



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 1038-1042

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Received: 13-01-2018

Accepted: 14-02-2018

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Diversity of mantids (Insecta: Mantodea) of Howrah district, West Bengal, India

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Abstract

The main aims of the present study were documentation of species, habitats and other ecological behaviors of Mantids in district Howrah, West Bengal, India during February 2013- October 2017. A total of 10 species of Mantids belonging to 9 genera under the three families viz., Hymenopodidae, Mantidae and Liturgusidae were documented. Under these 3 families 6 sub families and 7 tribes were present. Mantidae was the dominant family followed by Hymenopodidae and Liturgusidae. *Hestiasula brunneriana*, *Hierodula membranacea* and *Tenodera aridifolia* were uncommon species of the district. *Hierodula membranacea* and *Tenodera aridifolia* were found close to agricultural fields.

Keywords: mantids, predator, praying mantis, mantodea, Howrah, West Bengal, India

1. Introduction

Mantids (Insecta: Mantodea), usually known as Praying Mantis, hold significant place in the ecosystem as predators, mainly feed on grasshoppers, moths, butterflies, flies, aphids and they are well adapted in camouflage and mimicry^[1]. Mantids have attained their common popular name from the way they raise their two fore legs in a posture of prayer. They are often found waiting still for hours together for their prey with their heads rotating 180°^[2]. They are diurnal and are attracted to lights at night^[3]. They are weak flies and are generally seen sitting on herbs, shrubs and trees^[4]. There are around 2300 species of mantids under 434 genera all over the world^[5]. There are 162 species of mantids under 68 genera of six families in India^[6]. Research on mantids in India was further propelled by several researchers in India^[7-12]. 35 species and 24 genera of mantids have so far been recorded from all over West Bengal^[6]. Others work from state West Bengal is from District Purulia recorded six species from that district^[3]. There being no Mantids fauna from the Howrah district in particular, the present study aims at making a Mantid inventory though recording Mantid species from the district. In the face of rapid decline of all organism and habitats owing to fast urbanisation and industrialisation in this district, a list of Mantid fauna is extremely necessary to observe change in their biodiversity. We are representing here mantids diversity of Howrah district. Due to important ecosystem services of mantids and rapid habitat degradation, it is very important to study about the mantids diversity of this district along with their distribution and abundance.

2. Material and Methods

2.1 Study Area and Monitoring

Howrah is one of the small districts (467 km²) of the West Bengal situated southern part of this state (Fig 1). The Howrah district located between 22°48' N and 22°12' N latitudes and between 88°23' E and 87°50' E longitudes. Rupnarayan River and Bhagirathi-Hooghly River boundary are the west and east borderline of this district whereas Bally canal and Damodar River are situated north-east and north-west boundary. Annual average rainfall is 1461 millimetre and temperature varies between 9-42°C.

2.2 Sampling techniques and species identification

Different habitats of this district was assessed during February, 2013 to October, 2017 through line transect method. In this method 2 permanent 400 m line transects was setup in each 15 block of this district. By using these transects walked once a month to follow Pollard Walk Method^[13,14] for documenting the Mantids. A slow 180 degree visual sweep was carrying out during walking. Documentation were done on the whole the seasons viz., summer (March to May), monsoon (June to October), and post monsoon (November to February). Collection of

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samples was avoided to the extent possible. Generally photographic documentation was done. Photographs were taken using Cannon EOS 550D with 18-55 mm lens. Identification of Mantid species was done with the help of these authentic literatures ^[1,5,6] and by some Mantid experts.

2.3 Data analysis

Data analyses were performed by PAST software Version 3.02 ^[15].

a. Measurement of diversity

The type of diversity used here is α - diversity which is the diversity of species within a community or habitat. The diversity index was calculated by using the diversity index ^[16].

Diversity index = $H = -\sum P_i \ln P_i$, where $P_i = S / N$

S = number of individuals of one species

N = total number of all individuals in the sample

In = logarithm to base e

b. Measurement of species richness

Margalef's index was used as a simple measure of species richness ^[17].

Margalef's index = $(S - 1) / \ln N$

S = total number of species

N = total number of individuals in the sample

In = natural logarithm

c. Dominance and Simpson Index

$D = \sum (n_i/n)^2$ where n_i is number of individuals of taxon i.

Dominance = 1-Simpson index. Ranges from 0 (all taxa are equally present) to 1 (one taxon dominates the community completely).

Simpson index 1-D. Measures 'evenness' of the community from 0 to 1. Dominance and Simpson indices are often used interchangeably.

d. Species Accumulation Curve

Species accumulation curve is a move towards by plotting the cumulative number of species recorded against the sampling years (2013-2017). Species accumulation curve is a move towards by plotting the cumulative number of species recorded against the sampling years (2013-2017). From the year 2013, the species accumulation curve of whole district sampled individually, increased from 2013 to 2016 sampling through the number of new records added slowly but after 2016 number of new records were same in 2017.

e. PCA (Principle Component Analysis)

Principal components analysis (PCA) finds hypothetical variables (components) accounting for as much as possible of the variance in multivariate data ^[18, 19]. Two variables were choosing based on higher variance and eigenvalue scale. Density was plotted as component 1 and frequency was plotted on component 2.

3. Results

A total of 10 species of Mantids (Table 1) belonging to 09 genera of three families viz., Hymenopodidae, Mantidae and Liturgusidae were recorded from the district Howrah, West Bengal, India. Among 10 species (Fig 2) of Mantids 6 (60%) species were from family Mantidae, 3 (30%) species were from family Hymenopodidae and one (10%) species from family Liturgusidae (Fig 3). Under these 3 families 6 sub families (Hymenopodinae, Acromantinae, Paramantinae,

Amelinae, Mantinae and Liturgusinae) and 7 tribes (Hymenopodini, Acromantini, Mantini, Paramantini, Amelini, Polyspilotini and Liturgusini) were present. Documented Species description:

1) *Creobroter apicalis* Saussure, 1869 (Flower Mantis) (Fig 2A)

Greenish to pinkish coloured small mantis found on flowers and leaves wait for insects.

Butterflies, moths, bees and flies were their preferable foods.

2) *Hestiasula brunneriana* Saussure, 1871 (Unicorn Boxer Mantis) (Fig 2B)

Body brownish and wings were greenish. Superior edge of fore femora was domed, foliaceous, oval, internally with 3 black spots. Generally found on leaves of bushes, shake fore legs when got afraid.

3) *Odontomantis* Saussure, 1871 (Asian Ant Mantis) (Fig 2C1 and 2C2)

Nymphs were blackish resembled to little black ant. Praying fore legs was diagnostic character to identify nymphs as praying mantis. During growth they finally lost their ant-like form and embark on to look more like conventional praying mantis.

4) *Statilia apicalis* (Saussure, 1871) (Jumping Mantis) (Fig 2D)

Greyish to greenish in colour, relatively long in size and head was small in size. Very active in night and attracted by domestic light also. Small moths and grasshoppers were their very favorite food items.

5) *Statilia maculata* (Thunberg, 1784) (Asian Jumping Mantis) (Fig 2E)

Body brownish in colour, relatively long sized species and forewings were also long with costal area dark, discoidal area semi-unclear, cloudy. Antennae were also very long in sized. Grasshoppers and flies were their favorite food.

6) *Mantis religiosa inornata* Werner, 1930 (European Mantis) (Fig 2F)

Long in size, greenish, narrow, anterior femur with 4 discoidal and 4 external spines. Often found on herbs and shrubs, camouflaged with surroundings, also found in some agricultural fields. Feed on several types of insects, generally grasshopper, moths and flies were their preferable hunts.

7) *Hierodula membranacea* Burmeister, 1838 (Giant Asian Mantis) (Fig 2G)

Long in size, stout, greenish anterior femur with 4 discoidal and 4 external spines. Foods were butterflies, moths, aphids and beetles. Grasshoppers were their preferable food. Generally found on herbaceous plants.

8) *Amantis Giglio-Tos*, 1915 (Fig 2H1 AND 2H2)

Medium in size, blackish in colour and end part of body was more or less rounded. Antennae were short to medium sized. Flies were their preferable food. Very active in night and attracted by domestic light also.

9) *Tenodera aridifolia* (Stoll, 1813) (Fig 2I)

Long in size, stout and colour was greenish. Often found on herbs and shrubs, camouflaged with surroundings. Found on bushes of roadside, small forest and besides of agricultural

fields. Feed on several types of insects, generally grasshopper, moths and flies were their preferable hunts.

10) *Humbertiella ceylonica* Saussure, 1869 (Bark Mantis) (Fig 2J)

Greyish in colour, pronotum broader anteriorly and size was medium. Generally found on bark of older trees, close to ground. Very fast and keep with great camouflaged with bark of trees. Wait for their prey and hunts them quickly. Walking

beetles, ants and other insect by chance came to close.

Measurements of diversity related indices are represents in the table 2. Principal component analysis (PCA) of mantids of Howrah district, West Bengal based on Density and Frequency data (these two variables are taken based on higher Variance and Eigenvalue scale) are presented in fig 4. On both the cases, X axis (component 1) i.e. Density and on the Y axis (component 2) i.e. Frequencies are plotted which show similarities between different species.

Table 1: List of Mantids fauna of Howrah district (West Bengal, India)

SI No.	Name of the Species	Tribe	Subfamily	Family	Status
1	<i>Creobroter apicalis</i> Saussure, 1869	Hymenopodini	Hymenopodinae	Hymenopodidae	C
2	<i>Hestiasula brunneriana</i> Saussure, 1871	Acromantini	Acromantinae	Hymenopodidae	R
3	<i>Odontomantis</i> Saussure, 1871	Acromantini	Acromantinae	Hymenopodidae	C
4	<i>Statilia apicalis</i> (Saussure, 1871)	Mantini	Paramantinae	Mantidae	C
5	<i>Statilia maculata</i> (Thunberg, 1784)	Mantini	Paramantinae	Mantidae	U
6	<i>Mantis religiosa inornata</i> Werner, 1930	Mantini	Paramantinae	Mantidae	C
7	<i>Hierodula membranacea</i> Burmeister, 1838	Paramantini	Paramantinae	Mantidae	U
8	<i>Amantis</i> Giglio-Tos, 1915	Amelini	Amelinae	Mantidae	C
9	<i>Tenodera aridifolia</i> (Stoll, 1813)	Polyspilotini	Mantinae	Mantidae	R
10	<i>Humbertiella ceylonica</i> Saussure, 1869	Liturgusini	Liturgusinae	Liturgusidae	C

[C: Common (>15), U: Uncommon (5-15), R: Rare (<5)]

Table 2: Measurements of diversity related indices

SL. No.	Diversity related indices	Calculated result
1	Taxa_S	10
2	Simpson_1-D	0.8577
3	Dominance_D	0.1423
4	Shannon_H	2.035
5	Evenness_e^H/S	0.7654
6	Margalef	1.6

4. Discussion

The results accumulated so far clearly indicate that the overall diversity of mantids in this district is quite good as in Howrah no major forests and protected areas are absent and density of human population is high whereas from district Purulia with dense forest contain only 6 species of mantises [3]. 35 species and 24 genera of mantids have so far been recorded from all over West Bengal [6] whereas a small district Howrah contains 10 species and 9 genera alone. Among the 10 species *Creobroter apicalis*, *Odontomantis* sp., *Statilia apicalis*, *Mantis religiosa inornata*, *Amantis* sp. and *Humbertiella ceylonica* are common species in this district. *Statilia maculata* and *Hierodula membranacea* are uncommon; *Hestiasula brunneriana* and *Tenodera aridifolia* are rare species of this district. *Creobroter apicalis* is very common in Bagnan I, II blocks, Shyampur block due to cultivation of flowers than other blocks of the district. *Odontomantis* sp., *Statilia apicalis* and *Amantis* sp. are commonly found in domestic habitats in night. Nymph of *Odontomantis* sp. often found in home gardens. *Odontomantis planiceps* was recorded from district Paschim Medinipur, identified by a nymph stage of the mantis [20] which is very much doubtful as identification in species level through only nymph stage is very difficult task. Until today works on Mantises in India generally deals with preparation of checklist of a particular places or states [1, 2, 8, 9, 10, 11], very few deals with their behaviours [3, 4] so, this work help to understand behaviours of some species. The studies reveal that high species richness and evenness and low dominance at study area. The biodiversity (diversity index, species richness and evenness) of mantids fauna in Howrah district, West Bengal is mainly due to the rich roadside

vegetation and vegetation around agricultural fields as vegetation plays an important role for the existence of insect fauna in a community as it provides the resources for insects. For instance, the occurrence of a rich and diversified fauna in the district was largely attributed to the conservation of vegetations in this region [21]. PCA analysis shows that species with similar distributional pattern are come into the same coordinate. *Hestiasula brunneriana* and *Tenodera aridifolia* are present in same coordinate due to their similar distributional pattern in this district. Likewise *Statilia maculata* and *Hierodula membranacea* are present in another same coordinate. Species accumulation curve is represented in the fig 5. The species accumulation curve of whole district sampled individually increased from 2013 to 2016 sampling through the number of new records added slowly but after 2016 number of new records were same in 2017. Rapid development, urbanization and industrialization are the potential causes of declining Mantid species richness, diversity and abundance in this district.

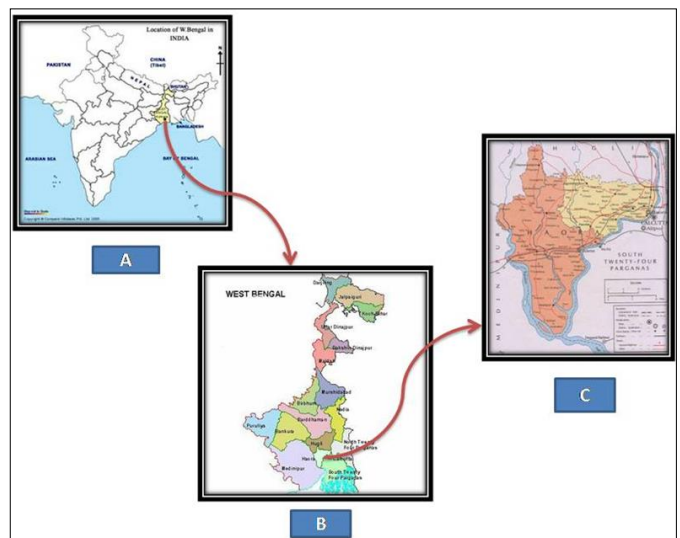


Fig 1: Study area [India (A), West Bengal (B), Howrah District (C)]



Fig 2 A: *Creobroter apicalis*, B: *Hestiasula brunneriana*, C1: *Odontomantis* sp., C2: Nymph of *Odontomantis* sp., D: *Statilia apicalis*, E: *Statilia maculata* F: *Mantis religiosa* G: *Hierodula membranacea*, H1: *Amantis* sp. H2: *Amantis* sp. I: *Tenodera aridifolia*, J: *Humbertiella ceylonica*

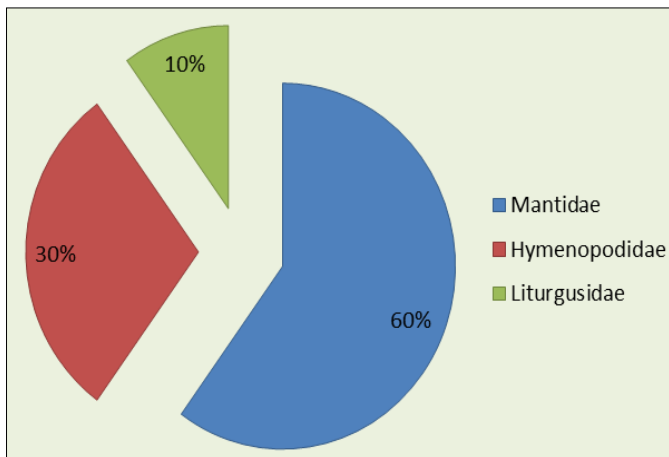


Fig 3: Family wise graphical representation of Mantis species

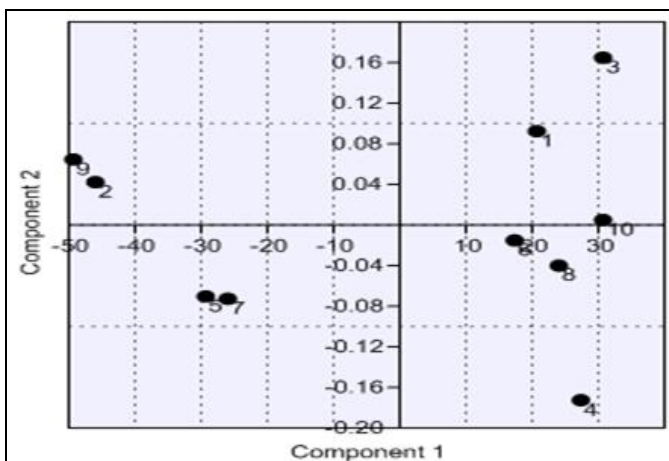


Fig 4: PCA (Principle component analysis) of species of Mantids created through PAST software. (Used characters: Number of individuals, density and frequency).

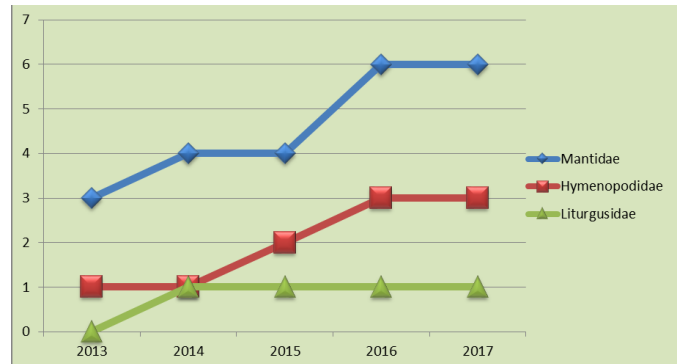


Fig 5: Graphical representation of cumulative number of species collected against the sampling years (2013-2017)

5. Conclusion

Our study afford a baseline data for the Praying Mantises of Howrah district which will help for further work on its detail role in ecosystem, abundance and also help to identify the potential threats which will further help in their conservation. We can conclude from our study that *Creobroter apicalis*, *Odontomantis* sp., *Statilia apicalis*, *Mantis religiosa inornata*, *Amantis* sp. and *Humbertiella ceylonica* are commonly found in this district. *Hestiasula brunneriana*, *Tenodera aridifolia* are rarely seen and *Statilia maculata*, *Hierodula membranacea* are uncommon in this district. Mantidae is the dominant Praying Mantis family among all families in the district. *Amantis* sp. is a species which very active in night time. As *Creobroter apicalis* found in flower of gardens and *Tenodera aridifolia* besides of agricultural fields they help to control harmful insects of respective habitats. We can also conclude from our study that as a non forest district Howrah contain a good number of species of Praying Mantis. But rapid industrialization and uncontrolled anthropogenic activities are the main present threats of mantises.

6. Acknowledgement

Authors would like to express our heartfelt indebtedness to Andrew Pfeifer, 4307 Windjammer Drive, Monroe, North Carolina 28110, USA for his help in the form of identification and inputs. Authors would like to thank Sagar Khunte, M. S. K. Kakade College for providing good photographs of *Statilia maculata* and *Mantis religiosa inornata*. We would also want to convey our gratitude to the honourable Dr. Sanjukta Mondal (Parui), WBES, HOD, Co-ordinator DST-BOOST-WB and Associate Professor, Post Graduate Department of Zoology, Lady Brabourne College, Kolkata-700017, West Bengal, India, for her consistence help during our study period. Also like to express our gratitude to UGC for their laboratory support in the form of DRS-SAP (Phage II) [2011-2016]. Special thanks to Anirban Ray, Subhadeep Chowdhury and Tridib Kumar Samanta for their support to our study. Authors would like to express thanks to all research scholars of Plant Taxonomy, Biosystematics and Molecular Taxonomy laboratory.

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