



Biodiversity and biogeography of praying mantid (Dictyoptera: Mantodea) in Punjab, Pakistan

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Abstract

Biodiversity means life variety of a particular place, habitation and when joint with biogeography becomes the study of biological diversity of environment isolated by barriers and both pronounce how and why distribution of plants and animals occurs. In support of this, biodiversity of praying mantids undertaken to identify and evaluate the species richness and evenness was measured through Shannon Index and three Simpson's Indexes. The mantids were collected from cultivated and non-cultivated fields and organize an inclusive and updated record of biodiversity of mantodea occurring in 13 districts of Punjab Province of Pakistan. Throughout survey 296 mantids were collected and arranged into 13 species. Pictures were captured by digital camera.

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Introduction

The stumpy premeditated assortment of crops organization is serious not only in stipulations of production but also in term of determinant of the entirety variety of life (Swift and Ingram, 1996). Diversity persuades compositions and plenty of allied biota as pest complex, insects which live in or on the earth, and microbes, which in twist seriously have an effect on flora and soil processes. While according to (Fernandez, 2005) the term biodiversity (fauna and flora) effectiveness supposition, organically wide-ranging systems are supplementary and dynamic, operative, durable and sustainable. For this in the direction of accomplish durability and sustainability in agriculture through incorporated agricultural methods then first it requires to uphold and safeguard the fauna and flora of the region. Even though, the applying malpractices reminiscent of underprivileged supervision of natural possessions, excess grazing of cattle and same crop cultivation every year, applying of chemicals (Pesticides, herbicides, fungicides, fumigation), unsuitable farming methods, forest cutting are the root causes to intimidation biodiversity (MFSC, 2000). Biodiversity refers entire variety of life, occupying, living on this globe (Kothari, 1992). Its study has huge impact for the reason that superfluous number of the globally reported animals are include insects (Wilson, 1992). Biogeography is to learn of ways and means by which all the living beings disperse, their process of allocation in was nicely studies by (Lomolino *et al.*, 2006). Mantids are the insect of great importance being predator and considered as lions in insect's world, like lioness

attempt most hunting similar female mantid also, but unlike lion's mantids never wait for the death of victim hence they are famous as pitiless predators. Mantids are ambush predator; consume insects, arthropods and rarely on small bird and vertebrate. They have carnivorous type of mouthparts (Khokhar *et al.*, 2009; N.M. Soomro, *et al.*, 2012; 2013). The entire past research work reported on mantids is fair but diverge from this project. Numerous researchers like Chandra *et al.*, 2011; Chaturvedi & Hedge 2000; Chaturvedi *et al.*, 2005; Ehrmann 2002; Ghate *et al.*, 2004; Jadhav 2009; Khokhar *et al.*, 2009; 2016; Mukherjee & Hazra 2007; N.M. Soomro, *et al.*, 2012; 2013; Roy & Svenson 2007; N.M., 2000; 2002, Vyjayanti *et al.*, 2009 defined the biogeography of mantids, but present work is illustrious and first time reported. Therefore, keeping in view the importance of mantids and replacing the huge necessity of the pesticide use, the present study was aimed, which may result solid base as biological control agent against pest management as commercial purpose for the farming community.

Materials and methods

The present study was conducted at different localities of Punjab Province of Pakistan to find out the biogeography of praying mantids.

Collection of material

The total 296 number of specimens were collected during May to October in both 2014-2015 consecutive years, from various districts and localities of Punjab, Pakistan as shown in (Fig.1).

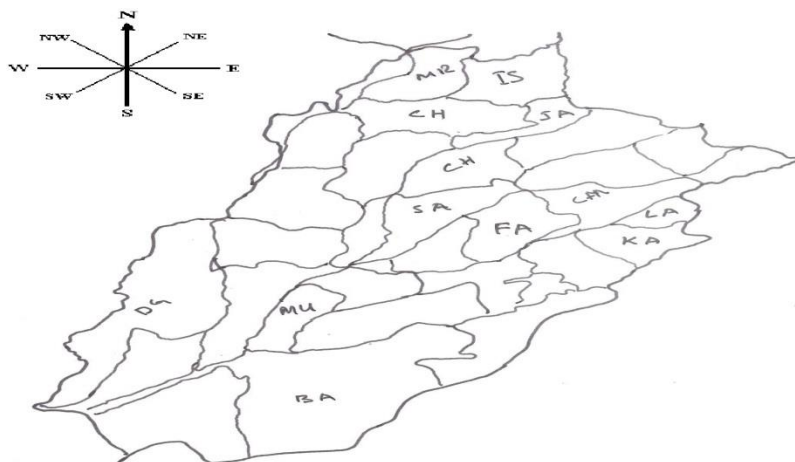


Fig. 1. Map showing the districts Punjab, visited for collection of praying mantids.

Preservation, Labeling and Identification

After successful collection of mantids, all of the specimens were brought into the post graduate lab of University of Sindh, Jamshoro to preserve through standard entomological methods and were kept in boxes along with information tag mentioning date of collection, locality, and name of collector as shown in (Fig.2). To prevent the attack of animals, Naphthalene bolls were used in boxes. Specimen's Identification was prepared by using keys given by (Soomro *et al.*, 2002), (Oliveira, 1996) and (Ehrman's, 2002).

Measurement and Analysis

To measure the biodiversity upcoming equations were used Simpson's Index (D), $D = \sum (n / N)^2$ where D=

Simpson's Index, $\Sigma =$ some of, n=sum of individuals of particular species, N= sum of individuals of all species. Here measures of D vary stuck between 0 and 1. Where 0 is infinite diversity and 1 means no diversity. Second Simpson's Index of Diversity is equal to $1 - D$, The significance of this equation will fall into 0 and 1, it shows, the better the value, the superior the sample diversity. In additional the Simpson's Reciprocal Index $1 / D$, was measured. The assessment of this index begins from 1 as the lowest possible Fig. and onward. This numeral would characterize a community enclose merely solitary species. This shows the privileged the value and the superior the variety of life. Finally Species Richness and Shannan Index were measured.



Fig. 2. A sample Insect box, showing the collection of praying mantids checklist of mantodea (Insecta) reported from Pakistan.

Results and discussion

Praying mantids (M. B, 1838) comprised of exclusively carnivorous insects, often live in the vegetation or on the ground, mostly feed on insects, spiders and sometimes even small vertebrates (Prete *et al.*, 1999). Almost 2300 species are known worldwide, most of these occur in the tropics and subtropics (Ehrmann, 2002). An overview regarding ecological studies of mantid usually concentrate on a single or few species, so far from temperate zones (Rathet & Hurd, 1983; Daniels *et al.*, 1985), however, the information about South East Asian species is yet

limited (Lieftinck, 1953). Almost no literature on mantids has been published, yet now, 102 species out of 47 genera have been recorded (Shelford, 1903; Ehrmann, 2002). Therefore, there is need to overview and identify some of the genera of mantids to fill up the gap of biogeography among the mantid species around the globe.

In this regard, the present study was designed to contribute to diversify the biodiversity of praying mantids in Punjab Province of Pakistan. To the best of our knowledge, this is first time attempted to study.

The geographical division of praying mantids occurring in Punjab is given for all the collected species state-wise, mainly based on survey. Only the existing valid names of the species are given in this effort. The list of the praying mantids made separately on the basis biodiversity and biogeography. This survey was carried out during 2014 to 2015 in which 296 specimens and four new records (*E. unicornis*, *E. laevifrons*, *M. religiosa inornata* and *S. transcaucasica*) are witness first time from Punjab province. Besides the distribution of previously recorded species has been extended to some new localities of cultivated and non-cultivated fields. Results show species richness within habitat biodiversity of praying mantids population is high at the places where their no tillage, no pesticides spray, and no biannual cultivation mean in (nonagricultural area). While in cultivated areas species richness and biodiversity of insect's fauna especially praying mantids decreases.

Overall half number of earlier reported species vanished from previously reported habitats. It may be because of excess practices of pesticides, herbicides, chemical fertilizers etc. It was observed that each

praying mantid have possession of micro habitat for instance some live in and on the grasses, while other found on the bark or on the trees etc, where they prey on the insects and other small animals, mating and live successfully due to their camouflage.

Total 296 specimens were sorted in to five families as cited in (Table 1). In which the families Amorphoscelidae and Eremiaphilidae, are precise smallest have only one species each while 3, 3, 5 species of Hymenopodae Empusidae, and Mantidae respectively collected. It shows that the family Mantidae is rich in diversity then rest families. The most abundant species are *Sphodromantis transcaucasica*, *Mantis noblis*, and *Tenodera fasciata* and hence have appropriate richness while other has very undersized richness (Table 2).

From collection of 296 specimens of praying mantids, 1.677, 0.241, 0.759, 4.149 and 0.679, Shannan Index, Simpson's Index of diversity, Simpson's Reciprocal Index and Species richness simultaneously measured as shown in (Table 3). The present study will help to categories the genera of mantids and may be used as predators for the commercial purposes.

Table 1. Distribution of praying mantids in thirteen (13) Districts of Punjab province.

Families/Name of Species	J H	S A	F A	I S	LA	MU	MR	KA	CH	CA	CM	DG	BA	#sp
<i>Amorphoscelidae</i>														
<i>Amorphoscelis annulicornis</i>	-	-	+	-	-	-	-	-	-	-	-	-	-	4
<i>Empusidae</i>														
<i>Empusa pauperata</i>	-	-	+	-	-	-	-	+	-	-	+	+	-	6
<i>Empusa penicornis</i>	+	-	+	-	-	-	-	+	+	-	-	-	-	8
<i>Empusa unicornis</i>	-	+	-	-	+	-	-	-	-	+	-	-	+	3
<i>Eremiaphilidae</i>														
<i>Eremiaphila laevifrons</i>	-	-	-	+	+	+	-	-	-	-	-	-	-	2
<i>Hymenopodinae</i>														
<i>Humbertilla affinis</i>	+	+	-	+	-	-	-	+	+	-	-	-	+	5
<i>Hestiasula brunneriana</i>	-	-	-	-	-	-	-	+	+	-	-	-	-	4
<i>Odontomantis sinensis</i>	-	-	+	-	-	-	-	+	-	-	-	-	-	6
<i>Mantidae</i>														
<i>Iris tiflisina</i>	-	-	-	+	+	+	-	-	-	-	-	-	-	11
<i>Mantis noblis</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	74
<i>Mantis inornata</i>	+	-	-	+	-	-	+	-	-	-	+	-	-	15
<i>Sphodromantis transcaucasica</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	103
<i>Tenodera fasciata</i>	-	-	+	-	-	-	-	-	-	-	+	-	+	55
Total specimen of praying mantids collected														296

Note: (+) sign indicates the presence of species while (-) sign indicates absence of the species.

JH	Jhelum	SA	Sarhodha	FA	Faisalabad	IS	Islamabad
LA	Lahore	MU	Multan	MR	Murree	KA	Kasoor
CH	Chiniot	CA	Chakwal	CM	Changa manga	DG	Dera Gazi Khan
BA	Bhawalpur						

Table 2. Name & number of species, their biodiversity index and Simpson’s index of diversity from Punjab province.

S#	Name of species	Total # collected	Biodiversity Index	S. I. D
1	<i>Amorphoscelis annulicornis</i>	04	0.00018	0.999
2	<i>Empusa pauperata</i>	06	0.00040	0.999
3	<i>Empusa penicornis</i>	08	0.00072	0.999
4	<i>Empusa unicornis</i>	03	0.00010	0.999
5	<i>Humbertiella affinis</i>	05	0.00028	0.999
6	<i>Hestiasula brunneriana</i>	04	0.00018	0.999
7	<i>Iris tflisina</i>	11	0.00013	0.999
8	<i>Mantis inornata</i>	05	0.00028	0.999
9	<i>Mantis noblis</i>	76	0.06580	0.934
10	<i>Sphodromantis transcaucasica</i>	105	0.12580	0.874
11	<i>Tenodera fasciata</i>	95	0.10290	0.897
12	<i>Odontomantis indica</i>	06	0.00720	0.999
13	<i>Eremiaphila laevifrons</i>	02	0.00018	0.999

Table 3. Shannan Index, and Simpson’s Diversity Indices from Punjab.

S#	Name of species	# *in	Pi	ln Pi	(Pi) ln Pi
1	<i>Amorphoscelis annulicornis</i>	04	0.012	4.423	0.053
2	<i>Empusa pauperata</i>	06	0.018	4.017	0.072
3	<i>Empusa penicornis</i>	08	0.025	3.729	0.089
4	<i>Empusa unicornis</i>	03	0.009	4.711	0.042
5	<i>Humbertiella affinis</i>	05	0.015	4.199	0.062
6	<i>Hestiasula brunneriana</i>	04	0.012	4.423	0.053
7	<i>Iris tflisina</i>	11	0.033	3.411	0.112
8	<i>Mantis inornata</i>	05	0.015	4.199	0.062
9	<i>Mantis noblis</i>	76	0.232	1.461	0.338
10	<i>Sphodromantis transcaucasica</i>	103	0.320	1.139	0.364
11	<i>Tenodera fasciata</i>	95	0.289	1.241	0.358
12	<i>Odontomantis indica</i>	06	0.018	4.017	0.072
13	<i>Eremiaphila laevifrons</i>	02	0.012	2.423	0.053
Total		296	0.999		1.677
Shannon Index, H		1.677			
Simpson’s Index, D		0.241			
Simpson’s Index of Diversity 1- D		0.759			
Simpson’s Reciprocal Index 1/D		4.149			
Species richness		0.697			

List of families

1. Amorphoscelidae
2. Empusidae
3. Eremiaphilidae
4. Hymenopodidae
5. Mantidae

Genus *Amorphoscelis* Stal, 1871

A. annulicornis Stal, 1871

Family Empusidae

Genus *Empusa (Empusa)* Illiger, 1798

E. pauperata Fabricius, 1781

E. unicornis Linnaeus, 1763*

E. penicornis Pallas, 1837

Genus and species checklist

Family: Amorphoscelidae

Family: Eremiaphilidae

Genus Eremiaphila Lefebvre, 1835

E. laevifrons Uvarov, 1922*

Family: Hymenopodidae

Genus Hestiasula Saussure, 1871

H. brunneriana Saussure, 1871

Genus Humbertiella Saussure, 1869

H. affinis Giglio-Tos, 1917

Genus Ormomantis Giglio-Tos, 1915

O. indica Giglio-Tos, 1915

Family: Mantidae

Genus Tenoderia Burmeister, 1838

T. fasciata(Olivier, 1792

Genus Mantis Linnaeus, 1758

M. nobilis Brunner, 1878

M. religiosa inornata Werner, 1930*

Genus Sphodromantis, Stal, 1877

S. transcaucasica Brunner, 1878*

Genus Iris Saussure, 1869

I. tiflisina Giglio-Tos 1917

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