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Diversity & Distributional Expansion of Mantid Species (Insecta : Montodea) in the Forested and Urban Landscapes of West Bengal, India

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ABSTRACT

Mantodea includes "praying mantids," a large group of predatory insects found in tropical and subtropical regions worldwide. These insects display fascinating behavioural traits, including camouflage, mimicry, and cannibalism. Mantids are strictly carnivorous, primarily preying on other arthropods and small vertebrates, thereby playing a crucial ecological role in controlling herbivorous insect populations, including significant agricultural pests. Despite their ecological significance, research on praying mantids has been largely overlooked, particularly in the context of West Bengal. This communication focuses on the diversity of praying mantises within the forested and urban landscapes of West Bengal, as well as their expanding distribution. The study identified a total of eight (8) mantid species across eight (8) genera, belonging to three (3) families and five (5) subfamilies. Notably, *Amantis reticulata* (Haan) is recorded for the first time from the state, and all eight (8) species are documented for the first time from the forests of Alipurduar district and the urban landscapes of North 24 Parganas district of West Bengal. Among these, the Asian Jumping Mantis, *Statilia maculata* (Thunberg), emerges as the most prevalent, abundant, and dominant species throughout the study area, with the highest sampling occurring during the post-monsoon season. The fauna, though primarily consists of Oriental elements, includes 75% Palaearctic species. This survey enhances the existing knowledge of mantis diversity in the region and will contribute to conservation management strategies, utilizing mantis as indicators of biodiversity.

Keywords: Diversity, distribution, expansion, mantis, forested, Alipurduar, urban areas, North 24 Parganas, West Bengal.

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INTRODUCTION

The praying mantis (Insecta: Mantodea), characterized by its elongated body, spiked forelegs, and stealthy behavior, is a formidable predator that captivates the interest of both entomologists and naturalists. This fascinating mantis can be spotted in agro and forest ecosystems (Mukherjee & Hazra 1985, 1993), gardens, and even urban areas. As mantids are mostly weak fliers, they are found on herbs, shrubs, and trees. The tropical climate, with its warm and humid summers, provides an ideal environment for the praying mantis to thrive. These insects are recognized for their remarkable camouflage skills, enabling them to merge effortlessly with their environment, rendering them effective hunters. The praying mantis is an apex predator in the insect world, feeding on a wide range of prey, from flies and bees to butterflies and even other mantis. It plays a crucial role in maintaining the ecological balance, serving as a natural pest control agent. Despite its fearsome reputation, praying mantis is generally harmless to humans and can be a fascinating addition to any garden or indoor space. In fact, many people in West Bengal and in abroad keep praying mantis as pets, appreciating their unique appearance and intriguing behavior (Battiston *et al.*, 2022). However, the praying mantis population in West Bengal is facing threats due to habitat destruction, pesticide use, and climate change. As a result, conservation efforts are necessary to protect these incredible insects and their habitats. By promoting sustainable gardening practices, reducing pesticide use, and preserving natural habitats, we can help ensure the long-term survival of the praying mantis in West Bengal.

The praying mantids represent a collection of more than 2500 carnivorous polyneopteran insects found in tropical and subtropical regions across the globe, ranging from rainforests to arid deserts. The order Mantodea includes over 20 families, with the family Mantidae being the most extensive, accounting for nearly 50% of all mantid species documented to date. Very few works are done in south-east Asia on mantis including of Borneo (Helmkampf *et al.*, 2007), Vietnam (Thinh, 2010), Pakistan (Ara *et al.* 2019) and Thailand (Unnahachote *et al.*, 2019). Mukherjee *et al*. (1995) were the first to gather all existing data on Indian mantids, which encompassed 162 species classified into 68 genera and six families. After Mukherjee *et al.* (1995), among Indian workers, Mukherjee and Shishodia (1999, 2000), Chaturvedi & Hedge (2000), Rane *et al.* (2000), Ghate et al. (2001a,b, 2006, 2019), Ghate & Ranade (2002), Patil & Sathe (2003), Ghate & Mukherjee (2004), Ranade *et al.* (2004), Rao *et al*. (2005), Sureshan *et al*. (2004 a,b, c,2006 a,b, c, 2008), Vyjayandi & Narendran (2003, 2005), Vyjayandi *et al.* (2006, 2010). Ghate *et al.* (2006), Jadhav *et al.* (2006), Vyjayandi *et al.* (2006, 2010), Mukherjee & Hazra (1993, 2007a, b), Mukherjee & Ghate (2007), Roy (2007), Roy & Svensen (2007), Vyjayandi (2007), Jadhav (2008, 2009), Chandra (2009, 2017), Sureshan *et al.* (2004a,b,c, 2006a,b,c), Sureshan (2009), Sureshan & Sambath (2009), Mukerjee & Ghate (2010), Mukherjee *et al.* (1995a,b, 2010, 2014, 2017a,b), Chandra *et al.* (2011), Sathe & Patil (2014), Ehrmann & Borer (2015), Majumder *et al*.,(2015); Hiral *et al*. (2018), More & Prashant (2018), Yadav (2018), Chhapekar *et al.* (2021), Yadav & Painkra (2021), Shah *et al.* (2022), Tiple *et al*. (2024) have contributed to the Indian Mantids. These investigations resulted in the discovery of new distribution records and the identification of additional species. In 2016, Patel & Singh created a checklist to address certain requirements related to global mantid studies, including the management of synonyms and distributions, as well as the absence of a comprehensive and current species listing. 1261 species distributed over 21 subfamilies are included in this check list globally under family Mantidae of order Mantodea, and from India reported only 89. Ghate *et al*. (2006) updated the checklist of Mukherjee *et al.*(1995). This resulted in the enumeration of 184 Indian species belonging to 73 genera under 11 families out of 2300 species belonging to 434 genera and 15 families globally (Ehrmann, 2002). Currently, over 2500 species of mantids have been recorded, spanning 436 genera and 31 families globally.

(Anderson, 2018; Otte *et al*., 2021; Wong *et al*., 2022). According to Kamila & Sureshan (2022), there are 169 mantid species classified into 69 genera across 13 families and 7 superfamilies known from India. Despite the rich diversity of fauna in India, our understanding of the diversity and biological attributes of mantids in West Bengal remains inadequate. Very limited information is available on diversity of mantis of West Bengal (Dutta & Sur, 2012; Dwari & Mondal, 2018). In West Bengal, a total 40 species are recognized (Ghate *et al.*, 2006). This prompt us to document the species diversity and richness of praying mantis of forest and urban landscapes of West Bengal.

STUDY AREA

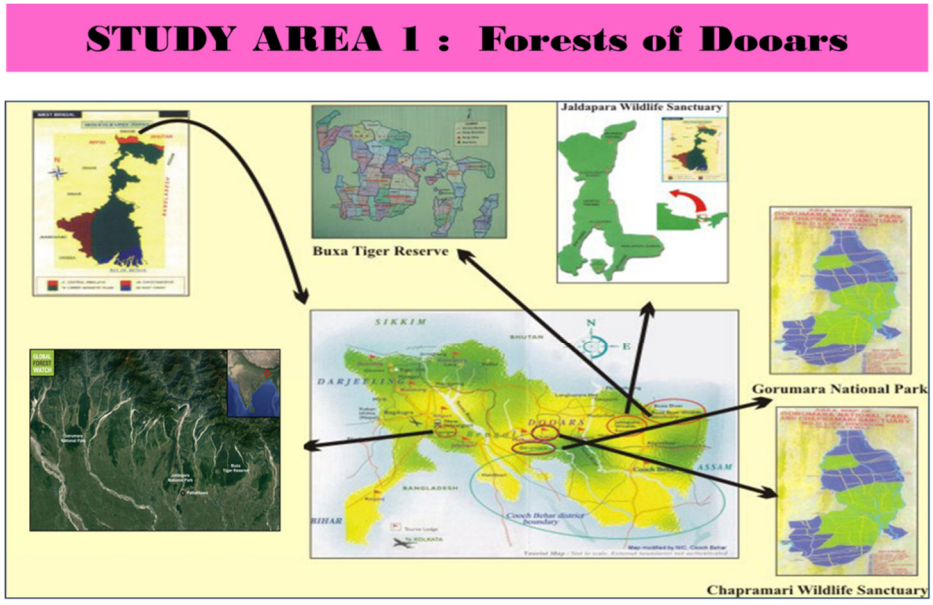


Figure 1A. Map Showing Study Area of Alipurduar (Dooars).

Figure 1B . Study Sites: Forests of Alipurduar (Dooars).

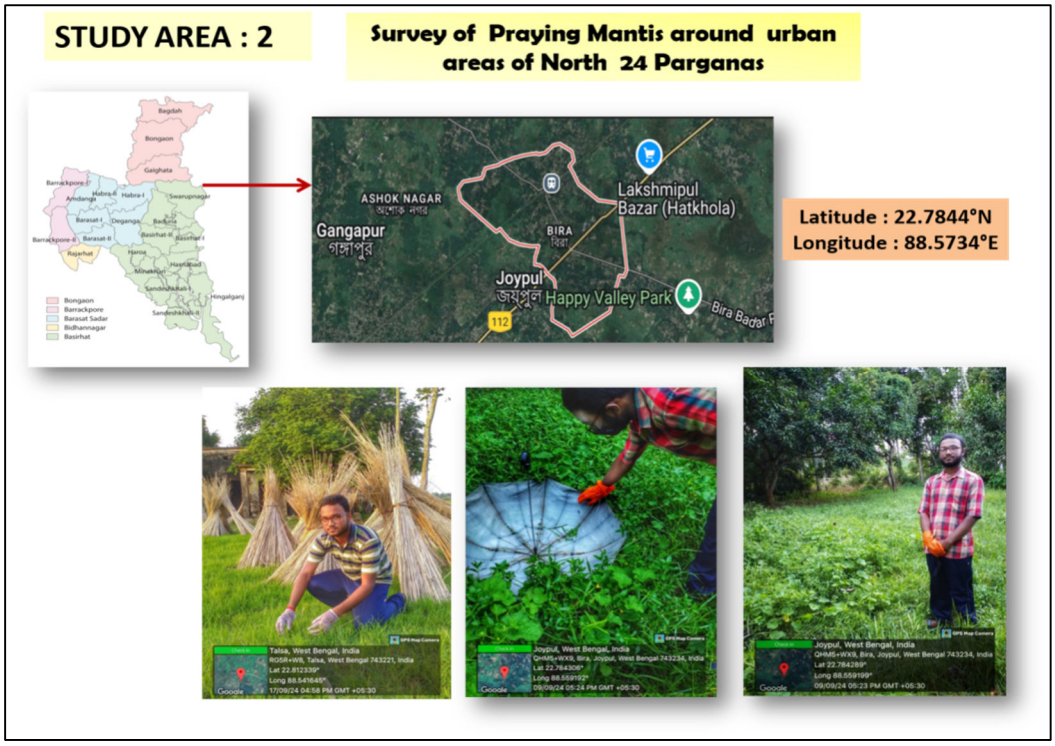


Figure 1C. Study Sites: Urban Areas of N 24 Parganas.

MATERIALS & METHODS

Collection of mantid specimens were conducted while sampling insects from different forest areas of Alipurduar, namely Buxa Tiger Reserve, Jaldapara Willife Sanctuary, Gorumara National Park Chapramari Wildlife Sanctuary, during 1992 to 2009 every year (Figs. 1A & B). Specimens were also sampled from the urban areas of North 24 Parganas from August 2024 to June 2025 (Fig.1C). The mantis were mostly captured with the help of insect net, hand picking, and inverted umbrella in the morning and evening time. Whenever possible these were photographed in nature. Samples were killed and preserved in 70% alcohol as per recommendation of Raychaudhuri & Saha (2014). Necessary data regarding date of collection, no. of individuals, etc., were noted in a field notebook. Insect specimens were transported to the laboratory for long-term storage (Fig.2). This was done following the recommendations of Jonathan & Kulkarni (1986) & Raychaudhuri & Saha (2014). The materials were studied using Stereo Zoom Binocular Microscope, model Olympus SZX-16. Specimens were identified in accordance with Mukherjee *et al*. (1995) and standard research paper published by Ehrmann *et al*. (2015). Materials are in the deposition of Entomology Laboratory, Ramakrishna Mission Vidyamandira, Belur Math, Howrah, West Bengal & Dept. of Zoology, Barasat Govt. College, Barasat, Kolkata. Ecological biodiversity indices of site specific mantid fauna were also analyzed from pooled data following Brower *et al*. (1998).

Figure 2. Preserved specimen in the laboratory.

TAXONOMY

Key to Families

1. Outer corner of forewing with obtuse spines ……. Gonypetidae: ***Amantis reticulata*** **(Haan)**

- Outer corner of forewing without any obtuse spines ……..…..2

2. External spines of fore tibiae numerous and very closely arranged; fore wing often with eye-like mark; claw groove of fore femora near base ..... **Hymenopodidae**

- External spines of fore tibiae straight, well separated, and less in number; fore wing without any eye- like mark ..... **Mantidae**

Key to Genera & Species of Family Hymenopodidae

1. Middle and hind femora with narrow or wide expansions; vertex without protuberance; disc of pronotum with prominent granules. . .....***Ambivia*** **Stål :** ***A. undata*** **(Fabricius)**

- Middle and hind femora without expansion; vertex with or without protuberance.....2

2. Superior edge of fore femora arched, foliaceous, oval; vertex with a tubercle/spine at the middle……..3

- Superior edge of fore femora simple; frontal sclerite transverse, superior border terminating to a point; pronotum oblong-ovoid and a little wide …..... ***Odontomantis*** Saussure**:** ***O. planiceps*** **Haan**

3. Superior border of fore femora internally with black spots ……***Hestiasula*** **Saussure:** ***H. brunneriana*** **Saussure**

- Superior border of fore femora internally without black spots; conical eyes with a deep concavity in between; eye spot in the middle of fore wings enclosing two black spots; pronotum rhomboidal, deeply constricted in front & back……..***Creobroter*** **serville:** ***C. apicalis*** **Saussure**

Key to Genera & Species of Family Mantidae

1. Hind femora with an apical spine……***Hierodula*** **burmeister:** ***H. patellifera*** **(Audinet-Serville)**

- Hind femora without apical spine 2

2. Claw groove of fore femora distally placed; vertex dorsally with blackish markings; prosternum near coxal joint with black patch; coxae with 6-7 triangular whitish spines, few spinules, and with internal black patch; femora with shining, pale yellow patch, often bordered anteriorly by a black line ..... ***Statilia*** **Stål :** ***S. maculata*** **(Thunberg)**

- Claw groove of fore femora medially placed; prosternum with two small rounded tubercles near the base; fore coxa with divergent internal apical lobes, internally with callous spots, a black spot at base enclosing an oval yellow spot, anterior edge with 6-8 spines and a few spinules between them; claw groove of femora yellow, longer internal spines entirely black ……..… …***Mantis* Linnaeus:*M. religiosa inornata* Werner**

RESULTS & DISCUSSION

Table 1. Encountered Praying Mantis (Order : Mantodea) during survey of Forests of Alipurduar (Dooars) & Urban areas of North 24 Parganas, West Bengal.

Family	Subfamily	Name of Species	Collected locality					Distribution			
			BTR	JWLS	GNP	CWLS	24 Pgs (N)	Within India	In World	Zoogeographical	Seasonal
I. Gonypetidae	**Iridopteryginae**	♣***Amantis reticulata* (Haan)**	+ (1)	+ (1)	+ (10)	-	+ (2)	Kerala, West Bengal (Alipurduar, North 24 Parganas)	India, Indonesia, Malaysia, Myanmar	OR	PrM (7), M (3), PsM (4)
II. Hymenopodidae	**Acromantinae**	♠***Ambivia undata* (Fabricius)** (Asian Twig mimicking mantis)	+ (3)	+ (2)	+ (3)	-	-	Andhra Pradesh, Arunachal Pradesh, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Sikkim, Tamil Nadu, West Bengal (Alipurduar, Sundarban Biosphere Reserve)	China, India Indonesia, Laos, Malaysia, Myanmar, Nepal, Sri Lanka, Thailand, Vietnam	OR, PL	PrM (3), M (5)
	Hymenopodinae	♠***Creobroter apicalis* Saussure** (Indian Flower Mantis)	+ (4)	-	-	-	-	Andhra Pradesh, Arunachal Pradesh, Assam, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Orissa, Sikkim, Tamil Nadu, West Bengal (Alipurduar, Howrah, Purulia)	Bangladesh, Bhutan, China, India, Indonesia, Nepal	OR, PL	PrM(3), PsM(1)

		♠***Odontomantis planiceps* Haan** (Asian Ant mimicking)	-	-	-	-	+ (1)	Gujarat, Karnataka, West Bengal (North 24 Parganas)	Hong Kong, India, Indonesia, Malaysia, Taiwan	OR, PL	PsM (1)
	Oxypilinae	♠***Hestiasula brunneriana* Saussure** (Unicorn Boxer Mantis)	+ (1)	-	-	-	-	Andhra Pradesh, Bihar, Chhattisgarh, Kerala, Maharashtra, Meghalaya, Orissa, Tamil Nadu, Uttar Pradesh, West Bengal (Alipurdiar, Howrah)	Banglades h, India, Nepal, Pakistan, Sri Lanka	OR	PsM (1)
III. Mantidae	**Mantinae**	♠***Hierodula patellifera* (Audinet-Serville)**	-	+ (2)	-	-	+ (2)	Andaman Island, Arunachal Pradesh, Bihar, Chhattisgarh, Himachal Pradesh, Kerala, Madhya Pradesh, Maharashtra, Nagaland, Tamil Nadu, Uttar Pradesh, West Bengal (Alipurduar, North 24 Parganas, Sundarban Biosphere Reserve).	Australia, China, Croatia, France, Hawaii, India, Indonesia, Italy, Japan, Korea, Malaysia, New Guinea, Pakistan, Philippines, Taiwan.	AS, OR, PL	M (2), PsM (2)
		♠***Mantis religiosa inornata* Werner** (European Mantis)	+ (2)	-	-	-	+ (2)	Karnataka, Kerala, Maharashtra, Madhya Pradesh, Manipur, Orissa, Uttar Pradesh, West Bengal (Alipurduar, Howrah, North 24 Parganas, Purulia)	Africa, Australia, Europe, India, Iran	AS, ET, OR, PL	M (2), PsM (2)

		♠***Statilia maculata* (Thunberg)** (Asian Jumping Mantis)	+ (6)	+ (10)	+ (2)	+ (2)	+ (13)	Andaman Island, Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Sikkim, TamilNadu, Telangana, Uttar Pradesh, West Bengal (Alipurduar, Howrah, North 24 Parganas)	China, India, Indonesia, Japan, Labuan, Laos, Malaysia, Myanmar, Nepal, New Guinea, Pakistan, Philippines, Russia, South Korea, Sri Lanka, Taiwan, Thailand, United States of America, Vietnam.	OR, PL	PrM (5), M (5), PsM (23)
			17	15	15	2	20				PrM (18), M (17), PsM (34)

Legend : BTR = Buxa Tiger Reserve, JWLS = Jaldapara Wildlife Sanctuary, GNP = Gorumara National Park, CWLS= Chapramari Wildlife Sanctuary, 24Pgs (N) – North 24 Parganas; OR = Oriental ; PL = Palearctic; PrM = Premonsoon; M = Monsoon; PsM = PostMonsoon; ♠ = New record from district; ♣ = New record from state

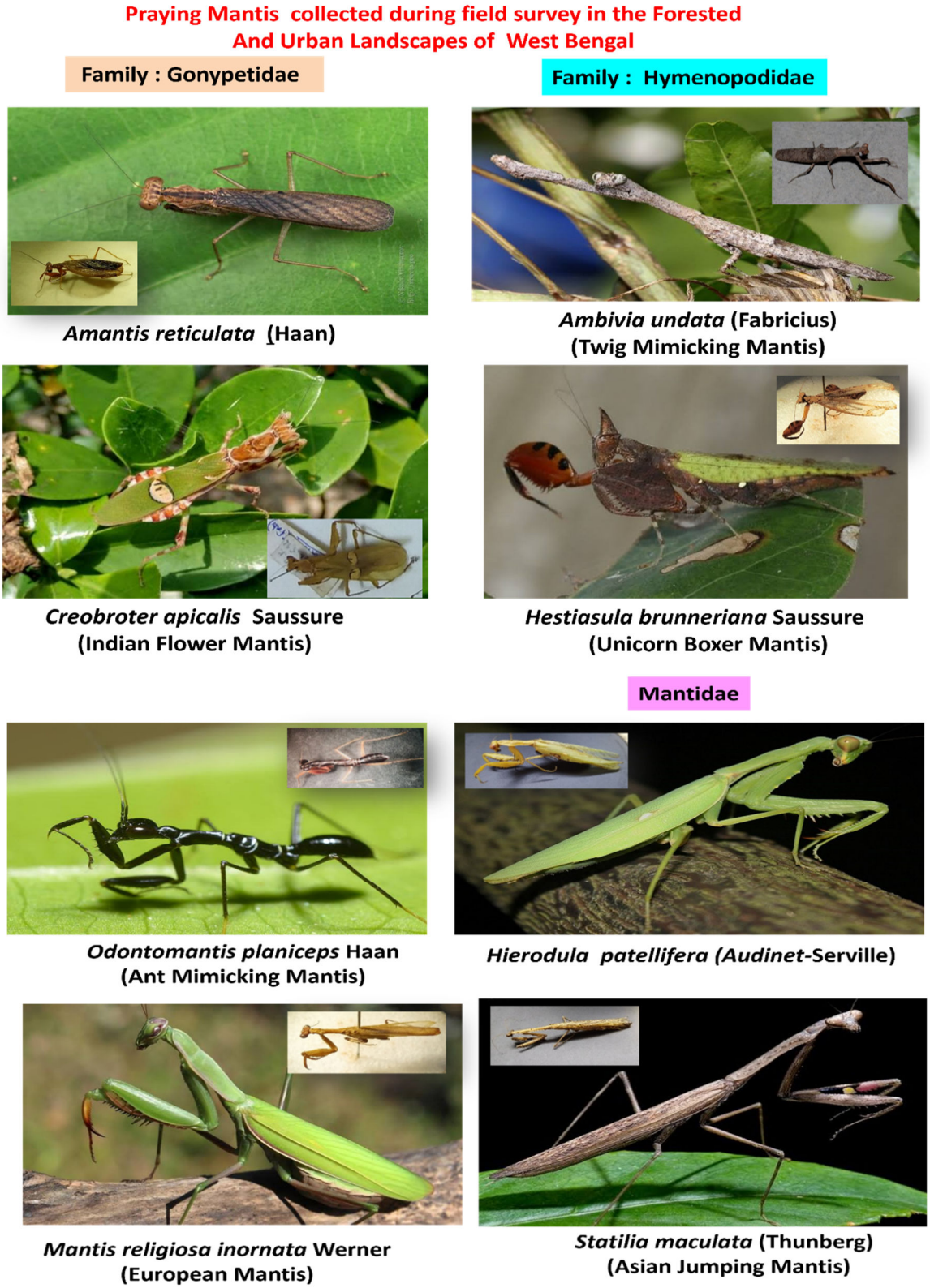


Figure 3. Mantis species encountered in the field (inset : Collected species stored in Laboratory).

Foreleg spination variation across Mantis species under different Mantodea family Encountered

Amantis reticulata

Ambivia undata

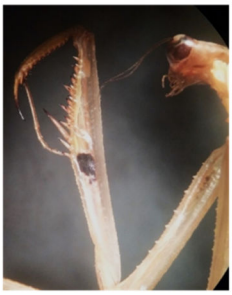
Creobroter apicalis

Hestiasula brunneriana

Odontomantis planiceps

Hierodula patellifera

Mantis religiosa inornata



Statilia maculata

Variation of head across Mantis species under different Mantodea family Encountered

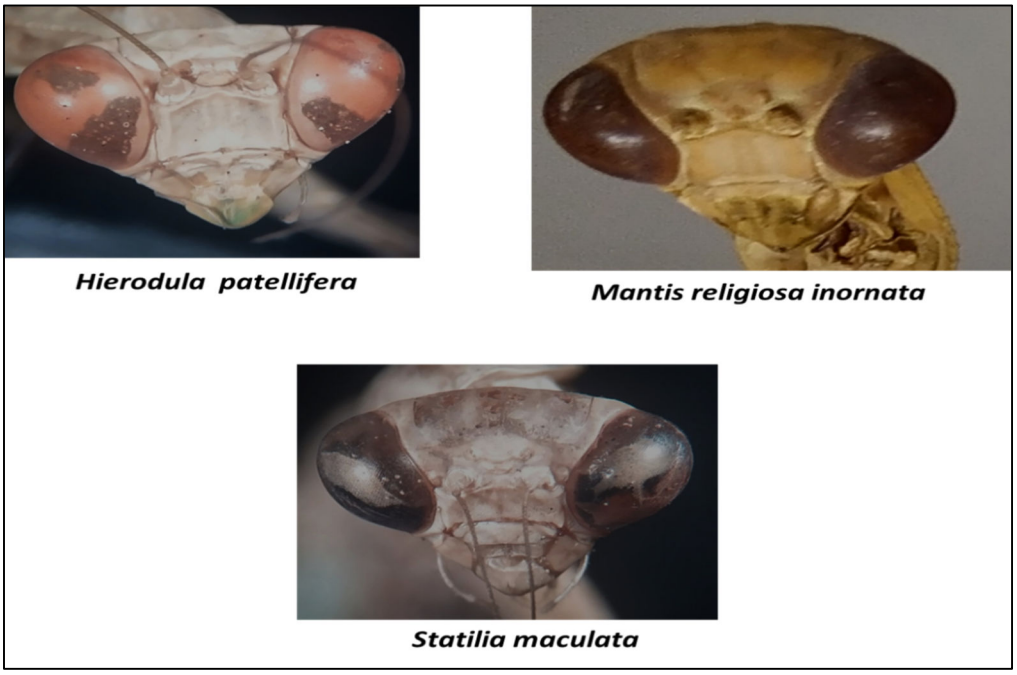
Amantis reticulata

Ambivia undata

Creobroter apicalis

Hestiasula brunneriana

Odontomantis planiceps



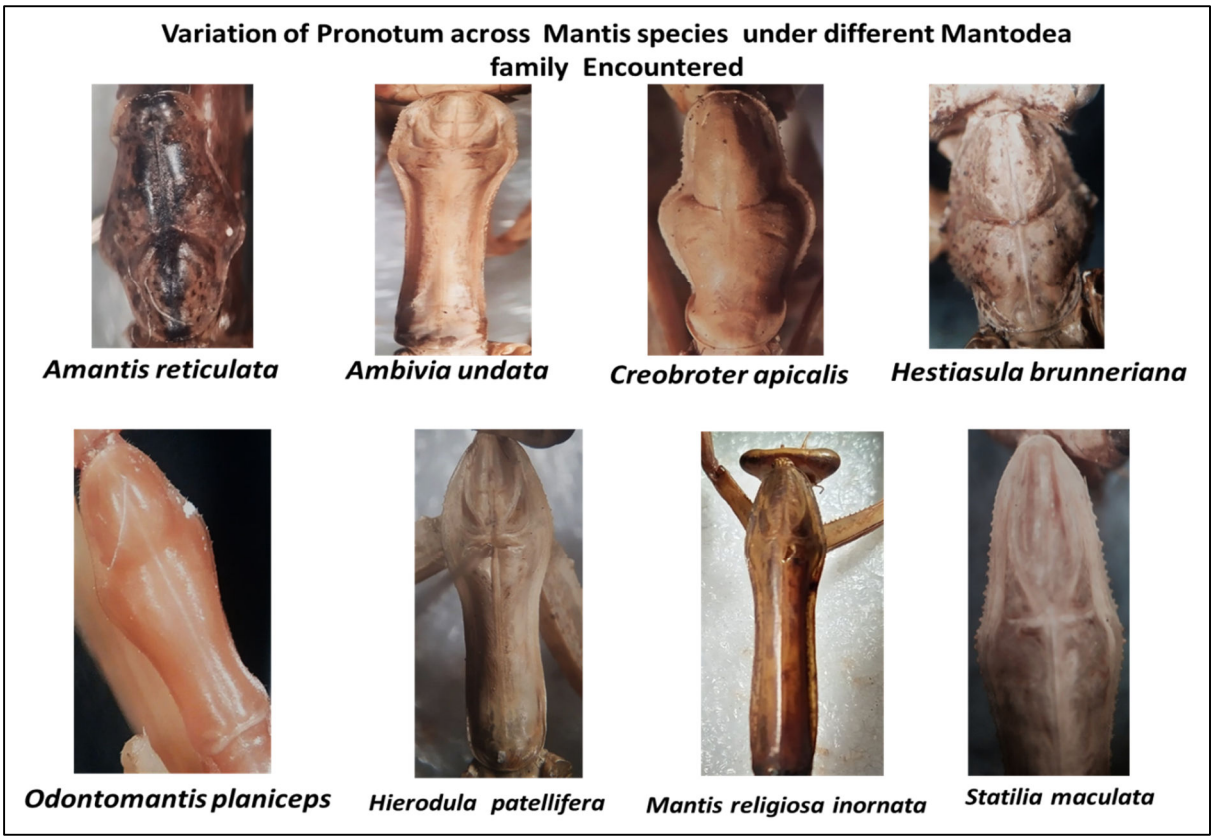


Figure 4. Details of body parts of encountered mantis species.

Ant mimicking Mantis

Ant Model

Dolichoderus affinis Emery

Mimicking Asian Ant Mantis

Odontomantis planiceps Giglio-Tos

The Asian ant mantis, a small mantis exhibits batesian mimicry in its juvenile stages, resembling black ant – adult is completely black from the 1st to 3rd instar at which it is most vulnerable from predators. After moulting to the 4th instar to its ultimate moult, it is mostly green with some colour variation depending on the vegetation in which it resides.

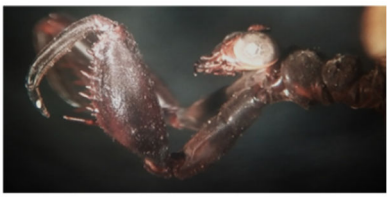
Camouflaging Behaviour

Ambivia undata **(Fabricius)**
(Asian Twig Mimicking Mantis)

It has a cryptic appearance that mimics the texture and colour of tree bark. This camouflage helps it blend seamlessly with its surroundings. It is an ambush predator. Its camouflage allows it to remain undetected by both prey and predators.

Euclimacia nodosa (West wood)
Lacewing - Mimicking Mantis & Wasp

Head



Foreleg

It is a rare and poorly known species of mantidfly in the lacewing family Mantispidae under Order Neuroptera. It was first recorded in West Bengal, India. It often mimic social wasps in its body shape and colour pattern. It has raptorial forelegs similar to the front legs of mantids used to hunt other insects.

Figure 5. Interesting Mantis Species in Collection.

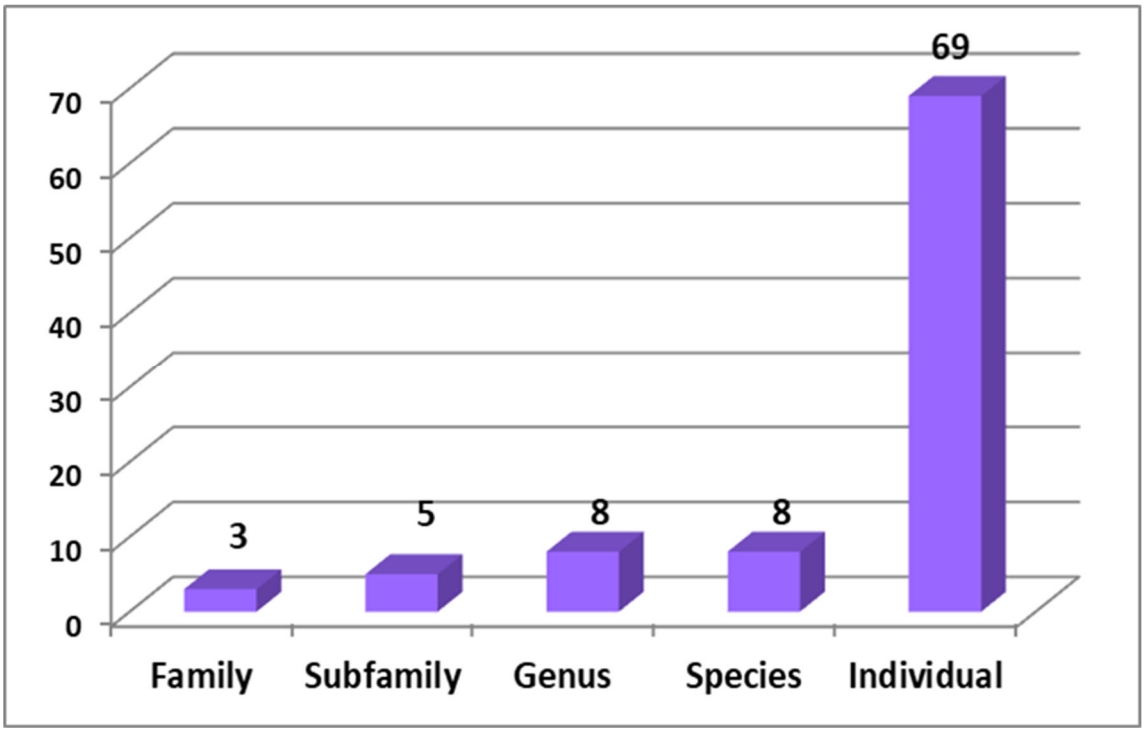


Figure 6. Total Mantid Taxa Encountered.

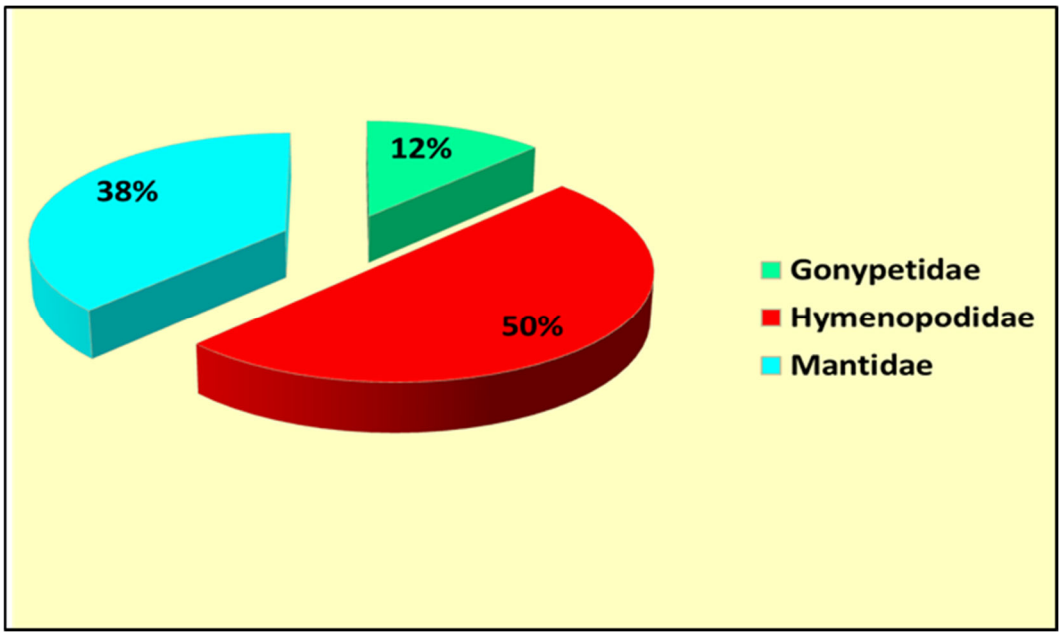


Figure 7. Family wise Mantid species encountered.

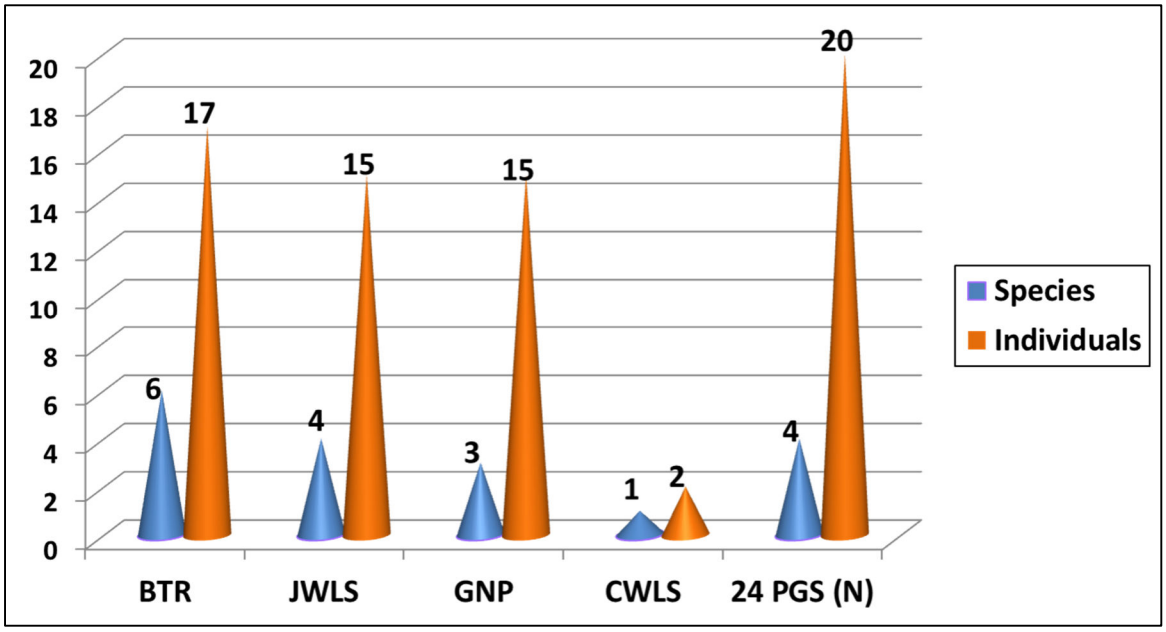


Figure 8. Total no. of Mantis Species & individuals encountered during survey in Forested and Urban Areas.

Table 2. Site specific biodiversity indices of recorded mantis fauna.

Diversity Indices	BTR	JWLS	GNP	CWLS	24 PGS (N)
Shannon-Wiener's Index	0.3675	0.3524	0.3219	0.1024	0.3466
Simpson's Diversity Index	0.9385	0.9526	0.9526	0.9996	0.9144
Pielou's Evenness Index	1.2105	0.2542	0.2930	0.1024	0.2153
Margalef's Index	1.4118	1.1078	0.7386	0.0000	1.3352
Sorensen's Similarity Index					
	BTR	JWLS	GNP	CWLS	24 PGS (N)
BTR	x	0.3750	0.4000	0.2222	0.3529
JWLS		x	0.4615	0.257	0.4000
GNP			x	0.3333	0.3333
CWLS				x	0.2500
24 Pgs (N)					x

The study identified a total of eight (8) mantid species distributed across eight (8) genera, belonging to three (3) families and five (5) subfamilies from protected reserve forests in foothills of Himalaya, West Bengal, and urban areas of North 24 Parganas (Table – 1; Figs. 3-7). The most abundant species belong to the family Mantidae (36%) represented by three (3) species and three (3) genera: [*Statilia maculata* (Thunberg) (Asian Jumping Mantis), *Hierodula patellifera* (Audinet-Serville) and *Mantis religiosa inornata* Werner (European Mantis)]. Among these, the Asian Jumping Mantis, *Statilia maculata* (Thunberg), emerged as the most prevalent, abundant, and dominant species throughout the study area, with the highest sampling occurring during the post-monsoon season. Notably, *Amantis reticulata* (Haan) is recorded for the first time in the state, and all eight (8) species are documented for the first time in the forests of Alipurduar district and the urban landscapes of North 24 Parganas district of West Bengal. There exists a distributional expansion of mantis species within West Bengal. *Odontomantis planiceps* Haan, known as the Asian ant mantis, is exclusively found in North 24 Parganas within an ant colony. This small mantis demonstrates Batesian mimicry during its juvenile stages, closely resembling a black ant (Fig.5). *Ambivia undata* (Fabricius), referred to as the Asian Twig Mimicking Mantis, possesses a cryptic appearance that imitates the texture and color of tree bark. This camouflage helps blend seamlessly with its surroundings. It is an ambush predator. Its camouflage allows it to remain undetected by both prey and predators (Fig.5). *Euclimacia nodosa* (West wood), a lacewing, was collected, a rare and poorly known species of mantidfly (Mantispidae : Neuroptera). It was the first record from West Bengal, India. It often mimic social wasps in its body shape and colour pattern. It has raptorial forelegs similar to the front legs of mantids used to hunt other insects (Fig.5). A greater no. of species and individuals are encountered in forests of Dooars (Alipurduar) compared to urban areas of North 24 Parganas (Fig.8). Postmonsoon can be a best time to observe mantids in the field (Table -1). The fauna primarily consists of Oriental elements, with 75% including Palaearctic species (Table -1). All the recorded mantid species show distributional expansion. Table 2 delineate the site specific biodiversity indices of the recorded mantid fauna.

CONCLUSION

This survey enhances the existing knowledge of mantis diversity in the region and will contribute to conservation management strategies, utilizing mantis as indicators of biodiversity (Battiston *et al*., 2020).

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