INSECTA MATSUMURANA

NEW SERIES 23: 21–39 JUNE 1981

TAXONOMY AND DISTRIBUTION OF ORIBATID MITES (ACARI) IN INDIA

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Research Trips for Agricultural and Forest Insects in the Subcontinent of India (Hokkaidô University, University of Calcutta, and Zoological Survey of India Joint Project) [Grants-in-Aid for Overseas Scientific Survey, Ministry of Education, Japanese Government, 1978, No. 304108; 1979, No. 404307], Scientific Report No. 10.

Abstract

BHADURI, A.K. and RAYCHAUDHURI, D.N. 1980. Taxonomy and distribution of Oribatid mites (Acari) in India. *Ins. matsum. n.s.* 23: 21–39, 1 tab.

This paper reports from India a total of 121 Oribatid mites over 64 genera under 40 families, a few of these species being determined only upto generic level. A discussion on the distribution of the determined species in India and also outside India has been provided.

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Contents

Introduction

The oribatid mites, which form a complex group under the subclass Acarina, show high degree of diversity in form, habitat and behaviour and represent one of the chief constituents of the soil fauna. According to Noordam and De Vlieger (1943) and Van der Drift (1951) Oribatei are a predominant group of inhabitants of soil litter. They are primarily fungivorous, algivorous and saprophagous and occur in soil litter, humus, compost heaps, moss, lichens growing over tree stumps, and similar habitats. The occurrence of these mites is also noticed in bird's nests (Aoki, 1966), in caves (Moritz et al., 1971), in lava caves (Yamamoto and Aoki, 1971) and in pasture soil; they also occur in coniferous taiga forest, in arctic tundra (Bregetova, 1965) and even in subantarctic zones (Wallwork, 1973). A few species are slightly hydrophilic and still fewer are known to inhabit the sea (Willmann, 1931). In fact, they occur in all ecological niches, especially where vegetative materials decay in sufficient moisture and are penetrated by mycelia. Enormous diversity is found in their organisation because they live in different types of ecological conditions, and consequently we find a good number of genera and species. On the basis of variations in the range of forms, structure and behaviour, approximately more than 5,000 species of oribatid mites belonging to 750 genera have been described from the world till date.

Recently attention of the acarologists has been drawn to this group in view of its great economic importance. It is claimed by them that the Oribatei are instrumental in decomposing organic matter in or on the soil and help in the promotion of soil fertility. Sellnick (1928) believed that they play an important role in the economy of nature in that they contribute considerably to the fertility of forest soil. Many species of oribatid mites possess the role of acting as intermediate hosts of certain anoplocephaline cestodes. Sunkard (1937, 1940, 1941), Kates and Runkel (1948), Potamkina (1941, 1944), Soldatova (1945), Anantaraman (1951), Allred (1954), Wallwork and Rodriguez (1961), Usova and Yarosenko (1971) studied the role of Oribatei as the intermediate hosts of anoplocephaline cestodes and other tape worms belonging to the family Cyclophyllidae. Jacot (1930) pointed out that the orbatid mites carry fungal spores in their mouth-parts, bodies, bristles and legs and it appears possible that they may help directly in the spread of fungal infection to plants. Rockett and Woodring (1966) found a new species, *Pergalumna omniphagus*, to feed (in all stages except larval) on both saprophytic and plant parasitic nematodes. It is suggested that normally saprophytic oribatids may constitute an important regulator of soil nematode population. In view of importance of these mites in veterinary, soil zoology and agriculture the taxonomy of this group has gained considerable momentum.

Our knowledge of the world oribatids has been greatly enriched by the pioneering works of Michael (1880 and later papers), Berlese (1895, 1904, 1905, 1908 and other papers published later), Oudemans (1906, 1917, 1937), Willmann (1919, 1928, 1931, 1936), Jacot (1933a, 1933b, 1934, 1936 and other papers), Grandjean (1931, 1933, 1936 and later papers), Sellnick (1925a, 1925b, 1928 and other papers), Balogh (1958, 1959, 1960, 1961 and later papers), Hammen (1952, 1953 and other papers), Hammer (1958, 1961, 1962, 1966, 1967, 1968), Aoki (1959, 1965a, 1965b and later papers), Knulle (1957), Pletzen (1963, 1965), Wallwork (1960, 1961, 1962, 1963, 1965, 1967, 1970), Engelbrecht (1969), Moritz (1964, 1965, 1966, 1968) and others.

Unfortunately, oribatid mites of India remained unattended till the beginning of the present century and the taxonomy of the oribatid fauna of India had long been neglected by the acarologists for the reasons best known to them. In comparison to the oribatid mites known from other parts of the world Indian mites of this group have little been explored and the literature relating to the taxonomy of Indian Oribatei are also very scanty.

Taxonomic studies of the oribatid mites of India came to the lime light of scientific investigation chiefly through the works of Pearce (1906), Ewing (1910), Jacot (1933b) and Baker (1945). Later Bhaduri and Raychaudhuri (1968), Chakrabarti and Bhaduri (1972), Chakrabarti, Bhaduri and Raychaudhuri (1972, 1973, 1977, 1978), Bhaduri, Chakrabarti and Raychaudhuri (1974), Bhattacharya, Bhaduri and Raychaudhuri (1974), Bhaduri, Bhattacharya and Chakrabarti (1975) and Hafeez Kardar (1972, 1974, 1976) worked on this group either by describing new species or by providing data on the distribution of the known species.

Pearce (1906) for the first time reported and described 20 species from Sikkim Himalaya. Ewing (1910) wrongly identified 2 species from the Nilgiri Hills. After a long gap Jacot (1933b) found the syntypes of Ewing's species from the same locality and correctly identified them. Later Baker (1945) described a new species from Uttar Pradesh. Anantaraman (1951) described a new species and reported the genus *Galumna* from Madras. Prosad (1965) reported 3 mites belonging to the genera *Cosmochthonius*, *Oppia*, and *Tectocepheus* from Sabur (Bihar). Bhaduri and Raychaudhuri (1967) for the first time reported 6 mites belonging to the genera *Hoplophorella*, *Oppia*, *Conoppia*, *Basilobelba*, *Xiphobelba* and *Lamellobates* from West Bengal. In subsequent year they (1968) added 7 more species to the list of Indian oribatid mites. Thus the total number of species reported and described from India till 1968 amounted to 40, then Chakrabarti and Bhaduri (1972), Chakrabarti, Bhaduri and Raychaudhuri (1972, 1973, 1977, 1978), Bhaduri, Chakrabarti and Raychaudhuri (1974), Bhattacharya, Bhaduri and Raychaudhuri (1974), Bhaduri, Bhattacharya and Chakrabarti (1975) reported and described 45 more species from West Bengal. Singh and Mukherjee (1971) and Singh and Pillai (1975) while working on the ecology of soil mesofauna of Varanasi (Uttar Pradesh) reported the occurrence of 15 species from there. Hafeez Kardar (1972, 1974, 1976) described 7 new species from Aligarh (Uttar Pradesh). Recently Misra (through personal communication) reported 16 species from Orissa. The total number of species reported and described from India till to-day stands at 121 distributed over 64 genera under 40 families.

List of species reported and described from India

Family Parhypochthoniidae

Genus *Gehypochthonius* Jacot, 1936a

Gehypochthonius sp.: Singh and Mukherjee, 1971

Family Hypochthoniidae

Genus *Eohypochthonius* Jacot, 1938

Eohypochthonius gracilis (Jacot, 1936): Chakrabarti and Bhaduri, 1972

Eohypochthonius vilhenarum (Balogh, 1958): Misra (Ph. D. thesis not yet submitted)

Genus *Malacoangelia* Berlese, 1913

Malacoangelia remigera Berlese, 1913: Chakrabarti and Bhaduri, 1972
Malacoangelia remigera indica Chakrabarti, Bhaduri and Raychaudhuri, 1972

Family Haplochthoniidae
Genus *Haplochthonius* Willmann, 1930
Haplochthonius clavatus (Hammer, 1958): Chakrabarti and Bhaduri, 1972
Haplochthonius intermedius Chakrabarti, Bhaduri and Raychaudhuri, 1972

Family Cosmochthoniidae
Genus *Cosmochthonius* Berlese, 1910
Cosmochthonius sp.: Prosad, 1965
Cosmochthonius bengalensis Chakrabarti, Bhaduri and Raychaudhuri, 1972

Family Sphaerochthoniidae
Genus *Sphaerochthonius* Berlese, 1910
Sphaerochthonius transversus Wallwork, 1960a: Misra (Ph. D. thesis not yet submitted)

Family Phthiracaridae
Genus *Hoplophorella* Berlese, 1923
Hoplophorella africana Wallwork, 1967: Misra (op. cit.)
Hoplophorella scapellata Aoki, 1965a: Misra (op. cit.)
Hoplophorella sp.: Bhaduri and Raychaudhuri, 1967

Family Euphthiracaridae
Genus *Rhysotritia* Markel and Meyer, 1959
Rhysotritia ardua (C.L. Koch, 1841): Singh and Mukherjee, 1971
Rhysotritia peruensis (Hammer, 1961): Chakrabarti, Bhaduri and Raychaudhuri, 1973

Family Epilohmanniidae
Genus *Epilohmannia* Berlese, 1916a
Epilohmannia cylindrica (Berlese, 1904): Singh and Mukherjee, 1971
Epilohmannia pallida pacifica Aoki, 1965b: Singh and Mukherjee, 1971
Epilohmannia sp.: Singh and Pillai, 1975

Family Lohmanniidae
Genus *Lohmannia* Michael, 1898
Lohmannia sp.: Singh and Mukherjee, 1971; Singh and Pillai, 1975
Genus *Annectacarus* Grandjean, 1950
Annectacarus longisetosus Bhattacharya, Bhaduri and Raychaudhuri, 1974
Annectacarus sp.: Chakrabarti and Bhaduri, 1972
Genus *Cryptacarus* Grandjean, 1950
Cryptacarus hirsutus Aoki, 1961: Bhattacharya, Bhaduri and Raychaudhuri, 1974
Cryptacarus dendrisetosus Bhattacharya, Bhaduri and Raychaudhuri, 1974
Cryptacarus sp.: Singh and Mukherjee, 1971; Singh and Pillai, 1975
Genus *Haplacarus* Wallwork, 1962
Haplacarus foliatus bengalensis Bhattacharya, Bhaduri and Raychaudhuri, 1974

Genus *Javacarus* Balogh, 1961

Javacarus kuehnelti Balogh, 1961: Chakrabarti and Bhaduri, 1972; Bhattacharya, Bhaduri and Raychaudhuri, 1974

Genus *Papillacarus* Kunst, 1959

Papillacarus indicus Hafeez Kardar, 1972

Papillacarus simplirostratus Bhattacharya, Bhaduri and Raychaudhuri, 1974

Family Camisiidae

Genus *Platynothrus* Berlese, 1913

Platynothrus peltifer (C.L. Koch, 1839): Pearce, 1906

Family Trhypochthoniidae

Genus *Trhypochthonius* Berlese, 1905

Trhypochthonius tectorum (Berlese, 1896): Pearce, 1906

Genus *Allonothrus* Van der Hammen, 1953

Allonothrus indicus Bhaduri and Raychaudhuri, 1968

Allonothrus monodactylus Wallwork, 1960: Bhaduri and Raychaudhuri, 1968

Allonothrus russeolus Wallwork, 1960: Bhaduri and Raychaudhuri, 1968

Genus *Archegozetes* Grandjean, 1931

Archegozetes longisetosus Aoki, 1965a (=*Archegozetes magna indicus* Bhaduri and Raychaudhuri, 1968)

Archegozetes magna (Sellnick, 1925a): Chakrabarti, Bhaduri and Raychaudhuri, 1977

Family Malaconothridae

Genus *Trimalaconothrus* Berlese, 1916b

Trimalaconothrus cajamarcensis Hammer, 1961: Chakrabarti, Bhaduri and Raychaudhuri, 1973

Trimalaconothrus longirostrum Hammer, 1966: Misra (Ph. D. thesis not yet submitted)

Genus *Cyrthermannia* Balogh, 1958

Cyrthermannia vicinicornuta Aoki, 1965a: Chakrabarti and Bhaduri, 1972

Cyrthermannia quadricornuta Chakrabarti, Bhaduri and Raychaudhuri, 1978

Genus *Masthermannia* Berlese, 1913

Masthermannia mamillaris (Berlese, 1904a): Chakrabarti and Bhaduri, 1972

Genus *Nanhermannia* Berlese, 1913

Nanhermannia himalayensis Chakrabarti, Bhaduri and Raychaudhuri, 1978

Family Hermanniidae

Genus *Hermannia* Nicolet, 1855

Hermannia convexa (C.L. Koch, 1842): Pearce, 1906

Family Plateremaeidae

Genus *Plateremaeus* Berlese, 1908

Plateremaeus rotandus Berlese, 1913: Chakrabarti, Bhaduri and Raychaudhuri, 1977

Family Liodidae
Genus *Liodes* Von Heyden, 1826
Liodes (?) *ocellatus* (Pearce, 1906)

Family Cepheidae
Genus *Conoppia* Berlese, 1908
Conoppia sp.: Bhaduri and Raychaudhuri, 1967
Genus *Ommatocepheus* Berlese, 1913
Ommatocepheus ocellatus (Michael, 1882): Pearce, 1906

Family Microzetidae
Genus *Microzetes* Berlese, 1913
Microzetes auxiliaris Grandjean, 1936: Chakrabarti and Bhaduri, 1972
Microzetes peruensis (Hammer, 1961): Chakrabarti, Bhaduri and Raychaudhuri, 1973
Microzetes auxiliaris applachicola Jacot, 1938: Chakrabarti, Bhaduri and Raychaudhuri, 1977

Family Gustaviidae
Genus *Gustavia* Kramer, 1879
Gustavia palmicinctum (Michael, 1880): Pearce, 1906

Family Amerobelbidae
Genus *Amerus* Berlese, 1896
Amerus speciosus Pearce, 1906

Family Eremobelbidae
Genus *Eremulus* Berlese, 1908
Eremulus flagellifer Berlese, 1908: Chakrabarti, Bhaduri and Raychaudhuri, 1973
Eremulus avenifer Berlese, 1913: Chakrabarti, Bhaduri and Raychaudhuri, 1973
Genus *Fosseremus* Grandjean, 1954
Fosseremus quadripertitus Grandjean, 1965: Singh and Mukherjee, 1971
Fosseremus sp.: Singh and Mukherjee, 1971; Singh and Pillai, 1975

Family Carabodidae
Genus *Carabodes* C.L. Koch, 1836
Carabodes peniculatus Aoki, 1970: Chakrabarti, Bhaduri and Raychaudhuri, 1977

Family Basilobelbidae
Genus *Basilobelba* Balogh, 1958
Basilobelba indica Bhaduri, Chakrabarti and Raychaudhuri, 1974
Genus *Xiphobelba* Csiszar, 1961
Xiphobelba sp.: Bhaduri and Raychaudhuri, 1967

Family Liacaridae
Genus *Liacarus* Michael, 1898
Liacarus nigrescens Pearce, 1906

Family Tectocepheidae
Genus *Tectocepheus* Berlese, 1913

Tectocepheus velatus (Michael, 1880): Pearce, 1906
Tectocepheus sp.: Prosad, 1965
Tectocepheus latilamellaris Hafeez Kardar, 1974
Tectocepheus translamellaris Hafeez Kardar, 1974
Tectocepheus velatus var. *sarekensis* Tragardh, 1910: Misra (Ph. D. thesis not yet submitted)

Family Oppiidae
Genus *Brachioppia* Hammer, 1961
Brachioppia cuscensis Hammer, 1961: Chakrabarti, Bhaduri and Raychaudhuri, 1977
Genus *Multioppia* Hammer, 1961
Multioppia stillifera Hammer, 1961: Chakrabarti, Bhaduri and Raychaudhuri, 1977
Gneus *Oppia* C.L. Koch, 1836
Oppia yodai Aoki, 1965a: Chakrabarti, Bhaduri and Raychaudhuri, 1977
Oppia fenestralis Wallwork, 1961: Misra (Ph. D. thesis not yet submitted)
Oppia suramericana Hammer, 1958: Misra (op. cit.)
Oppia sp.: Prosad, 1965; Bhaduri and Raychaudhuri, 1967; Singh and Mukherjee, 1971; Singh and Pallai, 1975
Genus *Striatoppia* Balogh, 1958
Striatoppia machadoi Balogh, 1958: Chakrabarti, Bhaduri and Raychaudhuri, 1973
Striatoppia niliaca (Popp, 1960): Chakrabarti, Bhaduri and Raychaudhuri, 1973

Family Suctobelbidae
Genus *Suctobelba* Paoli, 1908
Suctobelba elegantula Hammer, 1958: Chakrabarti, Bhaduri and Raychaudhuri, 1973
Suctobelba quadricarina Hammer, 1958: Chakrabarti, Bhaduri and Raychaudhuri, 1977
Suctobelba ponticulus Hammer, 1971: Chakrabarti, Bhaduri and Raychaudhuri, 1977
Genus *Suctobelbila* Jacot, 1937
Suctobelbila dentata (Hammer, 1961): Chakrabarti and Raychaudhuri, 1973

Family Cymbaeremaeidae
Genus *Cymbaeremaeus* Berlese, 1896
Cymbaeremaeus cymba (Nicolet, 1855): Pearce, 1906
Genus *Scapheremaeus* Berlese, 1910
Scapheremaeus fisheri Aoki, 1966: Chakrabarti and Bhaduri, 1972

Family Pelopidae
Genus *Eupelops* Ewing, 1917
Eupelops acromios (Hermann, 1804): Pearce, 1906
Eupelops acromios minor Chakrabarti, Bhaduri and Raychaudhuri, 1973

Family Oribatellidae

Genus *Lamellobates* Hammer, 1958

Lamellobates pallustris Hammer, 1958: Bhaduri and Raychaudhuri, 1968

Lamellobates angolensis Csiszar, 1961: Bhaduri and Raychaudhuri, 1968

Lamellobates sp.: Bhaduri and Raychaudhuri, 1967

Genus *Paralamellobates* Bhaduri and Raychaudhuri, 1968

Paralamellobates bengalensis Bhaduri and Raychaudhuri, 1968

Family Ceratozetidae

Genus *Hypozetes* Balogh, 1959

Hypozetes imitator Balogh, 1959: Chakrabarti, Bhaduri and Raychaudhuri, 1973

Family Mochlozetidae

Genus *Unguizetes* Sellnick, 1925b

Unguizetes clavatus Aoki, 1967: Chakrabarti, Bhaduri and Raychaudhuri, 1977

Genus *Podoribates* Berlese, 1887

Podoribates sp.: Chakrabarti, Bhaduri and Raychaudhuri, 1973

Family Mycobatidae

Genus *Mycobates* Hull, 1916

Mycobates sp.: Singh and Pillai, 1975

Family Galumnidae

Genus *Galumna* Von Heyden, 1826

Galumna tessellata (Ewing, 1910): Jacot, 1933a

Galumna nilgiria (Ewing, 1910): Jacot, 1933a

Galumna sp.: Anantaraman, 1951; Singh and Mukherjee, 1971; Singh and Pillai, 1975

Genus *Leptogalumna* Balogh, 1960

Leptogalumna sp.: Singh and Mukherjee, 1971

Family Oribatulidae

Genus *Oribatula* Berlese, 1896

Oribatula tibialis (Nicolet, 1855): Pearce, 1906

Oribatula sp.: Singh and Pillai, 1975

Genus *Liebstadia* Oudemans, 1906

Liebstadia similis (Michael, 1888): Pearce, 1906

Genus *Scheloribates* Berlese, 1908

Scheloribates chauhani Baker, 1945

Scheloribates madrasensis Anantarman, 1951

Scheloribates albialatus Hammer, 1961: Misra (Ph. D. thesis not yet submitted)

Scheloribates huancayensis Hammer, 1961: Misra (op. cit.)

Scheloribates luminosus Hammer, 1961: Misra (op. cit.)

Schelorbiates natalensis Pletzen, 1963: Misra (op. cit.)

Scheloribates parvus Pletzen, 1963: Misra (op. cit.)

Scheloribates rectus Hammer, 1958: Misra (op. cit.)

Scheloribates thermophilus Hammer, 1961: Misra (op. cit.)

Scheloribates baloghi Hafeez Kardar, 1976

Scheloribates rufafulvus Hafeez Kardar, 1976

Scheloribates bicuspidatus Hafeez Kardar, 1976
Scheloribates translamellaris Hafeez Kardar, 1976
Scheloribates sp.: Singh and Mukherjee, 1971; Singh and Pillai, 1975

Family Chaunoproctidae
Genus *Chaunoproctus* Pearce, 1906
Chaunoproctus cancellatus Pearce, 1906
Chaunoproctus asperulus Pearce, 1906
Chaunoproctus abalai Bhaduri, Bhattacharya and Chakrabarti, 1975
Chaunoproctus clavisetosus Bhaduri, Bhattacharya and Chakrabarti, 1975

Family Haplozetidae
Genus *Peloribates* Berlese, 1908
Peloribates sp.: Singh and Mukherjee, 1971
Genus *Protoribates* Berlese, 1908
Protoribates sp.: Singh and Pillai, 1975
Genus *Rostrozetes* Sellnick, 1925
Rostrozetes foveolatus Sellnick, 1925: Chakrabarti and Bhaduri, 1972

Correct position of the following species could not be ascertained due to non-availability of the specimens. They are listed here according to Pearce (1906) who reported and described them from Sikkim Himalaya.

Family Phthiracaridae
Genus *Hoploderma* Michael, 1898
Hoploderma claviger Pearce, 1906

Family Notaspidae
Genus *Notaspis* Herman, 1804
Notaspis hammatus Pearce, 1906

Family Oribatidae
Genus *Oribata* Latereille, 1802
Oribata ovalis Nicolet, 1855: Pearce, 1906
Oribata alata var. *major* Pearce, 1906
Oribata fallax Pearce, 1906

Distribution

Oribatid mites are known only from six states of India, viz., West Bengal, Bihar, Orissa, Uttar Pradesh, Tamil Nadu and Sikkim. The other Indian states are completely unexplored in so far as the mites of this group are concerned.

In the table (p.33) all the species of oribatid mites found in the Indian territory till to-day are listed. Only the specimens determined upto the specific level have been considered in the table. The 5 left columns show the occurrence of species in different parts of India, while the other columns their possible occurrence in other parts of the globe. From the table it is found that 54 species have been reported and described from West Bengal, 20 from Sikkim, 12 from Uttar Pradesh, 17 from Orissa (Misra: Ph. D. thesis not yet submitted) and 3 from Tamil Nadu. The reason why there is richness of species in West Bengal is perhaps due to the fact that this state has been better explored in comparison to other states.

Distribution of species in India at present seems to be rather casual, which must be explained as a result of fewer collection and consequently imperfect knowledge of their distribution.

Of the total of 103 species listed in the table 35 species have previously been reported and described from various parts of Southern Hemisphere. India has 19 species common to South America, 17 to Africa, 15 to Indonesia, 8 to New Zealand and 14 to other islands of the Pacific Ocean. Twenty species have a very wide range of distribution and are known from the different parts of Southern as well as Northern Hemisphere. These species include *Eohypochthonius gracilis, Malacoangelia remigera, Hoplophorella scapellata, Rhysotritia ardua, Javacarus kuehnelti, Platynothrus peltifer, Trhypochthonius tectorum, Archegozetes longisetosus, Masthermannia mamillaris, Microzetes auxiliaris, Eremulus flagellifer, Eremulus avenifer, Fosseremus quadripertitus, Carabodes peniculatus, Tectocepheus velatus, Striatoppia machadoi, Eupelops acromios, Lamellobates pallustris, Liebstadia similis,* and *Rostrozetes foveolatus.* The occurrence of these species in various regions of the Southern and Northern Hemispheres shows that our knowledge of the distribution of the oribatids is still very inadequate, but it is also seen that certain species have a far larger distribution and greater tolerance to diverse climatic conditions. It can be presumed that spreading must have taken place by gradually widening distribution through millions of years at a very early stage in the history of the earth before the continental drift when the whole continental surface was a single mass.

Fifteen of the species have previously been recorded only from the territories of the Northern Hemisphere like Europe, Canada, North America, Japan, Greenland and other areas. These species are *Epilohmannia cylindrica, Epilohmannia pallida pacifica, Cryptacarus hirsutus, Cyrthermannia vicinicornuta, Hermannia convexa, Ommatocepheus ocellatus, Microzetes auxiliaris appalachicola, Gustavia palmicinctum, Oppia yodai, Striatoppia niliaca, Cymbaeremaeus cymba, Unguizetes clavatus, Oribatula tibialis, Oribata ovalis,* and *Oribata alata* var. *major.*

Thus it is found that India which belongs to the Oriental realm contains a mixture of Neotropical, Ethiopian and Palaearctic species. The species which have been reported from the tropical plain lands of India like West Bengal, Orissa, Uttar Pradesh and Tamil Nadu agree with the species from South America, Africa, Indonesia and, to some extent, New Zealand, while those recorded from the warm temperate high altitude regions of India like Sikkim and Darjeeling show similarities with the species from Europe, North America, Canada and Japan.

It is interesting to note that certain species are restricted to the warm temperate high altitude regions like Sikkim Himalaya and Darjeeling only and have not been recorded from the tropical plain lands. Thus the occurrence of the species *Platynothrus peltifer, Trhypochthonius tectorum, Hermannia convexa, Liodes ocellatus, Ommatocepheus ocellatus, Gustavia palmicinctum, Amerus speciosus, Liacarus nigrescens, Cymbaeremaeus cymba, Eupelops acromios, Oribatula tibialis, Liebstadia similis, Chaunoproctus cancellatus, Chaunoproctus asperulus, Hoploderma claviger, Notaspis hammatus, Oribata ovalis, Oribata alata* var. *major* and *Oribata fallax* in the warm temperate high altitude regions of Sikkim and Darjeeling and their absence from the tropical plain lands of West Bengal, Orissa, Uttar Pradesh and Tamil Nadu suggest that these species are adapted to the bioecological conditions prevailing there. Some of these species had previously been reported from

Europe and Japan, and some of them from North America, Canada and Greenland.

Relationship between the African and Indian species seems probable, because Africa is nearer to India and is connected with Asia through Middle East. Moreover, Africa has tropical climate in which it agrees with India in some respects.

The similarity and relationship between Indonesian, particularly Javanese, species and Indian species are expected because these regions and many other adjoining islands in the East Indies had a land connection with India through Malayan Archipelago. Indonesia, Thailand and Malaysia which belong to the Oriental realm have geographical and climatic conditions similar to those in India.

Now the question naturally crops up about Neotropical influence in the Oriental Region like India and how the species from South America and New Zealand have gained footing in India. Despite topographical differences striking similarities are observed between the species from South America and India. Several continental masses like peninsular India, Africa, South America and Oceania were more closely aggregated in late Palaeozoic time forming Gondwana land. Therefore, perhaps similarities and relationship occur between India, South America, Africa and New Zealand.

Most of the species recorded from the high altitude regions of Sikkim and Darjeeling agree with European species, some with the species from Japan, North America and Canada. Sikkim stands on the border line of the Oriental and Palaearctic realms. The climate of Sikkim, particularly concerning the temperature and the degree of moisture, is somewhat similar to that of Europe, Japan and other temperate regions due to the presence of the Great Himalayan Range which rears its mighty summits far beyond the limits of perpetual snow. Therefore, Palaearctic influence dominates in Sikkim and Darjeeling which agree in oribatid fauna with Europe, Japan, North America, Canada and other warm temperate to temperate regions of the earth.

The far and wide distribution of oribatid mites suggests that they are a very ancient group of animals presumably spread over large areas of the world before land mass became divided to form the present continents.

With our present state of knowledge of the oribatids of the vast Indian territory it will be too early to suggest how the country have been populated with the mites of this group. At present it is difficult to make a detailed discussion on the zoogeography as our knowledge of oribatids of the Indian subcontinent is still rather poor. A thorough faunistic survey of the soil oribatid mites should be undertaken in order to throw more light on the distribution of this group of mites in India and on world basis.

Table 1. Distribution of Indian oribatid mites

Species	West Bengal	Orissa	Uttar Pradesh	Tamil Nadu	Sikkim	South America	Africa	New Zealand	Europe	North America	Canada	Japan	Egypt	Indonesia	Malaysia	Thailand	Tahiti	Fiji
Eohypochthonius gracilis	×	..	..	..	..	..	..	..	..	×	..	..	..	×	×	..	..	..
Eohypochthonius vilhenarum	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Malacoangelia remigera	×	..	..	..	..	..	×	..	..	..	..	..	..	×	×	..	×	×
Malacoangelia remigera indica	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Haplochthonius clavatus	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Haplochthonius intermedius	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cosmochthonius bengalensis	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sphaerrochthonius transversus	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Hoplophorella africana	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Hoplophorella scapellata	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	×	×	..
Rhysotritia ardua	..	..	×	..	..	..	..	..	×	×	×	..	..	×	..	..	×	..
Rhysotritia peruensis	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Epilohmannia cylindrica	..	..	×	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..
Epilohmannia pallida pacifica	×	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Annectacarus longisetosus	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cryptacarus hirsutus	×	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..
Cryptacarus tuberculatus	×	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
Cryptacarus dendrisetosus	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Haplacarus foliatus	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	×	..	..
Haplacarus foliatus bengalensis	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Javacarus kuehnelti	×	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	×	×
Papillacarus indicus	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Papillacarus simplirostratus	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Platynothrus peltifer	..	..	..	..	×	..	..	..	×	..	×	×	..	..	..	..	..	..
Trhypochthonius tectorum	×	..	..	..	×	..	..	..	×	..	×	×	..	..	..	..	..	..
Allonothrus indicus	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Allonothrus monodactylus	×	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Allonothrus russeolus	×	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Archegozetes longisetosus	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	×	..	..
Archegozetes magna	×	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
Trimalaconothrus cajamarcensis	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Trimalaconothrus longirostrum	..	×	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..
Cyrthermannia vicinicornuta	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..
Cyrthermannia quadricornuta	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nanhermannia himalayensis	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Masthermannia mamillaris	×	..	..	..	..	..	..	..	×	×	..	..	..	×	..	..	×	×
Hermannia convexa	..	..	..	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Liodes (?) ocellatus.	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Plateremaeus rotandus	×	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
Ommatocepheus ocellatus	..	..	..	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Microzetes auxiliaris	×	..	..	..	..	×	..	..	..	×	..	×	..	×	×	..	..	..
Microzetes auxiliaris appalachicola	×	..	..	..	..	..	..	..	..	×	..	..	..	..	..	..	..	..
Microzetes peruensis	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Gustavia palmicinctum	..	..	..	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Amerus speciosus	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Eremulus flagellifer	×	..	..	..	..	..	..	×	×	..	..	..	..	×	..	..	..	..
Eremulus avenifer	×	..	..	..	..	..	..	..	..	..	..	×	..	×	..	..	..	..
Fosseremus quadripertitus	..	..	×	..	..	..	..	×	×	..	..	..	..	×	..	..	..	..
Carabodes peniculatus	×	..	..	..	..	..	..	..	..	..	..	×	..	×	..	..	..	..
Basilobelba indica	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Liacarus nigrescens	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Tectocepheus velatus	×	..	..	..	×	..	..	×	×	×	×	×	..	..	..	..	..	..

Table 1. (Continued)

Species	West Bengal	Orissa	Uttar Pradesh	Tamil Nadu	Sikkim	South America	Africa	New Zealand	Europe	North America	Canada	Japan	Egypt	Indonesia	Malaysia	Thailand	Tahiti	Fiji
Tectocepheus velatus var. *sarekensis*	..	×	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..
Tectocepheus latilamellaris	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Tectocepheus translamellatus	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Brachioppia cuscensis	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Multioppia stillifera	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Oppia yodai	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×	..	..
Oppia fenestralis	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Oppia suramericana	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Striatoppia machadoi	×	..	..	..	..	..	×	..	..	×	..	..	..	..	..	..	..	..
Striatoppia niliaca	×	..	..	..	..	..	×	..	..	..	..	..	×	..	..	..	..	..
Suctobelba elegantula	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Suctobelba quadricarina	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Suctobelba ponticula	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	×
Suctobelbila dentata	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Cymbaeremaeus cymba	..	..	..	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Scapheremaeus fisheri	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eupelops acromios	..	..	..	..	×	..	×	..	×	..	..	..	..	×	..	..	..	..
Eupelops acromios minor	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lamellobates pallustris	×	..	..	..	..	×	..	×	..	..	..	..	..	..	..	×	..	..
Lamellobates angolensis	×	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Paralamellobates bengalensis	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hypozetes imitator	×	..	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Unguizetes clavatus	×	..	..	..	..	..	..	..	..	..	..	×	..	..	..	×	..	..
Galumna tessellata	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Galumna nilgiria	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Oribatula tibialis	..	..	..	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Liebstadia similis	..	..	..	..	×	..	..	×	×	..	..	..	..	..	..	..	..	..
Scheloribates albialatus	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates huancayensis	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates luminosus	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates natalensis	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Scheloribates parvus	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Scheloribates rectus	..	×	..	..	..	×	×	..	..	..	..	..	..	..	..	..	..	..
Scheloribates thermophilus	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates chauhani	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates madrasensis	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates baloghi	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates rufafulvus	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates bicuspidatus	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scheloribates translamellaris	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Calloppia papillata	..	×	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..
Chaunoproctus cancellatus	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Chaunoproctus asperulus	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Chaunoproctus abalai	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Chaunoproctus clavisetosus	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Rostrozetes foveolatus	×	..	..	..	..	×	..	×	..	×	..	×	..	×	..	..	..	..
Hoploderma claviger	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Notaspis hammatus	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
Oribata ovalis	..	..	..	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Oribata alata var. *major*	..	..	..	..	×	..	..	..	×	..	..	..	..	..	..	..	..	..
Oribata fallax	..	..	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..

Acknowledgements

The first author is grateful to Dr. D. B. Dutta, Principal, Vidyasagar College, Calcutta for laboratory facilities and to Dr. S. K. Bhattacharya, Zoological Survey of India for valuable suggestions and criticism. This paper is partly supported by grant from Ministry of Education, Japanese Government.

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