.		Cetoniinae	*Protaetia impavida* (Janson, 1879)	1A
1095.			*Diphyllomorpha glaberrima* (Westwood, 1842)	1B
1096.			*Diphyllomorpha parryi* (Westwood, 1842)	1C
1097.			*Rhomborrhina resplendens heros* (Gory and Percheron, 1833)	1C
1098.	Elateridae	Elaterinae	*Sericus lahaulensis* Vats and Chauhan, 1992	1A
1099.	Cantharidae	Cantharinae	*Pakabsidia ladakhensis* Wittmer, 1997	1B
1100.			*Pakabsidia lateriemarginata* Wittmer, 1997	1B

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1101.			*Themus lahoulensis* Wittmer, 1973	1B
1102.	Dermestidae	Dermestinae	*Dermestes undulatus* Brahm, 1790	1A
1103.		Attageninae	*Attagenus gobicola* Frivaldszky, 1892	1A
1104.			*Attagenus indicus* Kalík, 1954	1A
1105.		Megatominae	*Anthrenusindicus* Kadej, Háva and Kalík, 2007	1A
1106.			*Megatoma indica* Háva, 2000	1B
1107.	Melyridae	Dasytinae	*Mimothrix trapezicollis* Majer, 1995	1B
1108.			*Ebaeus pseudothoracicus* Wittmer, 1978	1B
1109.			*Hypebaeus drassicus drassicus* Wittmer, 1978	1B
1110.			*Hypomixis ladakhensis* (Wittmer, 1978)	1B
1111.	Cryptophagidae	Cryptophaginae	*Antherophagus himalaicus* Champion, 1922	1B
1112.	Ripiphoridae	Ripiphorinae	*Macrosiagon ferruginea* (Fabricius, 1775)	1A
1113.	Tenebrionidae	Lagriinae	*Laena ladakhica* Schawaller, 2014	1A
1114.			*Pseudethas ladakhensis* Kaszab, 1978	1A
1115.			*Blaps ladakensis* Bates, 1879	1B
1116.			*Gonocephalum karakorumense* Kaszab, 1961	1B
1117.			*Gonocephalum simulatrix* (Fairmaire, 1891)	1B
1118.	Meloidae	Meloinae	*Mylabris macilenta* Marseul, 1873	1B
1119.	Scraptiidae	Lamiinae	*Phytoecia lahoulensis* Breuning, 1951	1A
1120.		Chrysomelinae	*Oreomela meridionalis ladakhia* Daccordi, 1979	1A
1121.		Galerucinae	*Theone octocostata octocostata* (Weise, 1912)	1B
1122.	Curculionidae	Scolytinae	*Coptodryas mus* (Eggers, 1930)	1C
1123.			*Euwallacea interjectus* (Blandford, 1894)	1C
1124.		Cryptorhynchinae	*Hyperomias aenescens* Marshall, 1916	1C
1125.		Hyperinae	*Hypera postica* (Gyllenhal, 1813)	1A
	Order NEUROPTERA			
1126.	Chrysopidae	Chrysopinae	*Cunctochrysa albolineata* (Killington, 1935)	1B
	Order TRICHOPTERA			
1127.	Hydropsychidae		*Arctopsyche arcuata* Schmid, 1968	1C
1128.			*Arctopsyche composite* Martynov, 1930	1C
1129.			*Arctopsyche fissa* Schmid, 1968	1C
1130.			*Arctopsyche inaequispinosa* Schmid, 1968	1C
1131.			*Arctopsyche integra* Schmid, 1968	1C
1132.			*Parapsyche mahati* Schmid, 1968	1C
1133.			*Hydropsyche asiatica* Ulmer, 1905	1C
1134.			*Schmidopsyche rossi* Olah and Schefter, 2008	1C
1135.	Philopotamidae		*Kisaura eloct* Pandher and Saini, 2011	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1136.			*Kisaura elongate* Pandher and Saini, 2011	1C
1137.			*Kisaura gangtokensis* Pandher and Saini, 2011	1C
1138.			*Kisaura golitarensis* Pandher and Saini, 2014	1C
1139.			*Kisaura himachalica* Pandher and Saini, 2011	1C
1140.			*Kisaura kanchenjungaensis* Saini, Pandher and Ramamurthy, 2012	1C
1141.			*Kisaura truncate* Pandher and Saini, 2011	1C
1142.			*Wormaldia melanion* Schmid, 1991	1C
1143.			*Wormaldia sikkimensis* (Saini, Bajwa and Ghattor, 2005)	1C
1144.			*Chimarra crepidata* Kimmins, 1957	1C
1145.			*Chimarra dentata* Pandher and Saini, 2013 1C	1C
1146.			*Chimarra icar* Pandher and Saini, 2012 1C	1C
1147.			*Chimarra imperfecta* Saini, Pandher and Bajwa, 2011	1C
1148.			*Chimarra indentata* Saini, Pandher and Bajwa, 2011	1C
1149.			*Chimarra nigra* Kimmins, 1964	1C
1150.			*Chimarra pupi* Pandher and Saini, 2012	1C
1151.			*Chimarra quadrata* Pandher, Saini and Parey, 2014	1C
1152.			*Chimarra recurvata* Pandher and Saini, 2013	1C
1153.			*Chimarra rifati* Pandher and Saini, 2012	1C
1154.			*Chimarra rongliensis* Pandher and Saini, 2012	1C
1155.			*Chimarra sikkimensis* Pandher and Saini, 2012	1C
1156.	Stenopsychidae		*Stenopsyche apiguna* Schmid, 1969	1C
1157.			*Stenopsyche dirghajihvi* Schmid, 1969	1C
1158.			*Stenopsyche griseipennis* McLachlan, 1866	1C
1159.			*Stenopsyche haimavatika* Schmid, 1969	1C
1160.			*Stenopsyche splendida* Martynov, 1935	1C
1161.			*Stenopsyche montanus* Tillyard, 1922	1C
1162.	Polycentropodidae		*Plectrocnemia aurea* Ulmer, 1905	1C
1163.			*Plectrocnemia banksi* Fischer, 1962	1C
1164.	Psychomyiidae		*Psychomyia wangi* Schmid, 1997	1C
1165.			*Tinodes achtachastra* Schmid, 1972	1C
1166.			*Tinodes alpachastra* Schmid, 1972	1C
1167.			*Tinodes atichastra* Schmid, 1972	1C
1168.	Xiphocentronidae		*Proxiphocentron prathamajam* Schmid, 1982	1C
1169.			*Abaria richika* Schmid, 1982	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1170.			*Abaria uchinara* Schmid, 1982	1C
1171.			*Cnodocentron tchaturbhuja* Schmid, 1982	1C
1172.			*Drepanocentron abhimanyu* Schmid, 1982	1C
1173.			*Drepanocentron dacharatha* Schmid, 1982	1C
1174.			*Drepanocentron vicitravirya* Schmid, 1982	1C
1175.	Leptoceridae		*Setodes akalanka* Schmid, 1987	1C
1176.	Goeridae		*Goera kausalya* Schmid, 1991	1C
1177.			*Goera mandana* Mosely 1938	1C
1178.			*Goera raghu* Schmid, 1991	1C
1179.	Limnephilidae		*Aplatyphylax eupalinos* Schmid, 1991	1C
1180.			*Astratodina antenor* Schmid, 1991	1C
1181.			*Astratodina inermis* Mosely 1936	1B
1182.			*Asynarchus tibetanus* Schmid, 1966	1C
1183.			*Limnephilus fuscovittatus* Schmid, 1966	1C
1184.			*Pseudostenophylax aniketos* Schmid, 1991	1B
1185.			*Pseudostenophylax fimbriatofalcatus* Schmid, 1991	1C
1186.			*Pseudostenophylax glycerion* Schmid, 1991	1C
1187.			*Pseudostenophylax griseolus* Martynov, 1930	1C
1188.			*Pseudostenophylax latifalcatus* Schmid, 1991	1C
1189.			*Pseudostenophylax pauper* Schmid, 1991	1C
1190.	Lepidostomatidae		*Lepidostoma betteni* (Martynov, 1936)	1C
1191.			*Lepidostoma destructum* (Ulmer, 1906)	1C
1192.			*Lepidostoma kimsa* (Mosely, 1941)	1C
1193.			*Lepidostoma kurseum* (Mosely, 1949)	1C
1194.			*Lepidostoma sika* (Mosely, 1949)	1C
1195.			*Paraphlegopteryx orestes* Weaver, 1999	1C
1196.			*Paraphlegopteryx normalis* Mosely, 1949	1C
1197.			*Paraphlegopteryx pippini* Weaver, 1999	1C
1198.			*Paraphlegopteryx schmidi* Weaver, 1999	1C
1199.			*Paraphlegopteryx ulmeri* Weaver, 1999	1C
1200.	Phryganeidae		*Eubasilissa sikkimensis* Parey and Saini, 2012	1C
1201.			*Eubasilissa tibetana* Martynov, 1930	1C
1202.	Glossosomatidae		*Glossosoma fissum* Martynov, 1935	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1203.			*Glossosoma sikkimense* Saini, Lakhwinder, Parey and Rathor, 2013	1C
1204.	Hydroptilidae		*Stactobia throli* Schmid, 1983	1C
1205.	Rhyacophilidae		*Himalopsyche amitabha* Schmid, 1966	1C
1206.			*Himalopsyche angnorbui sherpa* Schmid, 1963	1C
1207.			*Himalopsyche biansata* Kimmins, 1952	1C
1208.			*Himalopsyche dolmasampa* Schmid, 1963	1C
1209.			*Himalopsyche gyamo* Schmid, 1963	1C
1210.			*Himalopsyche horai* (Martynov, 1936)	1C
1211.			*Himalopsyche lepcha* Schmid, 1963	1C
1212.			*Himalopsyche malenanda* Schmid, 1963	1C
1213.			*Himalopsyche tibetana* (Martynov, 1930)	1C
1214.			*Himalopsyche yongma* Schmid, 1963	1C
1215.			*Rhyacophila alticola* Kimmins, 1953	1C
1216.			*Rhyacophila anatina* Morton, 1900	1C
1217.			*Rhyacophila bidens* Kimmins, 1953	1C
1218.			*Rhyacophila chakungpa* Schmid, 1970	1C
1219.			*Rhyacophila changpa* Schmid, 1970	1C
1220.			*Rhyacophila chayulpa* Schmid, 1970	1C
1221.			*Rhyacophila chematangpa* Schmid, 1970	1C
1222.			*Rhyacophila chugalungpa* Schmid, 1970	1C
1223.			*Rhyacophila curvata* Morton, 1900	1C
1224.			*Rhyacophila dilatata* Martynov, 1935	1C
1225.			*Rhyacophila dongre* Schmid, 1970	1C
1226.			*Rhyacophila drotangpa* Schmid, 1970	1C
1227.			*Rhyacophila fletcheri* (Kimmins, 1952)	1C
1228.			*Rhyacophila gelukpa* Schmid, 1970	1C
1229.			*Rhyacophila hingstoni* Martynov, 1930	1C
1230.			*Rhyacophila hobsoni* Martynov, 1930	1C
1231.			*Rhyacophila indica* Saini, Cheema and Bajwa, 2013	1C
1232.			*Rhyacophila kadaphes* Schmid, 1959	1B
1233.			*Rhyacophila kashmirensis* Kaur and Saini, 2013	1B
1234.			*Rhyacophila kedara* Schmid, 1970	1B
1235.			*Rhyacophila khiympa* Schmid, 1970	1C

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1236.			*Rhyacophila kubrav* Schmid, 1970	1C
1237.			*Rhyacophila kyadongpa* Schmid, 1970	1C
1238.			*Rhyacophila laptsapa* Schmid, 1970	1C
1239.			*Rhyacophila lepcha* Schmid, 1970	1C
1240.			*Rhyacophila lhadzongpa* Schmid, 1970	1B
1241.			*Rhyacophila mortoni* Kimmins, 1953	1C
1242.			*Rhyacophila ngorpa* Schmid, 1970	1C
1243.			*Rhyacophila nigricans* Saini, Kaur and Rathor, 2012	1B
1244.			*Rhyacophila nyamangpa* Schmid, 1970	1C
1245.			*Rhyacophila obscura* Martynov, 1927	1B
1246.			*Rhyacophila poba* Schmid, 1970	1C
1247.			*Rhyacophila sanglungpa* Schmid, 1970	1C
1248.			*Rhyacophila scissa niyampa* Schmid, 1970	1B, 1C
1249.			*Rhyacophila scissoides* Kimmins, 1953	1C
1250.			*Rhyacophila sherpa* Schmid, 1970	1C
1251.			*Rhyacophila shingripa* Schmid, 1970	1C
1252.			*Rhyacophila spinalis* Martynov, 1930	1C
1253.			*Rhyacophila stenostyla* Martynov, 1930	1C
1254.			*Rhyacophila tarkiya* Schmid, 1970	1C
1255.			*Rhyacophila tashepa* Schmid, 1970	1C
1256.			*Rhyacophila tengyelingpa* Schmid, 1970	1C
1257.			*Rhyacophila tshiringpa* Schmid, 1970	1C
1258.			*Rhyacophila tshogpa* Schmid, 1970	1C
1259.			*Rhyacophila tsongkhapa* Schmid, 1970	1C
1260.			*Rhyacophila tungkorpa* Schmid, 1970	1C
1261.			*Rhyacophila yigrongpa* Schmid, 1970	1C
1262.			*Rhyacophila yishepa* Schmid, 1970	1C
1263.			*Rhyacophila yullha* Schmid, 1970	1C
1264.			*Rhyacophila zhungpa* Schmid, 1970	1C
	Order DIPTERA			
1265.	Trichoceridae		*Paracladura superbiens* (Alexander, 1960)	1A
1266.			*Trichocera abieticola* (Alexander, 1935)	1A
1267.			*Trichocera alticola* (Alexander, 1935)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1268.			*Trichocera auripennis* (Alexander, 1960)	1A
1269.			*Trichocera bellula* Alexander, 1960	1A
1270.			*Trichocera superna* (Alexander, 1961)	1A
1271.			*Trichocera thaunastopyga* (Alexander, 1960)	1A
1272.			*Trichocera percincta* (Alexander, 1961)	1A
1273.	Cylindrotomidae		*Cylindrotoma simplex* Alexander, 1972	1A
1274.	Limoniidae	Limoniinae	*Antocha biobtusa* (Alexander,1968)	1A
1275.			*Atarba bilobula* (Alexander, 1969)	1A
1276.			*Atarba bismila* (Alexander, 1969)	1A
1277.			*Atarba decineta* (Alexander, 1969)	1A
1278.			*Atarba sikkimensis* (Alexander, 1969)	1A
1279.			*Helius impensus* (Alexander, 1966)	1A
1280.			*Helius numenius* (Alexander, 1966)	1A
1281.			*Helius ssp.coracinus* (Alexander, 1966)	1A
1282.			*Helius tantalus* (Alexander, 1966)	1A
1283.			*Helius tanyrhinus* (Alexander, 1964)	1A
1284.			*Helius taos* (Alexander, 1966)	1A
1285.			*Helius verticillatus* (Alexander, 1966)	1A
1286.			*Afrolimnophila perdelecta* (Alexander, 1964)	1A
1287.			*Afrolimnophila perdilata* (Alexander, 1966)	1A
1288.			*Afrolimnophila pluriguttula* (Alexander, 1966)	1A
1289.			*Afrolimnophila coracina* (Alexander, 1964)	1A
1290.			*Afrolimnophila mecocera* (Alexander, 1964)	1A
1291.			*Dicranomyia abigor* (Alexander, 1966)	1A
1292.			*Dicranomyia ananta* (Alexander, 1964)	1A
1293.			*Dicranomyia dactylophora* (Alexander, 1964)	1A
1294.			*Dicranomyia euryrhyncha* (Alexander, 1966)	1A
1295.			*Dicranomyia parjanya* (Alexander, 1966)	1A
1296.			*Dicranomyia veda* (Alexander, 1965)	1A
1297.			*Dicranomyia perscitula* (Alexander, 1965)	1A
1298.			*Dicranomyia simplicis* (Alexander, 1965)	1A
1299.			*Dicranomyia acinacis* (Alexander, 1964)	1A
1300.			*Dicranomyia peramabilis* (Alexander, 1966)	1A
1301.			*Dicranomyia perproducta* (Alexander, 1966)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1302.			*Dicranomyia quinquenotata* (Brunetti, 1918)	1A
1303.			*Dicranomyia stenolabis* (Alexander, 1964)	1A
1304.			*Dicranomyia fulvonigrina* (Alexander, 1964)	1A
1305.			*Dicranomyia pernigrita* (Alexander, 1964)	1A
1306.			*Dicranomyia synspilota* (Alexander, 1935)	1A
1307.			*Dicranomyia tenuirama* (Alexander, 1965)	1A
1308.			*Dicranomyia luteipostica* (Alexander, 1964)	1A
1309.			*Orimarga pachyrhyncha* (Alexander, 1967)	1A
1310.			*Paradelphomyia bigladia* (Alexander, 1970)	1A
1311.			*Paradelphomyia edwardsi* (Alexander, 1961)	1A
1312.			*Paradelphomyia kumpa* (Alexander, 1961)	1A
1313.			*Taiwanomyia brevissima* (Alexander, 1967)	1A
1314.			*Erioptera litostyla* (Alexander, 1966)	1A
1315.			*Erioptera pila* (Alexander, 1966)	1A
1316.			*Erioptera tripilata* (Alexander, 1957)	1A
1317.			*Molophilus acinacis* (Alexander, 1969)	1A
1318.			*Molophilus acis* (Alexander, 1969)	1A
1319.			*Molophilus ictus* (Alexander, 1969)	1A
1320.			*Molophilustantalus* (Alexander, 1969)	1A
1321.			*Gonomyia reticulata* (Alexander, 1921)	1A
1322.			*Gonomyia dissidens* (Alexander, 1957)	1A
1323.			*Gonomyia elimata* (Alexander, 1957)	1A
1324.			*Gonomyia hirsutistyla* (Alexander, 1963)	1A
1325.			*Gonomyia tanaocantha* (Alexander, 1963)	1A
1326.			*Gonomyia involuta* (Alexander, 1961)	1A
1327.			*Gonomyia paleuma* (Alexander, 1961)	1A
1328.			*Gonomyia phallostena* (Alexander, 1957)	1A
1329.			*Gonomyia bisiculifera* (Alexander, 1963)	1A
1330.			*Lipsothrix kashmirica* (Alexander, 1935)	1A
1331.			*Ormosia grahami* (Alexander, 1931)	1A
1332.			*Ormosia hutchinsonae* (Alexander, 1935)	1A
1333.			*Ormosia kashmiri* (Alexander, 1965)	1A
1334.			*Ormosia atrotibialis* (Alexander, 1966)	1A
1335.			*Ormosia leucostictula* (Alexander, 1965)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1336.			*Toxorhina tuberifera* (Alexander, 1966)	1A
1337.	Pediciidae		*Dicranota asignata* (Alexander, 1964)	1A
1338.			*Dicranota magra* (Alexander, 1961)	1A
1339.			*Dicranota niphas* (Alexander, 1961)	1A
1340.			*Dicranota subreticularis* (Alexander, 1964)	1A
1341.			*Dicranota obesistyla* (Alexander, 1959)	1A
1342.			*Dicranota pallidithorax* (Alexander, 1935)	1A
1343.			*Dicranota tumidosa* (Alexander, 1959)	1A
1344.			*Dicranota uninebulosa* (Alexander, 1935)	1A
1345.	Tipulidae	Tipulinae	*Nephrotoma ericarum* (Alexander, 1965)	1A
1346.			*Nephrotoma euryglossa* (Alexander, 1965)	1A
1347.			*Nephrotoma irrevocata* (Alexander, 1935)	1A
1348.			*Nephrotoma maraca* (Alexander, 1935)	1A
1349.			*Nephrotoma trilobulata* (Alexander, 1935)	1A
1350.			*Tipula indra* (Alexander, 1961)	1A
1351.			*Tipula irrequieta* (Alexander, 1935)	1A
1352.			*Tipula kumpa* (Alexander, 1961)	1A
1353.			*Pselliophora aquila* (Alexander, 1963)	1A
1354.			*Pselliophora ballator* (Alexander, 1961)	1A
1355.			*Pselliophora Microphallus* (Alexander, 1963)	1A
1356.			*Brithura submarmoratipennis* (Alexander, 1935)	1A
1357.			*Brithura pandava* (Alexander, 1961) 1A	1A
1358.			*Brithura hypovalvata* (Alexander, 1935)	1A
1359.			*Brithura trialbosignata* (Alexander, 1935)	1A
1360.			*Nigrotipula achlypoda* (Alexander, 1965)	1A
1361.			*Nigrotipula bathroxantha* (Alexander, 1961)	1A
1362.			*Nigrotipula xanthocera* (Alexander, 1935)	1A
1363.			*Nigrotipula cruciata* (Edwards, 1928)	1A
1364.			*Nigrotipula fautrix* (Alexander, 1961)	1A
1365.			*Nigrotipula icarus* (Alexander, 1935)	1A
1366.			*Nigrotipula baltistanica* (Alexander, 1935)	1A
1367.			*Nigrotipula sordidipes* (Alexander, 1961)	1A
1368.			*Nigrotipula venerabilis* (Alexander, 1935)	1A
1369.			*Nigrotipula appendifera* (Alexander, 1955)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1370.			*Nigrotipula argentacea* (Alexander, 1961)	1A
1371.			*Nigrotipula indiscreta* (Alexander, 1935)	1A
1372.			*Nigrotipula kariyana* (Alexander, 1965)	1A
1373.			*Nigrotipula nigrocellula* (Alexander, 1935)	1A
1374.			*Nigrotipula pagastiana* (Alexander, 1965)	1A
1375.			*Nigrotipula tonnoirana* (Alexander, 1966)	1A
1376.			*Nigrotipula arjuna* Alexander, 1961	1A
1377.			*Nigrotipula callicoma* (Alexander, 1965)	1A
1378.			*Nigrotipula dryope* (Alexander, 1961)	1A
1379.			*Nigrotipula griseipennis* (Brunetti, 1912)	1A
1380.			*Nigrotipula hingstoni* (Edwards, 1928)	1A
1381.			*Nigrotipula hobsoni* (Edwards, 1928)	1A
1382.			*Nigrotipula hutchinsonae* (Alexander, 1935)	1A
1383.			*Nigrotipula hypsistos* (Alexander, 1961)	1A
1384.			*Nigrotipula sindensis* (Alexander, 1935)	1A
1385.			*Nigrotipula wardi* (Edwards, 1928)	1A
1386.			*Tipulodina avicularia* (Edwards, 1928)	1A
1387.			*Tipulodina mitchelli* (Edwards, 1927)	1A
1388.	Blephariceridae		*Dioptopsis bionis* (Agharkar, 1914)	1A
1389.	Psychodidae		*Phlebotomus longiductus* Parrot, 1928	1A
1390.			*Phlebotomus sergenti* (Parrot, 1917)	1A
1391.			*Phlebotomus baghdadis* (Adler and Theodor, 1929)	1A
1392.	Chironomidae	Chironominae	*Heterotrissocladius chandra* (Singh, 1958)	1A
1393.			*Himatendipes glacies* (Tokunga, 1959)	1A
1394.	Simuliidae	Simuliinae	*Simulium adventicium* Datta, 1985	1A
1395.			*Simulium barraudi* Puri, 1932	1A
1396.			*Simulium christophersi* Puri, 1932	1A
1397.	Dixidae		*Dixa christophersi* (Edwards, 1934)	1A
1398.			*Dixa kashmirensis* (Edwards, 1934)	1A
1399.			*Dixa platystyla* (Edwards, 1934)	1A
1400.	Culicidae	Anophelinae	*Anopheles varuna* Iyengar, 1924	1A
1401.		Culicinae	*Culex vagans* Wiedemann, 1828	1A
1402.	Anisopodidae	Anisopodinae	*Sylvicola nigroclavatus* (Edwards, 1928)	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1403.	Xylophagidae		*Coenomyia bituberculata,* Enderlein, 1921	1A
1404.	Tabanidae		*Philoliche amboinensis* (Fabricius, 1805)	1A
1405.			*Philoliche varipes* (Ricardo, 1911)	1A
1406.			*Chrysops dispar* (Fabricius, 1798)	1A
1407.			*Chrysops flavocinctus* Ricardo, 1902	1A
1408.			*Chrysops pettigrewi* Ricardo, 1913	1A
1409.			*Atylotus agrestis* (Wiedemann, 1828)	1A
1410.			*Hybomitra bouvieri* Philip, 1979	1A
1411.			*Hybomitra lamades* Philip, 1961	1A
1412.			*Tabanus acallus* Szilady, 1926 1A	1A
1413.			*Tabanus albofasciatus* Ricardo, 1911	1A
1414.			*Tabanus birmanicus* (Bigot, 1892)	1A
1415.			*Tabanus explicatus* Walker, 1854	1A
1416.			*Tabanus flaviscutellus* Philip, 1962	1A
1417.			*Tabanus fuscomaculatus* Ricardo, 1911	1A
1418.			*Tabanus imparicallosus* Schuurmans Stekhoven, 1926	1A
1419.			*Tabanus indianus* Ricardo, 1911	1A
1420.			*Tabanus jucundus* Walker, 1848	1A
1421.			*Tabanus leucopogon* (Bigot, 1892)	1A
1422.			*Tabanus monotaeniatus* (Bigot, 1892)	1A
1423.			*Tabanus orientis* Walker, 1848	1A
1424.			*Tabanus parafuscomaculatus* Schuurmans Stekhoven, 1932	1A
1425.			*Tabanus praematurus* Austen, 1922	1A
1426.			*Tabanuspullomaculatus* Philip, 1970	1A
1427.			*Tabanus rubidus* Wiedemann, 1821	1A
1428.			*Tabanus scutellus* Philip, 1970	1A
1429.			*Tabanus striatus* Fabricius, 1787	1A
1430.			*Haematopota annandalei* Ricardo, 1911	1A
1431.			*Haematopota sikkimensis* Stone and Philip, 1974	1A
1432.			*Cydistomyia aberrans* Philip, 1970	1A
1433.			*Gressittia nepalensis* Philip and Mackerras, 1960	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1434.	Xylomidae		*Solva nigra* (Brunetti, 1923)	1A
1435.			*Solva binghamis* Enderlein, 1921	1A
1436.			*Solva flavipes* (Doleschall, 1858)	1A
1437.			*Solva nigricoxis* Enderlein, 1921	1A
1438.			*Solva sikkimensis* (Enderlein, 1921)	1A
1439.	Stratiomyidae		*Epanastasis fumipennis* Kertész, 1923	1A
1440.			*Ptilocera amethystina* Snellen van Vollenhoven, 1857	1A
1441.	Bombyliidae		*Bombylisoma resplendens* (Brunetti, 1909)	1A
1442.			*Litorhina lar* Fabricius, 1781	1A
1443.	Asilidae		*Neolaparus volcatus* (Walker, 1849)	1A
1444.			*Cophinopoda chinensis* (Fabricius, 1794)	1A
1445.			*Promachus binghamensis* Ricardo, 1921	1A
1446.			*Trichomachimus excelsus* (Ricardo), 1922	1A
1447.			*Trichomachimus nr. pubiscenes* (Ricardo, 1922)	1A
1448.			*Trichomachimus pubescens* (Ricardo, 1922)	1A
1449.			*Trichomachimus rubisetosus* Oldroyd, 1964	1A
1450.			*Microstylum strigatum* Enderlein, 1914	1A
1451.			*Merodontina sikkimensis* Enderlein, 1914	1A
1452.	Syrphidae		*Eupeodes confrater* (Wiedemann, 1830)	1A
1453.			*Episyrphus balteatus* (De Geer, 1776)	1A
1454.			*Episyrphus viridaureus* (Wiedemann, 1824)	1A
1455.			*Meliscaeva cinctella* (Zetterstedt, 1843)	1A
1456.			*Scaeva selenitica* (Meigen, 1822)	1A
1457.			*Sphaerophoria viridaenea* Brunetti, 1915	1A
1458.			*Paragus serratus* (Fabricius, 1805)	1A
1459.			*Volucella ruficauda* Brunetti, 1907	1A
1460.			*Eristalis arbustorum* (Linnaeus, 1758)	1A
1461.			*Eristalis himalayensis* Brunetti, 1908	1A
1462.	Megamerinidae		*Texara dioctrioides* Walker, 1860	1A
1463.	Platystomatidae		*Xenaspis pedunculata* Enderlein, 1924	1A
1464.			*Xenaspispictipennis* (Walker, 1849)	1A
1465.			*Xenaspis polistiformis* Enderlein, 1924	1A
1466.			*Xenaspissikkimensis* Enderlein, 1924	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1467.			*Xenaspis stenoptera* Hendel, 1914	1A
1468.			*Euthyplatystoma rigidum* (Walker, 1856)	1A
1469.			*Lamprophthalma anaulaca* Hendel, 1914	1A
1470.			*Lamprophthalma rhomalea* Hendel, 1914	1A
1471.			*Loxoneura perilampoides* Walker, 1858	1A
1472.			*Loxoneura pictipennis* (Walker, 1849)	1A
1473.			*Plagiostenopterina interrupta* (Enderlein, 1924)	1A
1474.			*Plagiostenopterina angusta* Enderlein, 1924	1A
1475.	Tephritidae		*Adrama apicalis* Shiraki, 1933	1A
1476.	Pyrgotidae		*Adapsilia armipes* Hendel, 1914	1A
1477.			*Adapsilia opaca* Bezzi, 1914	1A
1478.			*Adapsilia vulpina* Hendel, 1914	1A
1479.			*Taeniomastix sumatrana* Enderlein, 1942	1A
1480.	Micropezidae		*Cothornobata nigrigenu* (Enderlein, 1922)	1A
1481.			*Mimegralla binghami* (Enderlein, 1922)	1A
1482.	Heleomyzidae		*Suillia nigripes* Czerny , 1932	1A
1483.	Agromyzidae		*Calycomyza artemisiae* Kaltenbach, 1856	1A
1484.	Speheroceridae		*Copromyza deeming* Hackman, 1965	1A
1485.	Drosophilidae		*Drosophila curviceps* Okada and Kurokawa, 1957	1A
1486.			*Drosophila pentaspina* Parshad and Duggal, 1966	1A
1487.			*Drosophila testacea* von Roser, 1840	1A
1488.			*Drosophila bifasciata* Pomini, 1940	1A
1489.			*Drosophila kikkawai* Burla, 1954	1A
1490.			*Drosophila melanogaster* Meigen, 1830	1A
1491.			*Drosophila rufa* Kikkawa and Peng, 1938	1A
1492.			*Scaptodrosophila ebonata* Parshad and Duggal, 1966	1A
1493.			*Scaptodrosophila pulchrella* Tan. Hsu and Sheng, 1949	1A
1494.			*Scaptomyza graminum* (Fallén, 1823)	1A
1495.			*Scaptomyza pallida* (Zetterstedt, 1847)	1A
1496.	Muscidae		*Musca hervei* Villeneuve, 1922	1A

Table 1 contd.

Sl. No.	Family	Subfamily	Species Name	Distribution in Indian Geographical Region 1
1497.			*Musca bezzii* Patton and Cragg , 1913	1A
1498.			*Neomyia gavisa* (Walker, 1859)	1A
1499.			*Neomyia timorensis* (Robineau-Desvoidy, 1830)	1A
1500.			*Orthellia viridis* (Wiedemann, 1824)	1A
1501.			*Gymnodia lasiopa* Emden, 1965	1A
1502.			*Lispe sericipalpis* Stein, 1904	1A
1503.			*Coenosia humilis* Meigen, 1826	1A
1504.			*Stomoxys calcitrans* (Linnaeus, 1758)	1A
1505.	Scathophagidae	Scathophaginae	*Scathophaga stercoraria* (Linnaeus, 1758)	1A
1506.	Oestridae		*Portschinskia himalayana* Grunin, 1962	1A
1507.			*Cephalopina titillator* (Clark, 1816)	1A
1508.			*Sarcophaga macroauriculata* Ho, 1932	1A
1509.			*Sarcophaga misera* (Walker, 1849)	1A
1510.	Calliphoridae	Calliphorinae	*Calliphora vomitoria* (Linnaeus, 1758)	1A
1511.			*Calliphora vicina* (Robineau-Desvoidy, 1830)	1A
1512.			*Lucilia cuprina* (Wiedemann, 1830)	1A
1513.			*Peleteria varia* (Fabricius, 1794)	1A
1514.			*Janthinomyia felderi* Brauer and Bergenstamm, 1893	1A

Scrub land in Trans Himalaya

Geological monuments in Cold desert

Marshes at Puga