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Diversity of Odonates in agricultural fields of Howrah district, West Bengal, India

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Abstract

The present study documented the odonates (Damselflies and Dragonflies) of agricultural fields of Howrah, West Bengal, India. Agricultural fields are unique ecosystems that provide some odonates to complete their life cycle. So the main aim of this study to prepare a list of those odonates which use these fields. A total number of 17 species of order Odonata were observed, among them 12 species belongs to sub order Anisoptera and 5 species belongs to suborder Zygoptera. Suborder Anisoptera was represented by the family Libellulidae and suborder Zygoptera by the family Coenagrionidae. Species composition was highest in the family Libellulidae (70%) followed by the family Coenagrionidae (30%). Among all agricultural fields Rice fields (13) contain highest number of odonates followed by Sugarcane (5), Sesame (5) and others. Rice field is show highest diversity of odonates showing 76.471% of total odonates. Odonata documentation is highly necessary in order to assess the agroecosystem health. The fact that health of agroecosystem is proportionately at par with the presence of the odonates can be easily perceived from this study.

Keywords: Odonata, agricultural field, diversity, agroecosystem health, Howrah

1. Introduction

The order Odonata, the dragonflies and damselflies are one of the most attractive, widely distributed groups of insects [1]. Due to relatively short generation time, high trophic position, the odonates are important members of ecosystem and efficient indicators of ecosystem health [2, 3]. Odonates occur close to different fresh water habitat Viz. River, stream, lakes, pools and rice fields [4]. Those are one of the most important invertebrate predators of any ecosystem [5]. The odonates have become most effective insect group in view to the ecological quality assessment [6]. Anecdotal observation suggests that some odonates are habitat specific that they might disappear at minor changes [7]. Odonates are the valuable insects which help adopting decision regarding environment and crop management [8]. Both larvae and adults of odonata are regarded as important predators of rice fields [9]. Rice ecosystem is looked upon as the most appropriate habitat among all agroecosystems because of its aquatic nature and availability of prey species [10]. Adults of some visit crop fields to search for foods in course of which they even control the insect pests in crops [11, 12]. Eight super families, 29 families and some 58 sub-families of approximately 600 genera and approximately 6000 species and subspecies have been described from all over the world [13]. Fraser (1933, 1934, 1936) published 3 volume of his books entitled 'Fauna of British India' where he mentioned 536 species of Odonates from British India [14, 15, 16]. Prasad and Varshney (1995) mentioned fewer number species than predecessor because of partition that came along with independence [17]. Later Mitra (2005) recorded 499 species and Subramanian (2005) 463 species respectively [18, 19]. The studies on odonates in West Bengal were initiated by Selys (1891) who documented nearly 22 species from Kolkata [20]. Srivastava and Sinha (1993) reported 178 species from West Bengal [21]. Ultimately Mitra (2002) recorded 65 species from Kolkata and its surroundings Howrah [22]. Most researches on odonata in India have been confined to rain feed canal, ponds, swamps, lowlands, lakes some paddy fields by Dawn (2014) and Nair (2011) [23, 7]. Forest areas (Katlia, 2014), some institute campuses (Bora, 2014) [24, 25]. Odonates diversity studies was carried out in paddy fields among agroecosystem by (Gunathilagaraj, 1999) and he recorded 16 species of Odonata from rice fields of Coimbatore region and later (Soniya Gandhi and Kumar, 2014) succeeded him in same course of studies to a certain extent [26, 27]. The odonata study on the broad aspect encompassing all varied agroecosystem was first done by (Rathod *et al.*, 2012), who recorded 31 species from agroecosystem of Amravati city [28]. The

The main objective of the present study was to record odonates in the agroecosystem of Howrah district, West Bengal. This will help to assess the present day agroecosystem health and the changes in the system of crop management in future. The present study also expedient to understand the negative effects of chemicals on odonates diversity.

2. Materials and Methods

2.1 Study Area

Howrah is a small district of the West Bengal state in eastern India (Fig 1). The Area of Howrah is 467 km². The Howrah district lies between 22°48' N and 22°12' N latitudes and between 88°23' E and 87°50' E longitudes. Boundaries of the district are naturally determined by Rupnarayan River on west and south-west, and by Bhagirathi-Hooghly River on east and south-east side. On north side, the boundary is an artificial one except for Bally canal on north-east and Damodar River on north-west. Annual normal rainfall is 1461 millimeter per year. Annual maximum temperature varies between 32-39 °C, whereas minimum temperature varies between 8-10 °C.

2.2 Monitoring (Line transect)

Different agricultural fields (Fig 2 and Fig 3) of this district was surveyed during April, 2011 to February, 2014 by using line transect method. In this method 5 permanent 300 m line transects was setup in each (4) group of the blocks. Through these transects walked once a month in each block to follow Pollard Walk Method [29, 30] for recording the odonates. A slow 180 degree visual sweep was performed during walking. Observations were done over all the seasons viz., summer (March to May), monsoon (June to October), and post monsoon (November to February). The blocks of entire district were divided into 4 groups on the basis of their geographical similarities. Two groups were agriculturally dominating, one was less agriculturally dominating and last one was industries dominating group. Collection of specimen was avoided to the extent possible. Mostly photographic documentation was done. Photographs were taken using Cannon EOS 550D with 18-55 mm lens. Identification of odonates was done with the help of these authentic literatures (Fraser, 1933, 1934 & 1936; Mitra, 2002; Subramanian, 2005 & 2009; Nair, 2011) [14-16, 22, 19, 31, 7]. Systematic arrangement and the taxonomy followed in the checklist and common names after Subramanian (2014 and 2009) [32, 31].

3. Results

The study revealed the presence of 17 species of odonates belonging to two families from all agricultural fields during surveys (Table1). Among the sub order Anisoptera 12 species were recorded belonging to the only family Libellulidae. In case of sub order Zygoptera 5 species were recorded belonging to the family Coenagrionidae (Table 1). The recorded species during the study was Coral tail cloud wing [*Tholymis tillarga* (Fabricius, 1798)] (Fig 4), Green marsh hawk [*Orthetrum Sabina* (Drury, 1770)] (Fig 5), Ground skimmer [*Diplocodes trivialis* (Rambur, 1842)] (Fig 6), Long legged marsh glider [*Trithemis pallidinervis* (Kirby, 1889)] (Fig 7), Common picture wing [*Rhythemis variegata* (Linnaeus, 1763)] (Fig 8), Pied paddy skimmer [*Neurothemis tullia* (Drury, 1773)] (Fig 9), Trumpet tail [*Acisoma panorpoides* (Rambur, 1842)] (Fig 10), Rudy marsh skimmer [*Crocothemis servilia* (Drury, 1773)] (Fig 11 and 12), Scarlet marsh hawk [*Aethriamanta brevipennis* (Rambur, 1842)] (Fig 13), Little blue marsh hawk [*Brachydiplax sobrina* (Rambur,

1842)] (Fig 14), Wandering glider [*Pantala flavescens* (Fabricius, 1798)] (Fig 15), Ditch jewel [*Brachythemis contaminata* (Fabricius, 1793)], Coromandel marsh dart [*Ceriagrion coromandelianum* (Fabricius, 1798)] (Fig 16), Milky dartlet [*Agriocnemis lacteola* (Selys, 1877)] (Fig 17), Golden dartlet [*Ischnura aurora* (Brauer, 1865)] (Fig 18), Orange tail marsh dart [*Ceriagrion cerinorubellum* (Brauer, 1865)] (Fig 19) and Pigmy dartlet [*Agriocnemis pygmaea* (Rambur, 1842)] (Fig 20). Rice fields were used by the Coromandel marsh dart [*Ceriagrion coromandelianum* (Fabricius, 1798)] (Fig 21) for their mating fields. Species composition was highest in the family Libellulidae (70%) followed by the family (30%). In the present study, the maximum number of species was observed in rice field (13) followed by Sugarcane (5), Sesame (5), Jute (4), Potato (3), Mustard (2), Arum (2) and Vegetables fields (2) (Table 2 and Fig. 22). Rice field is show highest diversity of odonates showing 76.471% of total odonates.

3.1 Species Accumulation Curve

Species accumulation curve is an approach by plotting the cumulative number of species collected against the sampling effort (sample unit). From the year 2011 to 2014 the species accumulation curve (Fig 23) for the four sites sampled individually, increased from first to the fourth sampling though the number of new species added slowly.

4. Discussion

In the present study 17 species of Odonata were documented from agricultural fields of the district Howrah, of which 12 species are Dragonflies and 5 species are Damselflies. Previously odonates diversity studies was carried out in paddy fields by (Gunathilagaraj, 1999) and he recorded 16 species of Odonata from fields of Coimbatore region [26]. Later (Soniya Gandhi and Kumar, 2014) followed him in same course of studies to a certain extent and recorded 8 species from rice fields [27]. The odonata study on the broad aspect encompassing all varied agroecosystem was first done by (Rathod *et al.*, 2012), who recorded 31 species from agroecosystem of Amravati city [28]. So, on the basis of these previous studies we can say that odonata diversity of Howrah district is satisfactory. Most important reason of presence of less number species than Amravati region is rapid urbanization and high density of human population in this District. The district Howrah is situated besides of Mega city Kolkata so; human population and urbanization are increasing day by day. This type of documentation is necessary for this District to understand the changes of Odonata fauna and agricultural system in this District. We also documented the fields' wise presence of odonates and reason behind these preferences. Some species showed preference for particular fields. These were the Pied paddy skimmer, Trumpet tail in rice field and Golden dartlet in potato field and milky dartlet in mustard field. Ditch jewel mainly sighted in the agricultural fields of less agriculturally rich blocks where fields were situated near the other industries. The availability of water in the field or nearby places has been shown to be correlated with species diversity. Odonata diversity also depends on presence of chemicals and pesticides in the fields. In the present study, the maximum number of species was observed in rice field where availability of water was greater than other fields whereas potato and mustard fields showed less odonates diversity because they are winter crop.

Table 1: List of Odonta (Dragonfly and Damselfly) fauna in agricultural fields of Howrah district (West Bengal, India) during 2011 to 2014

S No.	Common name	Scientific name	Occurrence	Local status
Sub order- Anisoptera				
Family- Libellulidae				
1	Coral tail cloud wing	<i>Tholymis tillarga</i> (Fabricius, 1798)	Jf, Sf	Common
2	Green marsh hawk	<i>Orthetrum Sabina</i> (Drury, 1770)	Sf, Rf, Af	Very common
3	Ground skimmer	<i>Diplocodes trivialis</i> (Rambur, 1842)	Rf, Sf	Very common
4	Long legged marsh glider	<i>Trithemis pallidinervis</i> (Kirby, 1889)	Rf, Sef	Common
5	Common picture wing	<i>Rhyothemis variegata</i> (Linnaeus, 1763)	Rf, Sef	Very common
6	Rudy marsh skimmer	<i>Crocothemis servilia</i> (Drury, 1773)	Jf, Rf, Sef, Pf	Very common
7	Pied paddy skimmer	<i>Neurothemis tullia</i> (Drury, 1773)	Rf	Locally common
8	Trumpet tail	<i>Acisoma panorpoides</i> (Rambur, 1842)	Rf	Common
9	Wandering glider	<i>Pantala flavescens</i> (Fabricius, 1798)	Rf	Very common
10	Scarlet marsh hawk	<i>Aethriamanta brevipennis</i> (Rambur, 1842)	Sef, Jf, Mf	Common
11	Little blue marsh hawk	<i>Brachydiplax sobrina</i> (Rambur, 1842)	Rf	Common
12	Ditch jewel	<i>Brachythemis contaminata</i> (Fabricius, 1793)	Rf, Af	Very common
Sub order- Zygoptera				
Family- Coenagrionidae				
13	Coromandel marsh dart	<i>Ceriagrion coromandelianum</i> (Fabricius, 1798)	Rf, Jf, Pf, Vf	Common
14	Golden dartlet	<i>Ichnura aurora</i> (Brauer, 1865)	Pf	Common
15	Milky dartlet	<i>Agriocnemis lacteola</i> (Selys, 1877)	Rf, Mf	Uncommon
16	Orange tail marsh dart	<i>Ceriagrion cerinorubellum</i> (Brauer, 1865)	Sf, Rf	Very common
17	Pigmy dartlet	<i>Agriocnemis pygmaea</i> (Rambur, 1842)	Sf, Sef, Vf	Very common

[Abbreviations: Rf- Rice field, Sf- Sugarcane field, Sef- Sesame field, Pf- Potato field, Jf- Jute field, Mf- Mustard field, Vf- Vegetable field (Pumpkin, bitter gourd, Egyptian cucumber, Indian gardening cucumber).]

Table 2: Odonata distribution in different agricultural fields of Howrah district (WB, India) during 2011- 2014.

S No.	Agricultural fields	Related Odonata species	Number of species
1	Rice	Green marsh hawk, Ground skimmer, Long legged marsh glider, Common picture wing, Rudy marsh skimmer, Pied paddy skimmer, Trumpet tail, Wandering glider, Little blue marsh hawk, Ditch jewel, Coromandel marsh dart, Milky dartlet, Orange tail marsh dart	13
2	Sugarcane	Coral tail cloud wing, Green marsh hawk, Ground skimmer, Orange tail marsh dart, Pigmy dartlet	5
3	Potato	Rudy marsh skimmer, Coromandel marsh dart, Golden dartlet	3
4	Mustard	Scarlet marsh hawk, Milky dartlet	2
5	Sesame	Long legged marsh glider, Common picture wing, Rudy marsh skimmer, Scarlet marsh hawk, Pigmy dartlet	5
6	Arum	Green marsh hawk, Ditch jewel	2
7	Jute	Coral tail cloud wing, Rudy marsh skimmer, Scarlet marsh hawk, Coromandel marsh dart	4
8	Vegetables	Coromandel marsh dart, Pigmy dartlet	2

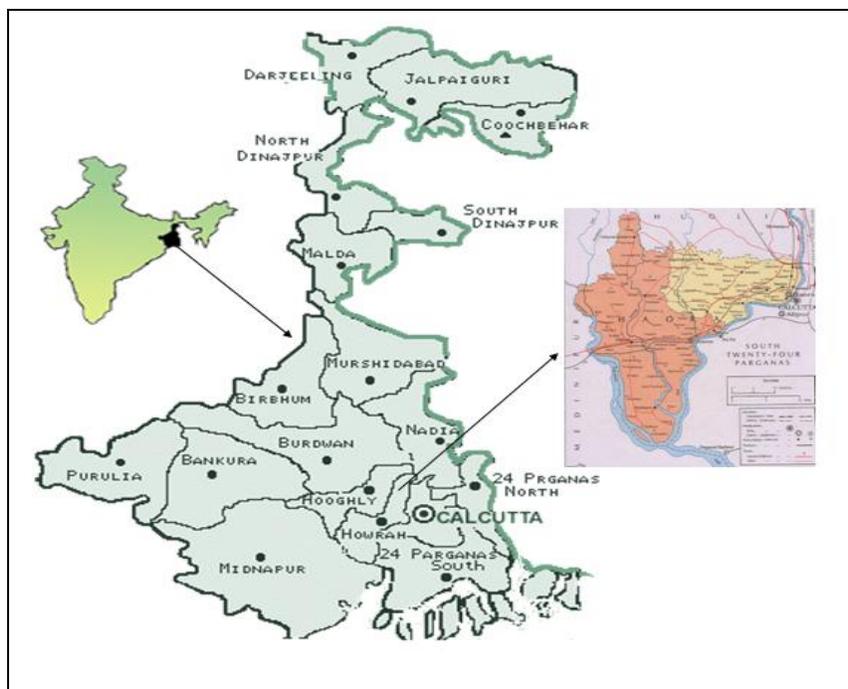


Fig 1: Howrah district, West Bengal of India (study area).



Fig 2: Rice field (One of the important habitat areas).



Fig 3: Sugarcane field (Another habitat area).



Fig 4: Coral tail cloud wing (*Tholymis tillarga*)



Fig 5: Green marsh hawk (*Orthetrum sabina*)



Fig 6: Ground skimmer (*Diplocodes trivialis*)



Fig 7: Long legged marsh glider (*Trithemis pallidinervis*)



Fig 8: Common picture wing (*Rhyothemis variegata*)



Fig 9: Pied paddy skimmer (*Neurothemis tullia*)



Fig 10: Trumpet tail (*Acisoma panorpoides*)



Fig 14: Female Little blue marsh hawk (*Brachydiplax sobrina*)



Fig 11: Male Rudy marsh skimmer (*Crocothemis servilia*)



Fig 15: Wandering glider (*Pantala flavescens*)



Fig 12: Female Rudy marsh skimmer (*Crocothemis servilia*)



Fig 16: Coromandel marsh dart (*Ceriagrion coromandelianum*)



Fig 13: Scarlet marsh hawk (*Aethriamanta brevipennis*)



Fig 17: Milky dartlet (*Agriocnemis lacteola*)



Fig 18: Golden dartlet (*Ischnura aurora*)



Fig 20: Pigmy dartlet (*Agriocnemis pygmaea*)



Fig 19: Orange tail marsh dart (*Ceriagrion cerinorubellum*)



Fig 21: Mating pair of Coromandel marsh dart

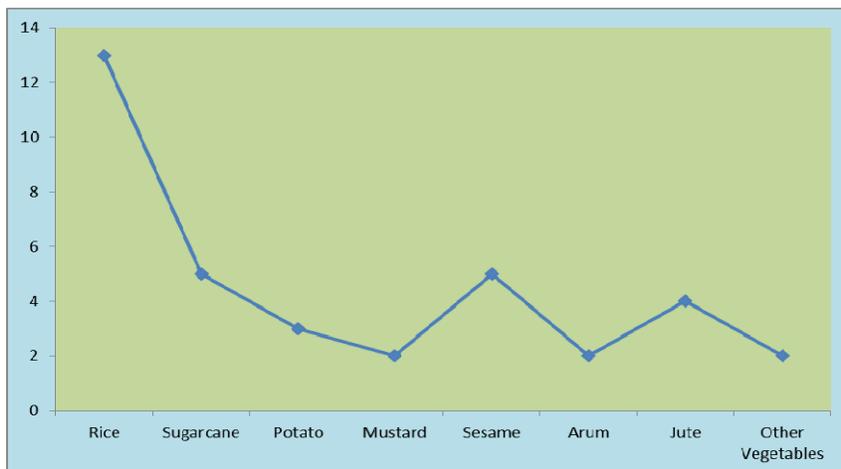


Fig 22: Graphical representation of total number of odonates in different fields.

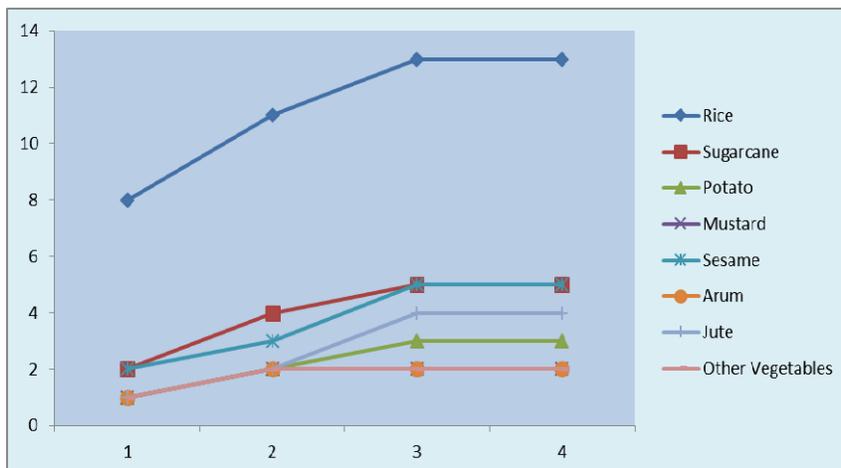


Fig 23: Graphical representation of cumulative number of species collected against the sampling effort (sample unit).

5. Conclusion

Odonata diversity of agroecosystem of the district Howrah was good but cannot compare with past due to lack of previous data. Agricultural fields are unique ecosystem that provides several services to odonates. So, different odonates depend on these fields, but now days due to urbanization these insects were under risk. Their diversity in the fields also signs of good health of agricultural fields. From this study it can be concluded that health of the fields of the district Howrah was fair in respect of odonata diversity because these insects are very good pollution indicators of whole environment. The present study is first record of odonates of agricultural fields of Howrah.

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