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Biodiversity of odonates in rice eco-system, Titabar, Assam

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Abstract

The present study was conducted at Farmers field near Regional Agricultural Research Station, Titabar, main rice bowl of the district Jorhat, Assam. Visual count and catch per unit effort was adopted to record the odonate diversity in the rice field. 68 individuals of odonate belonging to 14 species, equal number of species were recorded from each sub-order, Zygoptera and Anisoptera. The study revealed more number of damselfly population (40) than the dragonfly (28). Vegetative growth of rice crop support more number of Odonates (17 damselfly and 10 dragonfly) followed by reproductive (15 damselfly and 10 dragonfly) and ripening stage (8 damselfly and 8 dragonfly). The most dominant damselfly and dragonfly species were *Ceriagrion coromandelianum* and *Diplacodes trivialis* with 11 and 10 individuals respectively. Diversity of damselfly (1.73) was greater than dragonfly (1.42) same as in case of richness and evenness index in vegetative stage. But dragonfly diversity (1.75) was more than damselfly (1.55) as in richness and evenness index particularly when the crop was at reproductive stage. The ripening stage of rice crop support more or less similar diversity of damselfly (1.32) and dragonfly (1.30) with richness and evenness index (1.44, 1.92 & 0.95, 0.81) respectively.

Keywords: Dragonfly, damselfly, diversity, richness and evenness

1. Introduction

Odonata is the second largest aquatic insect order distributed in different habitats from forest to pasture and aquatic to agro-ecosystem. Rice fields are excellent habitats to study Odonates diversity as rice ecosystem provides ideal foraging ground and large numbers of insect prey for them [24]. The order consists of three suborder viz., Anisoptera, (Dragonflies) Zygoptera (Damselflies) and Anisozygoptera (Primitive Dragonflies). Odonates are denizens of many aquatic ecosystem distribute in various riverine, lake and pond water body areas [6]. They are distributed in different habitats in every corner of the world. Presently Odonates richness composed of 6000 species belonging to 600 genera, 8 super families, 29 families and 58 subfamilies [28]. More than 600 species are documented in Indian sub-region (India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and Myanmar) [23]. In North East India, Odonates diversity was studied long back during 1979 when Lahiri reported 33 species of Odonates from Assam, Arunachal Pradesh, Manipur and Mizoram [18]. Mitra (1999) reported 148 species from Meghalaya [21], Majumder *et al.*, 2013 reported 10 species contributing 32.25% species richness in urban lakes of Tripura [19], Devi *et al.*, 2013 reported Libellulidae and Coenagrionidae as dominant families in Lokatak Lake of Manipur [7]. Richness and abundance of Odonates are recorded in many wet land places of North eastern region of India to determine the health of water bodies. Five species of predacious Odonates belonged to Libellulidae and Coenagrionidae family were recorded by Bhattacharyya *et al.*, 2006 from Jorhat district of Assam [5]. However, information about diversity of this predacious order in rice ecosystem of Assam is scanty. Therefore the present study was carried out to record Odonates diversity in rice ecosystem as they are potential predator to many insect pests of rice which are of economic importance.

2. Materials and methods

2.1 Location, sampling and Identification

The present study was conducted at farmers' field during kharif season, 2013 & 14, near Regional Agricultural Research Station, Titabar, Jorhat located at 26.60° N, 94.20° E and has an average elevation of 172 Meters. The average temperature ranges from 24-28 °C and average annual rainfall is 2121 mm. The place is considered as the Rice bowl of Assam,

particularly in Jorhat district. Rice variety, Ranjit was grown by following all the recommended package and practices of Assam [1]. An area of 500m² was selected for sampling and chemical pesticide was not allowed to spray in the study area. Sampling was done with the help of an entomological sweeping net of 30cm diameter and 80cm depth. Catch per unit effort was used to record the Odonata species associated with rice crop. Sampling was done during evening time at 3 growth stage of the crop viz., vegetative stage, reproductive stage and ripening stage. Specimens were identified by following the taxonomic keys given by Subramanian (2005) and Kiran and David (2013) [29] [14].

2.2 Species diversity, richness and evenness:

The diversity was calculated by using “Shannon Wiener Index (1949)” which is defined as [27]

$$H' (S) = -\sum p_i \ln p_i$$

Where, $P_i = n_i/N$

n_i = Number of individual of a species at a time i ,

N = Size of whole community,

Σ = Number of species/ Number of seasons,

S = Total number of species.

The Richness indices was calculated by using “Margalef index (1958)” which is defined as [20]

$$D = (S-1)/\ln (N)$$

Where, S = Number of species,

N = Total number of individual of all the species.

For calculating the evenness of species, “Pielou’s Evenness Index (1966)” was used, which is defined as [25]

$$e = H' / \ln S$$

H' = Shannon – Wiener diversity index,

S = total number of species in the sample

support the more number of Odonates (17 damselfly and 10 dragonfly) followed by reproductive (15 damselfly and 10 dragonfly) and ripening stage (8 damselfly and 8 dragonfly) (Table 3), Possible reasons may be due to the presence of more numbers of insect prey and availability of water during vegetative stage which act as a potential breeding site for the predacious order. Some of the species of damselfly, *Aciagrion hisopa*, *Ceriagrion coromandelianum* and *Ischnura aurora* and dragonfly, *Brachythemis contaminata*, *Diplacodes trivialis* and *Orthetrum sabina* Sabina were encountered in all the three growth stages of rice crop. The most dominant, damselfly and dragonfly species were *Ceriagrion coromandelianum* and *Diplacodes trivialis* with 11 and 10 individuals respectively. The result was confirmatory with the work carried out by Jafer *et al.*, 2005 at Palghat, Kerala [11]. They recorded some of the dominant Odonates viz., *Ceriagrion coromandelianum*, *Ischnura aurora aurora*, *Orthetrum sabina sabina*, *Brachythemis contaminata*, *Diplacodes trivialis* and *Pantala flavescens* when rice crop was in two months old (growing stage). Recently, Thangjam *et al.*, 2014 reported 17 species of Odonates from Agricultural fields and aquatic habitats, Jorhat, Assam [31]. Among 17 species 12 individuals were belonging to Libellulidae, 3 individuals from Coenagrionidae and rest belonged to Gomphidae and Aeshnidae respectively. A similar kind of study was carried out by Krishnaswamy *et al.*, 1984, they reported *O. sabina*, *P. flavescens*, *I. aurora*, *A. pygmaea* and *C. coromandelianum* are predaceous Odonates of rice-field habitats in Assam [15]. Kanidabane *et al.*, 2007 put forward a similar kind of observation in rice ecosystem [12]. They found 12 species of Odonates in which 9 species were dragonflies and 3 species were damselflies. Rathod *et al.*, 2012 reported 31 species of Odonates belonging to six different families, in which *Libellulidae* family recorded highest (17) followed by *Coenagrionidae* (9), *Gomphidae* (2) while *Aeshnidae*, *Platycnemididae* and *Lestidae* registered one species each respectively around Amravati city in monsoon season [26].

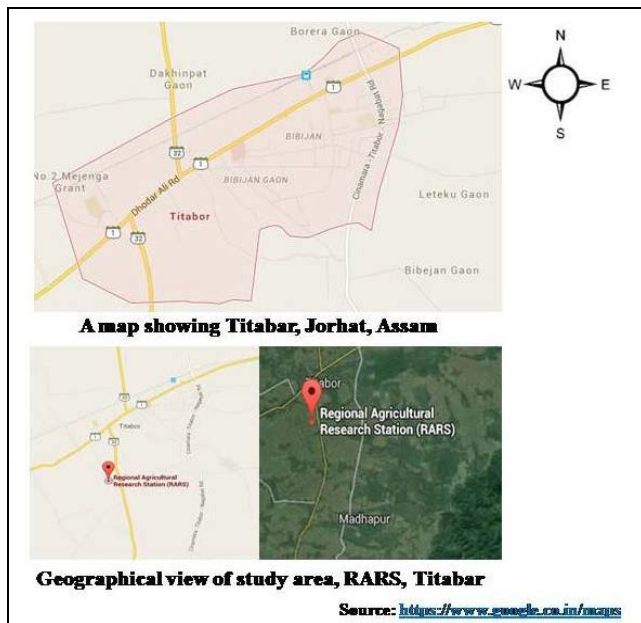


Fig 2: Aerial view of study area

3. Results and Discussion

3.1 Species composition of Odonata

A total of 68 individuals of Odonates belonging to 14 species, equal number of species (7) were recorded from sub-order, Zygoptera and Anisoptera belonging to Coenagrionidae (damselfly) and Libellulidae (dragonfly) respectively (Table 1). Among all Odonates, number of damselfly (40) was more than the dragonfly (28) (Table 2) during the study period. While when we compare in three growth stages of rice it was found that vegetative stage

Table 1: Odonata species recorded in rice ecosystem of Titabor

Suborder	Family	Species
Zygoptera	Coenagrionidae	<i>Aciagrion hisopa</i> Selys, 1876
		<i>Agriocnemis pieris</i>
		<i>Agriocnemis pygmaea</i> Rambur, 1842
		<i>Ceriagrion calamineum</i> Lieftinck, 1951
		<i>Ceriagrion coromandelianum</i> Fabricius, 1798
		<i>Ceriagrion olivaceum</i> Laidlaw, 1914
		<i>Ischnura aurora</i> Brauer, 1865
Anisoptera	Libellulidae	<i>Brachythemis contaminata</i> Fabricius, 1793
		<i>Crocothemis servilia servilia</i> Drury, 1773
		<i>Diplacodes nebulosa</i> Fabricius, 1793
		<i>Diplacodes trivialis</i> Rambur, 1842
		<i>Neurothemis fulvia</i> Drury, 1773
		<i>Orthetrum sabina</i> Sabina Drury, 1773
		<i>Pantala flavescens</i> Fabricius, 1793

Table 2: Species composition and number of individuals of Odonata collected during three growth stages of rice crop at Titabor

Sl. No.	Suborder	Species	Vegetative stage	Reproductive stage	Ripening stage
1	Zygoptera	<i>Aciagrion hisopa</i>	3	2	1
2		<i>Agriocnemis pieris</i>	2	0	0
3		<i>Agriocnemis pygmaea</i>	3	2	0
4		<i>Ceriagrion calamineum</i>	2	0	0
5		<i>Ceriagrion coromandelianum</i>	5	3	3
6		<i>Ceriagrion olivaceum olivaceum</i>	0	3	2
7		<i>Ischnura aurora</i>	2	5	2
8	Anisoptera	<i>Brachythemis contaminata</i>	1	2	2
9		<i>Crocothemis servilia servilia</i>	3	1	0
10		<i>Diplacodes nebulosa</i>	0	0	1
11		<i>Diplacodes trivialis</i>	4	3	3
12		<i>Neurothemis fulvia</i>	0	2	1
13		<i>Orthetrum sabina Sabina</i>	1	1	1
14		<i>Pantala flavescens</i>	1	1	0
Total			27	25	16

Table 3: Diversity indices of Odonata in three different stages of rice crop

Sub-order	Crop stage	Species abundance	Species Richness (S)	Margalef Richness index (D)	Shannon- Weiner diversity index (H)	Pielou's Evenness Index (e)
Zygoptera	vegetative stage	17	6	1.76	1.73	0.97
	reproductive stage	15	5	1.48	1.55	0.96
	ripening stage	8	4	1.44	1.32	0.95
Anisoptera	vegetative stage	10	5	1.74	1.42	0.88
	reproductive stage	10	6	2.17	1.75	0.98
	ripening stage	8	5	1.92	1.3	0.81

More or less some similar kind of studies were carried out by Baruah *et al.*, 2015, they reported 45 species of Odonates from different habitats of Barpeta district [3], 34 species of Odonates from Bodoland University [4] and 26 species of damselflies from Kapla Beel of Barpeta [17] Assam. Fraser (1933, 1936) mentioned 3 species of Odonates from paddy fields of Bangalore [8][9]. Kumar and Prasad (1977) recorded 10 species from the paddy fields of Dehradun valley [16]. Gunathilagaraj *et al.*, 1999 listed 16 species from the rice fields of Coimbatore [10]. Asaithambi and Manikarasagam (2002) recorded *Tholymis tillarga* (Fabricius) from paddy field near Annamalai University area in Tamil Nadu [2]. Talmale and Kulkarni (2003) have reported 19 species of Odonata from the paddy field of Bhandara district of Maharashtra [30].

3.2 Species diversity richness and evenness

Species diversity, richness and evenness of butterflies are represented in Table 3. Diversity of Odonates across the study revealed that there was a variation of individuals in three growth stages of rice crop. In vegetative stage diversity of damselfly (1.73) was greater than dragonfly (1.42) and the trend was similar in case of richness and evenness index as

well. However in reproductive stage, diversity of dragonfly (1.75) was more than damselfly (1.55) along with the parallel trend of richness and evenness index. The ripening stage of rice crop support more or less similar diversity of damselfly (1.32) and dragonfly (1.30) with richness and evenness index (1.44, 1.92 & 0.95, 0.81) respectively. Mogi (1993) reported that appearance of Odonates solely depends on availability of water [22]. Fluctuation of Odonates depends upon the habitat and also in growth stages of the crop. Diversity of Odonates was also recorded by Karthika *et al.*, 2014 they recorded 11 species of dragonfly with diversity (1.32 – 1.44), dominance (0.96 – 1.08) and evenness indices (0.72 – 0.84) from four aquatic habitats of Coimbatore [13]. In Assam diversity of Odonates was studied by Kumar *et al.*, 2015 in Kapla beel, Barpeta [17]. They found that diversity of Odonates (1.30 – 1.39) and dominance (0.035 – 0.049) during the study period from June 2013 to May, 2014. More or less a similar kind of study was carried out by Zuliyanti *et al.*, 2008 at Sumatera, Malaysia [32]. They found diversity of Odonates (1.31 - 2.26) richness (0.98 - 1.98) and evenness (0.49 - 0.80) in three habitats *viz.*, lowland, terrace and control rice plots of two rice growing seasons.

Table 3: Species diversity richness and evenness of Odonates in three growth stages of rice crop

Sub-order	Crop stage	Species abundance	Species Richness (S)	Margalef Richness index (D)	Shannon- Weiner diversity index (H)	Pielou's Evenness Index (e)
Zygoptera	vegetative stage	17	6	1.76	1.73	0.97
	reproductive stage	15	5	1.48	1.55	0.96
	ripening stage	8	4	1.44	1.32	0.95
Anisoptera	vegetative stage	10	5	1.74	1.42	0.88
	reproductive stage	10	6	2.17	1.75	0.98
	ripening stage	8	5	1.92	1.3	0.81



Fig 1: *Aciagrion hisopa* (Female)



Fig 6: *Ceriagrion olivaceum olivaceum*



Fig 2: *Agriocnemis pieris*



Fig 7: *Ischnura aurora*



Fig 3: *Agriocnemis pygmaea*



Fig 8: *Brachythemis contaminata*



Fig 4: *Ceriagrion calamineum*



Fig 9: *Crocothemis servilia servilia*



Fig 5: *Ceriagrion coromandelianum*



Fig 10: *Crocothemis servilia servilia* (Female)



Fig 11: *Diplacodes nebulosa*



Fig 16: *Pantala flavescens*



Fig 12: *Diplacodes trivialis*



Fig 13: *Diplacodes trivialis* (Female)



Fig 14: *Neurothemis fulvia*



Fig 15: *Orthetrum sabina*

4. Conclusion

The present study revealed equal numbers of species belonged to Zygoptera and Anisoptera. Moreover more numbers of damselfly individual were recorded during the study period. Rice growing stages viz. vegetative and reproductive stage supported more damselfly than dragonfly whereas reproductive stage supported equal number of Odonates individual. Damselfly populations were more as they recorded from different microclimate habitats in rice fields. In addition to that promising number of predacious Odonates were recorded which are of great importance to control the serious insect pests of rice crops. Therefore, greater emphasis should be given to conserve and augment this natural enemy in rice ecosystem of Assam. However, study on nymphal stage, seasonal distribution and wild vegetation in an around the rice fields will give a clear cut idea to influence many insect pests rice crops.

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