



Biosystematics and Biogeography of Indian Mantodea (Insecta)

Sureshan, P. M.*¹ and Kamila, A.P²

Zoological Survey of India, Western Ghat Regional Centre
Kozhikode 673006, Kerala, India.

pmsuresh43@gmail.com¹; kamiii619@gmail.com²

Abstract

Praying mantises are always been an attractive insect group. Even though they are charismatic, the studies on them are still untouched in many parts of the world. Here, we are discussing the biosystematics and biogeography of praying mantids of India.

Introduction

The order Mantodea (Insecta) popularly called “Praying mantises”, “Preying mantids” etc. includes large predatory insects, distributed in tropical and subtropical habitats of the world. They are small to large, stubby to elongate, rather slow moving insects that are striking in appearance because of their peculiarly modified forelegs. They have a head which is freely movable and they are the only group of insects that can rotate the head to 180 degrees. The size of mantids ranges from 1cm to more than 17cm and females are usually larger than males. Mantids also exhibit interesting behaviour patterns such as camouflage, mimicry and cannibalism. They groom themselves frequently; they wipe their eyes and head using their forelegs, clean their forelegs with the mouth. When faced with danger, most species attempt to run or fly away while some do assume a threatening posture. Mantids remain motionless for hours together, often on a suitable place like flowers that attract insects, with only the head moving to watch approaching insects that serve as their food. Mantids are exclusively carnivorous feeding mainly on other arthropods as well as small vertebrates, thus having a very important ecological role in the suppression of herbivorous insect populations including major agriculture pests (Symondson *et al.*, 2002). Though ecologically important,

the studies on preying mantids have been largely ignored and in Indian context the situation is also not encouraging. The present study is the compilation of information from literatures to detail the biosystematics and biogeography of Indian praying mantids.

Biosystematics

The early works on mantid fauna of India were started in the late 1700s. Major studies on Indian Mantodea were undertaken mainly by foreigners like Thunberg, Saussure, Stål, Burmeister, Beier, Uvarov etc. during the pre-independence period. One of the significant contributor on Indian Mantodea was Wood-Mason (1889, 1891), the then curator of Indian Museum, Calcutta. In the early 1930s, Werner made notable contributions to the study of Indian mantid fauna. The contributions by Indian scientists are very negligible during the post-independence period. After the independence, Nadkerny (1965) studied the collections of mantids at Bombay Natural History society. Mukherjee and Hazra (1983-1992) published several papers on Indian Mantodea which included many new taxa. Mukherjee *et al.* (1995) compiled a comprehensive list with a possible dichotomous key up to specific level of Indian mantids which included 162 species under 68 genera and 6 families.

Thereafter some studies on regional mantid fauna of various Indian states are being undertaken by scientists and such studies yielded some new distributional records and few new taxa. In 2014, Mukherjee *et al.* compiled the checklist of Indian Mantodea following the then latest classification by Ehrmann (2002). Accordingly, 169 species under 71 genera and 11 families were listed out from India. The classification of Mantodea was always in a state of flux and the most relevant system of classification of the order were Giglio-Tos (1919), Handlirsch (1930), Chopard (1949), Beier (1964) and Ehrmann (2002). Recently, Schwarz and Roy (2019) provided the latest classification system for Mantodea based mainly on male genital structure supplemented by morphological, chromosomal and molecular data. Accordingly, more than 2500 species of mantids belonging to 436 genera under 31 families are known worldwide (Anderson, 2022) out of which 169 species under 69 genera in 13 families and 7 superfamilies are known from the country (Kamila and Sureshan, 2022b). The contribution of Indians towards the enrichment of Indian mantid fauna is only 2 genera and 20 species since the late nineties to till date. Recently, two species from Southern Western Ghats were newly described (Kamila and Sureshan, 2022a; Sureshan *et al.*, 2023).

The Indian families and subfamilies present in the order Mantodea are given below (Kamila and Sureshan, 2022b).

CLASS INSECTA

ORDER MANTODEA

I. Superfamily METALTYICOIDEA Giglio-Tos, 1917

1. Family Metaltyicidae Giglio-Tos, 1917

II. Superfamily EREMIAPHILOIDEA Saussure, 1869

2. Family Eremiaphilidae Saussure, 1869

Subfamily: Eremiaphilinae

Iridinae

Parathespininae

3. Family Rivetinidae Ehrmann & Roy, 2002

Subfamily: Deiphobinae

Rivetininae

4. Family Toxoderidae Saussure, 1869

Subfamily: Oxyothespininae

Toxoderinae

III. Superfamily GONYPETOIDEA Westwood, 1889

5. Family Gonypetidae Westwood, 1889

Subfamily: Gonypetinae

Iridopteryginae

IV. Superfamily HAANIOIDEA Giglio-Tos, 1915

6. Family Haaniidae Giglio-Tos, 1915

Subfamily: Caliridinae

Haaniinae

V. Superfamily HYMENOPOIDEA Giglio-Tos, 1915

7. Family Empusidae Burmeister, 1838

Subfamily: Blepharodinae

Empusinae

8. Family Hymenopodidae Giglio-Tos, 1915

Subfamily: Acromantinae

Hymenopodinae

Oxypilinae

Phyllothelyinae

VI. Superfamily MANTOIDEA Latreille, 1802

9. Family Deroplatyidae Westwood, 1889

Subfamily: Deroplatyinae

10. Family Mantidae Latreille, 1802

Subfamily: Choeradodinae

Hierodulinae

Mantinae

Tenoderinae

VII. Superfamily NANOMANTOIDEA Brunner De Wattenwyl, 1893

11. Family Amorphoscelidae Stål, 1877

Subfamily: Amorphoscelinae

12. Family Leptomantellidae Schwarz & Roy, 2019

13. Family Nanomantidae Brunner De Wattenwyl, 1893

Subfamily: Nanomantinae

Tropidomantinae

The diversity of mantid fauna of Maharashtra, Kerala, Tamil Nadu, Uttar Pradesh and West Bengal are better documented when compared to the other parts of the country (Table-1). The ecological regions of deserts and semi-arid areas, Andaman and Nicobar Islands, North-East India, Gangetic plains, Central India and major parts of the Deccan plateau are very poorly explored for mantid collections. Studies on the ecology, biology, ethology and phylogeny of this

interesting group of insects are also greatly neglected in India.

Table- 1. The state-wise status of mantid fauna.

States/ Union-territories	Number of genera	Number of species
Andhra Pradesh	25	31
Arunachal Pradesh	14	21
Assam	23	27
Bihar	17	20
Chhattisgarh	26	33
Gujarat	8	9
Goa	8	9
Haryana	0	0
Himachal Pradesh	14	21
Jharkhand	7	7
Karnataka	29	39
Kerala	41	68
Madhya Pradesh	18	27
Maharashtra	29	55
Manipur	8	9
Meghalaya	17	25
Mizoram	0	0
Nagaland	4	4
Odisha	19	27
Punjab	4	4
Rajasthan	10	11
Sikkim	10	17
Tamil Nadu	34	53
Telangana	5	6
Tripura	1	1
Uttar Pradesh	28	49
Uttarakhand	1	1
West Bengal	29	45

States/ Union-territories	Number of genera	Number of species
Andaman & Nicobar	8	12
Chandigarh	2	2
Dadra Nagar Haveli, Daman & Diu	1	1
Delhi	0	0
Jammu & Kashmir	4	4
Ladakh	0	0
Lakshadweep	1	1
Puducherry	3	3

Biogeography

The biogeography of world Mantodea has not been much studied until the 21st century. There have been several publications dealing with the biogeography of praying mantids of different areas. They are; Rivera and Cobián (2017) on Peruvian mantids, Ursani *et al.* (2017) on mantids of Punjab, Pakistan, Okely *et al.* (2020) on Egyptian mantids. The main biogeographic works on single taxa are; Rivera *et al.* (2011) on the genus *Pseudopogonogaster* Beier, 1942; Shcherbakov (2017) on the genus *Parapsychomantis* Shcherbakov, 2017; Rivera (2017) on Neotropical polymorphic earless praying mantises.

Mantodea is generally assumed to be poor dispersers (non-migrants) (Johnson 1969). However, the ootheca of mantids are resistant to all kinds of harsh conditions and this allows for an easy distribution of species via floating driftwood or human dispersal (Salt and James, 1947; Ehrmann 2002). It is also assumed that several interesting disjunctive distributions among extant and fossil Mantodea worldwide may be due to the same reasons. The most comprehensive study on the biogeography of Mantodea was published by Svenson and Whiting (2009) based on molecular data.

The studies on the mantid fossils indicate that mantids originated in the early Jurassic period and most modern mantises originated on Gondwana in the Cretaceous (Svenson and Whiting, 2009). Mantid fauna of the Oriental region shows close affinity with that of the Afrotropical and Australasian regions. Neotropical and Nearctic elements are very rarely reported from the region. The occurrence of a Neotropic Subfamily Choeradodinae represented by the genus *Asiadodis* in the Oriental region is an example of disjunctive distribution. As per the classification of

Schwarz and Roy (2019), three families (Metallicidae, Leptomantlidae and Haaniidae) and seven subfamilies (Tropidomantinae, Iridopteryginae, Deiphobinae, Parathespininae, Iridinae, Phyllothelinae and Deroplatyinae) are endemic to the Oriental region. The other families occurring in the Oriental region are Gonypetidae, Hymenopodidae, Mantidae, Deroplatyidae, Rivetinidae, Toxoderidae, Empusidae, Eremiaphilidae, Amorphoscelidae and Nanomantidae. An analysis of the distributional data of Indian taxa shows that the mantid fauna of India is mainly composed of Oriental elements at the generic level. Among the 69 genera reported from the country 57 are distributed only in the oriental region and out of which 7 genera endemic to India (*Dysaulophthalma*, *Parariventina*, *Cotigaonopsis*, *Indothespis*, *Toxodanuria*, *Indomenella* and *Parananomantis*). Four genera (*Amorphoscelis*, *Iris*, *Blepharopsis* and *Empusa*) are common in the Oriental and Afrotropical regions. The genera *Mantis* and *Tenodera* have a wider distribution and are common in the Oriental, Afrotropical, Palearctic and Australian regions. The genera *Nanomantis*, *Acromantis*, and *Tamolonica* are common in the Oriental and Australasian regions while the genera *Toxomantis* and *Euthyphleps* are common in the Oriental and Palearctic regions. The genus *Statilia* occur in Oriental, Afrotropical and Australasian regions and the genus *Hierodula* occur in Oriental, Palearctic and Australasian regions.

The analysis of the available data shows that some species of *Mantis*, *Statilia*, *Tenodera*, *Hierodula*, *Humbertiella*, *Eomantis* and *Amorphoscelis* are widely distributed in the country. Species like *Didymocorypha lanceolata* (Fabricius, 1798), *Schizocephala bicornis* (Linnaeus, 1758), *Gongylus gongyloides* (Linnaeus, 1758), *Creobroter apicalis* Saussure, 1869 and *Ephestiasula rogenhoferi* (Saussure, 1872) were

reported from almost all parts of the country. The species of family Eremiaphilidae is restricted to the semi-arid area of the country. Twelve species of mantids are so far reported from Andaman and Nicobar Islands including an endemic species viz. *Acromantis nicobarica* Mukherjee, 1995 while only one species (*Hierodula tenuidentata* Saussure, 1869) is reported from Lakshadweep Islands which is probably an introduced species. The records of some species from the island ecosystems may be due to introduction from the main land. The fauna of South and North Eastern India appears richer than other parts of the country indicated by the occurrence of rare taxa. More interesting taxa of mantids will be discovered from the tropical rainforests of Western Ghats and North east India if serious field explorations are undertaken in these regions. Because of the incompleteness in the field explorations and collection of specimens throughout the country, it is very difficult to make a general statement on the distributional patterns of mantids at species level.

Discussion

Though order Mantodea is considered an economically

important group of insects, the group has been greatly neglected for biosystematics from India. Taxonomic revisions of mantid taxa supplemented by the modern tools of molecular studies are very essential. Due to the incompleteness of field studies and poor documentation of diversity, it is not possible to predict a pattern of distribution for Indian Mantodea. Being a less studied group of insects, taxonomic research in the group has to be promoted in order to understand the mantid biodiversity of the country and utilizing them for biological control programmes against agricultural pests. Detailed studies on the life history, ecology, ethology, phylogeny or any other facet of mantid life will also be highly rewarding in entomological science.

Acknowledgment

We are thankful to the Director, Zoological Survey of India, Kolkata for giving the opportunity and facilities. We are also grateful to the Officer-in-Charge, WGRC, Zoological Survey of India, Kozhikode for the support and encouragement. The second author is thankfully acknowledges University of Calicut for giving the opportunity to do the Ph.D., and University Grand Commission for the funding.

References

- Anderson, K. 2022. Mantodea Mundi: July 2022. Las Vegas: Kris Anderson.
- Beier, M. 1964. Ordnung: Mantodea Burmeister 1838 [Order: Mantodea Burmeister, 1838]. In: Bronns, H.G. (Ed.), *Klassen und Ordnungen des Tier reichs, wissenschaftlich dargestellt in wort und bild*, 849-970 (Published by C.F. Winter, Leipzig, Germany).
- Chopard, L. 1949. Sous-ordre des Mantodea. In: *Traité de Zoologie*, 9: 386-407 (Published by Masson, Paris).
- Ehrmann, R. 2002. *Mantodea: Gottesanbeterinnen der Welt*. 375 pp (Published by Natur und Tier, Munster, Germany).
- Giglio-Tos, E. 1919. Saggio di una nuova classificazione dei mantidi. *Bullettino della Società Entomologica Italiana*, 49: 50-87.
- Handlirsch, A. 1930. Mantodea oder Fangheuschrecken. In: *Handbuch der Zoologie, 4. Progoneata-Chilopoda-Insecta I (10) ordnung der Pterygonea*, 803-819 (Published by Walter de Gruyter & Co, Berlin und Leipzig).
- Johnson, C.G. 1969. *Migration and dispersal of insects by flight*, 763pp (Published by Methuen & Co. Ltd., London)
- Kamila, A.P. and Sureshan, P.M. 2022a. Taxonomic study on praying mantids (Insecta: Mantodea) of Goodrical range forest, Kerala, India, with the description of a new species. *Entomon*. 47(1):89-102. doi:10.33307/entomon.v47i2.708.
- Kamila, A.P. and Sureshan, P.M. 2022b. An updated checklist of mantid fauna (Insecta: Mantodea) of India. *Halteres* (This paper is published recently. Volume number and page numbers are; 13: 15-34).
- Mukherjee, T.K. and Hazra, A.K. 1983. On a small collection of Mantidae (Dictyoptera) from Maharashtra, India, with the description of a new species. *Records of Zoological Survey of India*, 80: 459-465.
- Mukherjee, T.K. and Hazra, A.K. 1985. New record of deserticolous mantid family (Mantodea: Eremiaphilidae) from India. *Entomon*, 10(3): 245-247.
- Mukherjee, T.K. Hazra, A.K. and Balderson, J. 1992. Type specimens of Mantodea in the Zoological Survey of India collections, Calcutta, India. *The Raffles Bulletin of Zoology*, 40(1): 65-68.

- Mukherjee, T.K., Hazra, A.K. and Ghosh, A.K. 1995. The mantid fauna of India (Insecta: Mantodea) *Oriental Insects*, **29**: 185-358.
- Mukherjee, T.K., Ehrmann, R. and Chatterjee, P. 2014. Checklist of Mantodea (Insecta) from India. *Priamus*, 1015: 8243.
- Nadkerny, N.T. 1965. A note on the Mantids and Tettigonids in the collection of the Bombay Natural History Society. *The journal of the Bombay Natural History Society*, **62** (1): 76-83.
- Okely, M., Nasser, M., Enan, R., GadAllah, S. and AlAshaal, S. 2020. Mantodea oasis of Palaearctic region: biogeographical analysis of Mantodea in Egypt. *Egyptian Journal of Biological Pest Control*, **30**: 136. <https://doi.org/10.1186/s41938-020-00336-8>
- Rivera, J., Yagui, H. and Ehrmann, R. 2011. Mantids in the Mist – Taxonomy of the Andean genus *Pseudopogonogaster* Beier, 1942, a cloud forest specialist, with notes on its biogeography and ecology (Mantodea: Thespidae: Miopteryginae). *Insect Systematics & Evolution*, **42**(4):313-335.
- Rivera, J. 2017. *Systematics and Biogeography of the Neotropical “Polymorphic Earless Praying Mantises” (Mantodea: Acanthopoidea)*. Ph.D. thesis, Department of Ecology and Evolutionary Biology, University of Toronto, 457 pp.
- Rivera J. and Cobián C.V. 2017. A checklist of the praying mantises of Peru: new records, one new genus (*Piscomantis* gen. n.) and biogeographic remarks (Insecta, Mantodea). *Zootaxa*, **4337** (3): 361-389. DOI: 10.11646/zootaxa.4337.3.3. PMID: 29242423.
- Salt, R.W. and James, H.G. 1947. Low temperature as a factor in the mortality of eggs of *Mantis religiosa*. *The Canadian Entomologist*, **79**: 33-36.
- Shcherbakov, E. 2017. New genus and species of flower mantids (Insecta: Mantodea: Hymenopodidae) from Vietnam. *Proceedings of the Zoological Institute RAS*, **321**(4):411.
- Schwarz, C.J. and Roy, R. 2019. The systematics of Mantodea revisited: an updated classification incorporating multiple data sources (Insecta: Dictyoptera). *Annales de la Société entomologique de France (N.S.)*, **55**(2): 101-196.
- Sureshan, P.M., Kamila, A.P. and Fasano, A. 2023. Description of a new species of praying mantis (Insecta: Mantodea) from Agasthyamalai Biosphere Reserve, India, *Oriental Insects*, DOI: 10.1080/00305316.2023.2192530.
- Svenson, G.J. and Whiting, M.F. 2009. Reconstructing the origins of praying mantises (Dictyoptera, Mantodea): the roles of Gondwanan vicariance and morphological convergence. *Cladistics*, **25**: 468-514.
- Symondson, W.O.C., Sunderland, K.D. and Greenstone, M. H.2002. Can generalist predators be effective biocontrol agents? *Annual Review of Entomology*, **47**:561–94.
- Ursani, T.J., Khokhar, J.A., Dhiloo, K.H., Malik, S., Yaseen, M., Chandio, J.I., Soomro, A.R. and Chandio, W.A. 2017. Biodiversity and biogeography of praying mantid (Dictyoptera: Mantodea) in Punjab, Pakistan. *Journal of Biodiversity and Environmental Sciences*, **11**(5): 251-257.
- Werner, F. 1930. Indian Mantids or Praying Insects. *Proceedings of the Zoological Society of London*, 689-690.
- Werner, F. 1931. Further notes on Indian Mantids or praying insects. *Proceedings of the Zoological Society of London*, 1329-1334.
- Werner F. 1933. Third contribution to the knowledge of Indian Mantids or Praying Insects. *Proceedings of the Zoological Society of London*, 897-901.
- Werner F. 1935. Further communication on Indian Mantids or praying Insects. *Proceedings of the Zoological Society of London*, 495-498.
- Wood-Mason, J. 1889. A catalogue of the Mantodea with descriptions of new genera and species, and an enumeration of the specimens, in the collection of the Indian Museum. *Trustees of the Indian Museum, Calcutta*, **1**: 1-48 pp.
- Wood-Mason, J. 1891. A catalogue of the Mantodea with descriptions of new genera and species, and an enumeration of the specimens, in the collection of the Indian Museum. Issue 2. *Trustees of the Indian Museum, Calcutta*, **2**: 49-66, pl. I–II.