



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 2552-2557
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www.thepharmajournal.com

Received: 02-03-2023

Accepted: 04-04-2023

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Inventory of mantids fauna in different ecosystems of North Gujarat

Nikita S Chaudhari, Patel PS, Gothi HR and Barad CS

Abstract

Field survey was carried out during 2019-2021 to study the mantid fauna in agroecosystem, forest ecosystem and grassland ecosystem in North Gujarat. The result indicated occurrence of the twenty-one mantid species belonging to eight families viz., Mantidae, Hymenopodidae, Empusidae, Gonypetidae, Eremiaphiidae, Rivetiniidae, Toxoderidae and Nanomantidae. Out of 21 species recorded, 8 were belong to family Mantidae followed by family Hymenopodidae (4), Empusidae (2), Toxoderidae (2), Rivetiniidae (2), Gonypetidae (1), Eremiaphiidae (1), Nanomantidae (1). Among family of Mantidae, 2 sub-families of Hierodulinae and Mantinae both were the dominant group. An inventory of mantid fauna of North Gujarat was also prepared. Further, 9 species of mantids were recorded first time in Gujarat viz., *Mantis religiosa inornata* (Werner, 1930), *Staltia guineensis* (Chopard, 1954), *Hierodula tenuidentata darvasica* (Lindt, 1963), *Anaxarcha* sp. (Stal, 1877), *Hestiasula brunneriana* (Saussure, 1871), *Mantis marginalis* (Stoll, 1813), *Toxoderopsis taurus* (Wood-Mason, 1889), *Deiphobe brunneri* (Saussure, 1871) and *Deiphobe brevipennis* (Sjostedt, 1930).

Keywords: Mantid, ecosystem, inventory, North Gujarat

Introduction

Convention of biodiversity (CBD) arose from the UNCED process (the Earth Summit) in 1992 commits signatory nations to undertake inventory of their biological diversity (CBD, 1994) [3]. Inventories provide fundamental information about the distribution and abundance of biodiversity and such data are necessary for the long-term sustainable management, use and conservation of biodiversity areas (Heywood, 1995) [8]. It is not feasible to attempt the inventory of all biota at once. Order Mantodea (Insecta) is one such focal group for biodiversity inventorying, because they represent an economically important group of insects in the terrestrial ecosystem. Living solitarily in the vegetation - or, more rarely, on the ground - they ambush insects, spiders and occasionally even small vertebrates (Prete *et al.*, 1999) [9]. Mantids belong to the top predators of the arthropod community. Some species wear cryptic colours and resemble leaves, flowers, sticks or bark. Mantids are characterized by their highly specialised raptorial forelegs and a mobile head with powerful compound eyes that allow for binocular sight. An elongated prothorax is also typical.

Mantids play both positive and negative roles in the ecosystem. They are predators of insects which include both beneficial and harmful ones. Mantids are commonly of large size; however, there are only two species, which are of 10 mm in size. In appearance, these insects are extremely striking including some of the most picturesque and bizarre forms of insect life (Helmkamp *et al.*, 2007) [7]. They have a sedentary ambush style in habitat and lead cryptic life, often resorting to various forms of mimicry and mimesis. Mantids posing itself on its posterior legs and swaying lightly from side to side and moved by the breeze. Others that live in the grass are slender and green coloured, either dry grass green or green (Sureshan *et al.*, 2004) [13]. Antennae and cerci coloured like the dry tips of withered grass (Bottiston and Massa, 2008) [2]. Others are leaf green, living among the leaves of the bushes or are the colour of bark and are found on tree trunks.

Unfortunately, the fauna of Mantodea is very poorly known in India and especially in Gujarat where losses suffered due to damages by insect pests are often enormous. The work on the praying mantids of Gujarat is very limited. Till date from Gujarat only four species belonging to four genera were reported by Zoological Survey of India (Sureshan, 2009) [12]. Therefore, the present study was under taken with a view to find out the diversity of Mantodea, particularly in North Gujarat.

Materials and Methods

A survey program was undertaken during 2019-20 to 2020-21 for collecting mantid species to ascertain biodiversity of mantids in North Gujarat in different 45 agricultural fields, 6 forest lands and 2 grasslands, thus a total of 53 sites. Two types of survey were conducted during the study period *viz.*, roving survey and fixed site survey.

Sampling and collection

Roving survey

Main purpose of roving survey was to find out different species existing in agro ecosystem, grassland ecosystem and forest ecosystem; their geographical distribution. Different sites were visited and collections were made using sweep net and visual observations. Sampling was done by sweeping ten times each in a 2 m × 2 m cropped, grassland and forest area and average number of mantids per sweep was recorded. Collected species preserved properly for further identification. Two exploratory surveys were conducted in each year under the study period. Record was maintained regarding number of mantids of each species collected during survey trip.

During roving survey Banaskantha, Sabarkantha, Mehsana, Aravalli, Patan and Gandhinagar districts from North Gujarat were chosen for collecting mantids species in agro ecosystem of the North Gujarat. The forest area was visited during roving survey includes Vijaynagar (Polo Forest), Danta, Ambaji, Ambagata, Shamalaji and Jessore all are in the Aravalli hill tract. The grassland area was visited during roving survey includes Mervada and Chandisar.

Fixed site survey

Fixed site survey was conducted to determine the biodiversity of mantids and community structure of important species in different ecosystems *viz.*, agro ecosystem, grassland ecosystem and forest ecosystem. The Agronomy Instructional Farm of C. P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar was selected for diversity study because most of the important field crops of the North Gujarat were grown in the farm either in *kharif* or *rabi* or both, hence representing a typical agro ecosystem of the North Gujarat. Mervada village from Vadgam taluka, Banaskantha was selected as grassland for the study of diversity of mantid. The forest area of Polo Forest, also known as Vijaynagar forest is a dry mixed deciduous forest near Abhapur village in Vijaynagar Taluka, Sabarkantha district, Gujarat, India. It is located at the foothills of the Aravalli range and on the banks of perennial Harnav River, spread over the area of 400 sq. km. was selected as forest ecosystem for diversity studies.

In case of fixed site survey, monthly population estimation was carried out. For this purpose, each selected site will be divided into ten quadrates measuring 10 m x 10 m and four such quadrates were chosen at random for sampling. Catch per unit time method (Atwal and Bains, 1974 and Sanjayan *et al.*, 1994) ^[1, 11] was used for the population estimation. It involved hand sweeping, intensive searching entire ground level vegetation and hand picking from the vegetation after locating them. Thirty minutes was spent in each quadrate (2 hrs/site) during morning hours between 9 a.m. to 11 a.m. Data

was recorded as number of individuals per quadrate of each species encountered during a period of 30 minutes for further analysis.

Dry Preservation

The collected mantids were suffocated in the killing jar, made up of plaster of paris and sodium cyanide for approximately 20 minutes. After killing, they were air dried and wings were spread. They were stored in the insect boxes made of wood and fixed on the spreading board using entomological pins passed through the pronotum, for further morphometric and taxonomical study.

Identification

The initial identification of the praying mantids was done with the help of the keys of state fauna services of Zoological Survey of India, Kolkata. The final confirmation was done with the help of taxonomist.

Results and Discussion

An extensive survey under taken during 2019-20 and 2020-21 have resulted in recording a total of 21 species of mantids belonging to different families in three different ecosystems *viz.*, agroecosystem, forest ecosystem and grassland ecosystem covering a total 53 habitats under these categories. Six habitats *viz.*, Polo Forest, Ambaji, Danta, Ambagata, Shamalaji and Jessore cover under forest ecosystem; 45 under Agriculture (Banaskantha, Sabarkantha, Patan, Mehsana, Gandhinagar and Aravalli district) and two habitats under grassland (Mervada village from Vadgam taluka, Chandisar from Palanpur taluka).

The composition and status of the species observed in different ecosystems of North Gujarat in table 1. During the present study, total 21 species of mantids were recorded from different location which belongs to 8 families, 10 sub-families with 15 genera, which was clearly indicated that species observed in different ecosystems of North Gujarat is distributed among eight families *viz.*, Mantidae, Hymenopodidae, Empusidae, Gonypetidae, Eremiaphiidae, Rivetinidae, Toxoderidae and Nanomantidae.

The maximum number of species (8), were belong to family Mantidae distributed among 2 sub-families and 3 genera, the maximum representation of the taxonomic group. This was followed by family Hymenopodidae which represented by 2 sub-families and 4 genera with 4 species forming second highest taxonomic representation. The members of the family Empusidae and Toxoderidae belongs to 1 sub-families with 2 genera and 2 species. The members of the family Rivetinidae distributed among 1 sub-family, 1 genera and 2 species followed by members of the family Gonypetidae, Eremiaphiidae and Nanomantidae with poor taxonomic representation distributed among 1 sub-family, 1 genera and 1 species. Among them 38.10 per cent species belongs to family Mantidae, 19.5 per cent from Hymenopodidae, 9.52 per cent from Empusidae, 4.76 per cent from Gonypetidae, 4.76 per cent from Eremiaphiidae, 9.52 per cent from Rivetinidae and Toxoderidae and remaining 4.76 per cent from Nanomantidae.

Table 1: Species distribution of mantids in different families in North Gujarat

	Super family	Family	Sub family	Genera	No. of species	Species (%)
Order Mantodea	Hymenopoidea	Hymenopodidae	2	4	4	19.05
		Empusidae	1	2	2	9.52
	Gonypetetoidea	Gonypetidae	1	1	1	4.76
	Eremiaphiloidea	Eremiaphiidae	1	1	1	4.76
		Rivetinidae	1	1	2	9.52
		Toxoderidae	1	2	2	9.52
	Nanomantoidea	Nanomantidae	1	1	1	4.76
Mantoidea	Mantidae	2	3	8	38.10	
Total	5	8	10	15	21	100

The list of mantodea recorded during the present study at 3 different ecosystem in North Gujarat were presented along with their scientific name here under (Table 2).

Clade: Euarthropoda
Class: Insecta
Superorder: Dictyoptera
Order: Mantodea (Burmeister, 1838)

Systematic list of order Mantodea

Kingdom: Animalia

Table 2: Systematic list of order Mantodea

Sr. No.	Scientific Name	Common Name
I. Family: Mantidae		
1.	<i>Mantis religiosa religiosa</i> (Linne, 1758)	European mantid
2.	<i>Statilia guineensis</i> (Chopard, 1954)*	
3.	<i>Hierodula tenuidentata darvasica</i> (Lindt, 1963) *	Giant Asian mantid
4.	<i>Hierodula coarctata</i> (Saussure, 1869)	
5.	<i>Hierodula venosa</i> (Giglio-Tos, 1912)	Indian golden mantid or Red armed mantid
6.	<i>Statilia maculate continentalis</i> (Werner, 1935)	Asian jumping mantid
7.	<i>Hierodula ventralis</i> (Giglio-Tos, 1912)	
8.	<i>Mantis religiosa inornata</i> (Werner, 1930)*	
II. Family: Eremiaphiidae		
9.	<i>Schizocephala bicornis</i> (Linnaeus, 1758)	Indian stick mantid
III Family: Hymenopodidae		
10.	<i>Anaxarcha</i> sp.(Stal, 1877)*	
11.	<i>Creobroterapicalis</i> (Westwood, 1889)	Flower mantid
12.	<i>Hestiasula brunneriana</i> (Saussure, 1871)*	
13.	<i>Mantis marginalis</i> (Stoll, 1813)*	
IV. Family: Gonypetidae		
14.	<i>Theopompa septentrionum</i> (Wood-Mason, 1891)	Bark Mantid
V. Family: Empusidae		
15.	<i>Empusa (Empusa) guttula</i> (Thunberg, 1815)	
16.	<i>Gongylus gongylodes</i> (Linnaeus, 1758)	Violin Mantid
VI. Family: Toxoderidae		
17.	<i>Loxomantis indica</i> (Giglio-Tos, 1914)	Indian grass mantid
18.	<i>Toxoderopsis taurus</i> (Wood-Mason, 1889)*	
VII. Family: Nanomantidae		
19.	<i>Tropidomantis (Eomantis) guttatipennis</i> (Stal, 1877)	
VIII. Family: Rivetinidae		
20.	<i>Deiphobe brunneri</i> (Saussure, 1871)*	
21.	<i>Deiphobe brevipennis</i> (Sjostedt, 1930)*	

*Recorded first time in Gujarat

Family and their representative previously presented in Gujarat.

Family: Liturgusidae

Humbertiella indica (Saussure, 1869)

Family: Hymenopodidae

Tropidomantis (Stal, 1877)

Family: Empusidae

Gongylus gongylodes (Linnaeus, 1758)

Family: Mantidae

Mantis religiosa (Burmeister, 1838)

If we look at ecosystem wise taxonomic composition, there is not much difference table 3 as all species were distributed in 8 families, 10 sub-families and 15 genera in different habitats. The species were maximum in grassland ecosystem (16), followed by agroecosystem (13) and forest ecosystem land (13).

Table 3: Taxonomic compositions of mantids in different ecosystems of North Gujarat

Ecosystem	No. of species	No. of family	No. of subfamily	No. of genera	Species (%)
Agroecosystem	13	6	8	9	61.90
Forest ecosystem	13	6	7	9	61.90
Grassland ecosystem	16	8	9	12	76.19

The list of mantids collected in different habitats of three ecosystems during the survey period and its taxonomic composition is given in table 4. A perusal of the data given in table 4 indicated that among the different ecosystems, grassland ecosystem represented maximum 16 species followed by agroecosystem (13) and forest ecosystem (13). The habitat preference of different mantid species in different ecosystems of North Gujarat is presented in table 5 and also updated state wise mantids diversity of India is given in table 6 (Patel, 2018) [14].

Agricultural habitats occupied by 13 species, however 8 species viz., *Anaxarcha* sp., *Mantis marginalis*, *Empusa* (*Empusa*) *guttula*, *Schizocephala bicornis*, *Deiphobe brunneri*, *Loxomantis indica*, *Tropidomantis* (*Eomantis*) *guttatipennis* and *Stalitia guineensis* were not observed in different agricultural habitats under survey in North Gujarat (Table 5). In grassland, under survey revealed 16 species of mantids and 5 species viz., *Anaxarcha* sp., *Mantis marginalis*, *Hestiasula brunneriana*, *Stalitia guineensis* and *Mantis religiosa inornata* were not observed during survey period. Forest ecosystem reported 13 species and 8 species viz., *Creobroter apicalis*, *Hestiasula brunneriana*, *Empusa* (*Empusa*) *guttula*, *Gongylus gongylodes*, *Toxoderopsis taurus*, *Tropidomantis* (*Eomantis*) *guttatipennis*, *Deiphobe*

brevipennis and *Mantis religiosa inornata* were not represented by the different forest habitats under study. Hence, species *Theopompa septentrionum*, *Hierodula venosa*, *Hierodula ventralis*, *Hierodula tenuidentata*, *Hierodula coarctata*, *Stalitia maculate continentalis* and *Mantis religiosa religiosa* observed all three ecosystems under study and can be categorised as very common species observed in different habitats of North Gujarat. Seven species viz., *Creobroter apicalis*, *Gongylus gongylodes*, *Deiphobe brevipennis*, *Deiphobe brunneri*, *Schizocephala bicornis*, *Toxoderopsis taurus* and *Loxomantis indica* represented two ecosystems under study where as other seven species viz., *Anaxarcha* sp., *Mantis marginalis*, *Hestiasula brunneriana*, *Empusa* (*Empusa*) *guttula*, *Tropidomantis* (*Eomantis*) *guttatipennis*, *Stalitia guineensis* and *Mantis religiosa inornata* observed only one ecosystem, the least distributed species in different habitats of North Gujarat.

A perusal of the information presented in table 5 indicated that the *Anaxarcha* sp., *Mantis marginalis* and *Stalitia guineensis* represented forest ecosystem under study. *Hestiasula brunneriana* was habitat specific as it was observed only in agroecosystem. Similarly, *Empusa* (*Empusa*) *guttula* and *Tropidomantis* (*Eomantis*) *guttatipennis* were presence only in grassland ecosystem.

Table 4: Inventory of mantid species in different ecosystem of North Gujarat

Sr. No.	Name of species	Sub-family	Ecosystem		
			Agro-ecosystem	Grassland-ecosystem	Forest- ecosystem
A					
Superfamily: Hymenopoidea					
a) Family: Hymenopodidae					
1	<i>Anaxarcha</i> sp.	Hymenopodinae	-	-	+
2	<i>Mantis marginalis</i>	Hymenopodinae	-	-	+
3	<i>Creobroter apicalis</i>	Hymenopodinae	+	+	-
4	<i>Hestiasula brunneriana</i>	Oxypilinae	+	-	-
b) Family: Empusidae					
5	<i>Empusa</i> (<i>Empusa</i>) <i>guttula</i>	Empusinae	-	+	-
6	<i>Gongylus gongylodes</i>	Empusinae	+	+	-
B					
Superfamily: Gonyptetoidea					
c) Family: Gonyptetidae					
7	<i>Theopompa septentrionum</i>	Gonyptetinae	+	+	+
C					
Superfamily: Eremiaphiloidea					
d) Family: Eremiaphiidae					
8	<i>Schizocephala bicornis</i>	Iridinae	-	+	+
f) Family: Rivetiniidae					
9	<i>Deiphobe brevinnis</i>	Deiphobinae	+	+	-
10	<i>Deiphobe brunneri</i>	Deiphobinae	-	+	+
g) Family: Toxoderidae					
11	<i>Loxomantis indica</i>	Toxoderinae	-	+	+
12	<i>Toxoderopsis taurus</i>	Toxoderinae	+	+	-
D					
Superfamily: Nanomantoidea					
h) Family: Nanomantidae					
13	<i>Tropidomantis</i> (<i>Eomantis</i>) <i>guttatipennis</i>	Tropidomantinae	-	+	-
E					
Superfamily: Mantoidea					
i) Family: Mantidae					
14	<i>Hierodula coarctata</i>	Hierodulinae	+	+	+
15	<i>Hierodula tenuidentata</i>	Hierodulinae	+	+	+
16	<i>Hierodula ventralis</i>	Hierodulinae	+	+	+
17	<i>Hierodula venosa</i>	Hierodulinae	+	+	+

18	<i>Mantis religiosa religiosa</i>	Mantinae	+	+	+
19	<i>Mantis religiosa inornata</i>	Mantinae	+	-	-
20	<i>Statilia maculatecontinentalis</i>	Mantinae	+	+	+
21	<i>Statilia guineensis</i>	Mantinae	-	-	+

+ = Presence of species, - = Absence of species

Table 5: Habitat preference by different species of mantids in different ecosystems

Sr. No.	Name of species	Ecosystem		
		Agroecosystem	Grassland- ecosystem	Forest- ecosystem
1	<i>Anaxarcha</i> sp.	-	-	+
2	<i>Mantis marginalis</i>	-	-	+
3	<i>Creobroter apicalis</i>	+	+	-
4	<i>Hestiasula brunneriana</i>	+	-	-
5	<i>Empusa (Empusa) guttula</i>	-	+	-
6	<i>Gongylus gongylodes</i>	+	+	-
7	<i>Theopompa septentrionum</i>	+	+	-
8	<i>Schizocephala bicornis</i>	-	+	+
9	<i>Deiphobe brevinis</i>	+	+	-
10	<i>Deiphobe brunneri</i>	-	+	+
11	<i>Loxomantis indica</i>	-	+	+
12	<i>Toxoderopsis Taurus</i>	+	+	-
13	<i>Tropidomantis (Eomantis) guttatipennis</i>	-	+	-
14	<i>Mantis religiosa inornata</i>	+	-	+
15	<i>Statilia guineensis</i>	-	-	+
No. of species absent		8	5	8

+ = Presence of species, - = Absence of species

Table 6: Updated state wise mantids diversity of India

State	Genera	Species
Maharashtra	31	56
Meghalaya	17	25
Manipur	7	10
Orissa	18	27
Punjab	3	3
Rajasthan	8	9
Sikkim	12	16
Tamil Nadu	36	44
Uttar Pradesh	29	55
West Bengal	26	40
Andhra Pradesh	23	30
Arunachal Pradesh	12	20
Assam	22	29
Bihar	12	13
Jharkhand	12	16
Goa	13	16
Gujarat	15	21
Himachal Pradesh	15	23
Karnataka	23	27
Kerala	34	49
Madhya Pradesh	17	25

Dwari and Mondal (2018) ^[6] in a study also reported a total 10 species of mantids belonging to 9 genera under 3 families viz. Mantidae, Hymenopodidae and Liturgusidae. The Mantidae was the most dominant family. Under the present study Mantidae was the most dominant family comprises of 8 genera and 12 species with 57.14 per cent species distribution. This may be more or less in accordance with the earlier work. Further, Rivera and Cobian (2017) ^[10] from Peru also recorded Mantidae as one of the most dominant family, therefore closely support the present findings.

The present findings also in accordance with earlier work of Chandra (2009) ^[4] and Chaturvedi *et al.*, (2005) ^[5] who also reported mantidae as most common family in various parts of Bandhavgarh and Sanjay Gandhi National Park, Mumbai.

Conclusion

Out of 21 species recorded, 8 were belong to family Mantidae followed by family Hymenopodidae (4), Empusidae (2), Toxoderidae (2), Rivetiniidae (2), Gonypetidae (1), Eremiaphiidae (1), Nanomantidae (1). The member of family Mantidae were distributed among 2 sub-families of which Hierodulinae and Mantinae both comprised of four species. Hymenopodidae which represented by 2 sub-families, Empusidae, Rivetiniidae, Toxoderidae belongs to 1 sub-families and Gonypetidae, Eremiaphiidae, Nanomantidae with 1 sub-family. The species and its group differed greatly in different ecosystems. Grassland ecosystem recorded highest number of 16 species, whereas agro ecosystem and forest ecosystem contain 13 species. Hierodulinae and Mantinae were important representatives of all three ecosystems.

Acknowledgement

The authors are grateful to the Professor and Head, Department of Agricultural Entomology and Principal, C. P. College of Agriculture, SDAU, Sardarkrushinagar providing necessary facilities and guidance during the course of research study. I am also grateful to Dr. H. V. Ghate, Department of Zoology, Modern College of Arts, Science and commerce, Pune for identifying mantid species.

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