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Research Article

Population builds up and diversity of Odonate species in relation to food preference in a fish farming Lake at Media, West Bengal, India.

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Abstract

Field survey were conducted to study of population structure and to clarify the seasonal variation of Odonate nymph in a fresh water fish farming lake at Media during the period of June, 2010 to May, 2011. Large numbers of dominant insect species like *Agrioenemis splandidissma* (Laidlow), *Ischnura aurora* (Brauer), *Ceriagrion coromandelianum* (Fabricius), *Brachythemis contaminate* (Febricious), *Diplacodes frivialis* (Rambur) and *Potamarcha obscura* (Rambur) were recorded periodically in the study lake. Most of the species were significant indicator species and they are strongly correlated with good quality aquatic environment of the lake. Correlation between food in water, gut content and population density of the odonate nymph was made. Result obtained that highest density of Odonate nymph were noted during the month of October and lowest in May. Observation of gut contents of these nymphs suggests that animal diet comprises the maximum percentage in their dietary component. The present study did not show any definite correlation between food and population density of Odonate nymph. However it may be predicted that food may never become the factor limiting kinds of insects present in an aquatic habitat, since within certain broad limitations, most species can use a variety of food materials for nutrition during the active period of body growth.

Keywords: Indicator species, Odonate nymph, Population density, Seasonal variation.

Introduction

Odonates are important invertebrate (Insecta) lead amphibious modifications where nymphs are excluding remain in aquatic conditions. Insects often make good indicators because they are present in some capacity in almost every type of habitat and many are habitat specialists (Lewis and Gripenberg, 2008). The order Odonata represents one set of insects that is being widely studied for its potential in indicating environmental quality. This population can also be indicative of the richness of other invertebrates and macrophytes (Bried and Ervin, 2005). Few works have been done on the food and feeding habits of odonate nymphs (Hassan, 1976). But there is little data available on the relationships between food preferences and water environments of Odonates. The present study has been made for assessment food preference of Odonate nymphs through gut content analysis periodically. Correlations between food in water environment, gut contents and population density of odonate nymphs have been made also.

Materials and Methods

The Qualitative samplings of insect were collected from different depth and sites of the lake at the first and last week of every month (during the period of June, 2010 to May, 2011) from village Media of the district North 24 Parganas, W.B., India (9.75 meter above the sea level, latitude $23^0$15'N - $22^0$11'N and longitude $89^0$5'E - $88^0$20'E) by process of sweep netting, a box type sampler of 20 x 20 x 40 cm^3 size (Pal and Nandi, 1997). After collection of nymphs, these were preserved in 70% alcohol and next transferred to 3% formalin. Abundance (Population

density) represents the number of individuals per unit area. In the present study the number of Odonate nymph were expressed as number of individuals per meter square using the formula put forwarded by Welch (1948).

$$n = \frac{O}{a \times s} \times 10{,}000$$

Where,

n = number of organisms per meter square,
O = number of organisms counted
a = area of the sampler, s = number of replicates taken

The specimens were dissected under water or 3% formalin. The insect foregut was removed and dissected further on a glass slide, as suggested by Shapas & Hilsenhoff (1976) however some modifications to characterize feeding habits have been made. The gut contents were counted using the method of Brown (1961). Approximate percent by volume of food items (animals, plants, and other matters) was recorded for each month. No attempt was made to analyze mid gut contents since possible misinterpretation of the source of undeterminable matter might result (i.e. what appears as undeterminable matter in the mid-gut could have been ingested in that form, or may have resulted from proventricular action or partial digestion). Plankton of overlying water were collected by a plankton net made of bolting silk no.25 (mesh size 0.03 - 0.04mm) and counted by Lackey (1938) micro transect method. Pearson's correlation coefficients were calculated to evaluate the parametric relationships between the foods in water environment, gut contents and population density of Odonate nymphs have been made. The tests were all two tailed and the correlations were tested at 5% and 1% level of significance (SPSS version 10).

Results

Seasonal change in population density of Odonate nymphs the Zygoptera and Anisoptera is represented in Fig.1. The peak density was observed in the month of October and where as lowest in the month of May. The dominant species diversity of sub-order Zygoptera (under order Odonata) were *Agrioenemis splandidissma* (Laidlow), *Ischnura aurora* (Brauer) and *Ceriagrion coromandelianum* (Fabricius), while species under sub-order Anisoptera were *Brachythemis contaminate* (Febricious), *Diplacodes frivialis* (Rambur) and *Potamarcha obscura* (Rambur) were found to have distinctively strong relationships with some of the water environmental parameters. The gut content analysis of their nymphs is represented in table-1 & -2 respectively. The gut content analysis of the nymphs revealed that they are primarily carnivorous in habit (Roy, 1984) and feeding on Rizopoda, Rotifers, micro-crustacea (Copepoda and Cladocera), aquatic insects and other animal tissues inhabit in the pond. Small percentage of plant materials mainly algae (Chlorophyta, Bacillariophyta and Myxophyta) have been also detected in the gut.

Present study shows that both the member of Zygoptera and Anisoptera nymphs prefer to consume Rotifers, Cladocera, Copepoda, Rhizopoda and aquatic insects (mayfly nymphs, Chironomous larvae, mosquito larvae and pupae). Due to semi-digestion of food items in the foregut, certain animal originated materials could not properly identify. Maximum percentage of food items in damselfly nymphs (Zygoptera) were aquatic insects, Cladocera, Rizopoda and Rotifera. In dragonfly nymphs (Anisoptera) maximum percentage of food items were Cladocera, Rotifera and aquatic insects, but very small amount of Rhizopods were recorded. In damselfly muscular tissues were not in good percentage, but in dragonfly it present in good percentage. Small amount of algae were recorded in the gut content of Odonate nymphs. Algal percentage was high in dragonfly rather than damselfly. The percentage composition of plankton in the environment and the gut contents of these nymphs are summarized in the Table-1 and Table-2 for Zygoptera and Anisoptera, respectively.

Correlation coefficient (r-value) was clarified between gut content of Odonate nymphs and Odonate nymph population density (Table-3). No definite correlation present between food in water, gut content of Odonate nymph and Odonate nymph population density. In both Damselfly and Dragonfly Rizopoda (Water) and other aquatic Insects (gut) shows positive correlation with nymph population density and only Algae (gut) shows negative correlation.

Discussion

Odonate larvae are known to use the aquatic plants for egg laying site (Singh. 1989). The species of Odonates breed throughout the year. In the present study,

Table-1. Monthly variation of Population density and major dietary components in the environmental water and in the gut (*mg/wt.) of damselfly nymphs (Zygoptera) at Media Lake during the year 2010-2011.

Month	**Rotifera**		**Cladocera**		**Copepoda**		**Rizopoda**		**Other Aquatic Insect**		**Algae%**		**Muscular tissue**	**Other unidentified matter**	**Population density of nymph**
	Gut*	Water*	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Gut	-
July	8.5	30.40	21.5	5.3	2.5	16.8	18.5	6.2	17.0	24.8	5.2	16.5	14.0	12.8	18
Aug.	14.8	31.2	17.9	4.8	9.6	18.2	13.8	5.7	28.3	27.1	2.9	13.0	7.5	5.2	21
Sep.	14.6	30.9	17.6	5.1	10.2	17.5	13.9	6.3	29.2	24.5	2.6	15.7	9.1	2.8	29
Oct.	15.1	28.5	18.2	8.4	10.3	22.3	14.0	17.5	29.5	16.8	2.1	6.5	7.2	3.6	35
Nov.	15.3	27.8	18.4	8.9	10.1	22.7	14.2	16.8	28.5	15.3	1.9	8.5	7.1	4.5	32
Dec.	15.7	27.2	18.5	9.1	10.0	23.2	14.0	18.3	27.0	15.1	1.8	7.1	5.0	8.0	28
Jan.	16.5	27.4	21.5	9.2	14.3	23.8	7.7	18.4	20.5	14.8	1.9	6.4	6.6	11.0	27
Feb.	18.5	32.6	23.4	16.6	14.5	8.5	7.9	12.3	21.6	25.0	1.3	5.0	5.8	7.0	26
Mar.	19.5	32.8	24.3	16.4	15.0	8.7	8.0	11.8	21.0	24.9	1.7	6.4	5.5	5.0	21
Apr.	13.5	8.0	15.8	33.3	5.0	20.4	25.2	4.3	15.5	14.0	7.5	20.0	7.0	10.5	16
May	13.4	8.9	15.9	32.6	5.2	19.7	24.0	5.6	16.2	14.8	7.8	18.4	6.9	10.6	14
June	8.6	29.3	21.3	4.6	2.7	15.6	18.7	5.9	18.2	24.7	5.4	19.9	14.3	10.8	16

Table-2. Monthly variation of Population density and major dietary components in the environmental water and in the gut (*mg/wt) of dragonfly nymphs (Anisoptera) and monthly population density of nymph at Media Lake during the year 2010-2011.

Month	**Rotifera**		**Cladocera**		**Copepoda**		**Rizopoda**		**Other Aquatic Insect**		**Algae%**		**Muscular tissue**	**Other unidentified matter**	**Population density of nymph**
	Gut*	Water*	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Water	Gut	Gut	-
July	15.2	30.6	19.0	4.6	13.0	16.5	2.6	5.6	10.4	25.0	5.7	17.7	21.0	13.0	20
Aug.	15.5	29.1	22.1	6.5	12.0	18.5	4.2	15.9	11.8	18.2	4.4	11.8	18.2	12.8	25
Sep.	16.4	28.5	25.0	7.2	11.8	20.1	3.9	16.7	12.5	17.5	3.5	10.0	17.3	9.5	30
Oct.	17.1	28.4	26.3	7.3	11.5	21.1	2.8	16.2	16.7	16.8	2.5	10.2	14.4	9.7	35
Nov.	18.5	27.5	26.8	7.9	10.1	21.0	4.1	16.8	14.4	15.5	1.9	11.3	15.3	9.9	23
Dec.	18.7	27.2	27.8	8.2	10.2	21.5	4.5	17.0	15.0	15.1	1.8	11.0	12.0	10.0	19
Jan.	21.3	28.1	29.2	15.2	6.7	10.2	4.8	14.3	14.2	27.2	5.5	5.0	9.3	9.0	17
Feb.	25.0	32.4	35.5	16.8	5.0	8.5	5.2	12.3	12.0	25.0	7.8	5.0	3.5	6.0	16
Mar.	24.2	32.1	32.8	16.5	8.4	8.2	3.6	12.7	9.7	24.5	10.2	6.0	5.7	5.4	15
Apr.	22.8	16.5	28.1	20.2	9.8	15.2	2.4	8.9	9.5	20.2	10.0	19.0	7.4	10.0	15
May	20.0	8.0	24.0	33.3	10.0	20.4	1.5	4.3	8.5	14.0	12.0	20.0	10.5	13.5	14
June	15.0	25.1	21.0	16.2	12.0	18.7	1.9	5.0	9.2	20.2	8.4	14.8	19.5	13.0	16

Table -3: Correlation coefficient (r-value) between gut content of Odonata nymph and Odonate nymph population density.

Gut-Content.	r -value with different nymph Population Density	
	Zygoptera	**Anisoptera**
Rotifer(gut)	0.474*	-0.543
Rotifer(water)	0.491	0.342
Cladocera(gut)	0.033	-0.251
Cladocera(Water)	-0.485	-0.668*
Copepoda(gut)	0.603*	0.473
Copepoda(water)	0.306	0.516
Rizopoda(gut)	-0.596*	0.123
Rizopoda(water)	0.783**	0.601*
Other aquatic Insect(gut)	0.832**	0.668*
Other aquatic Insect(water)	-0.192	-0.366
Algae (gut)	-0.803**	-0.731**
Algae (water)	-0.732**	-0.167
Muscular Tissue	-0.387	0.485
Other unidentified matter	-0.687*	0.065

Odonates were recorded good numbers in post-monsoon seasons of the study lake when lake is supported by huge aquatic macrophytes (Fig. 1). Large numbers of species were found to have distinctively strong relationships with some of the water environmental parameters. The gut contents analysis of Odonata nymphs show that the animal diet comprises the maximum percentage of dietary components whereas non-animal diet forms insignificant percentage. This observation confirm with the view of Benke (1976) and Roy (1984).

In the gut of damselfly nymph (Zygoptera) percentage composition of Rotifera and Copepoda were found lower except pre-monsoon. The percentage composition of Cladocera (except pre-monsoon), Rizopoda(except post-monsoon) and other aquatic insect(except pre-monsoon) was found more in gut than in environmental water. It was probably due to the scarcity of food in the habitat.

In the gut contents of dragonfly nymphs (Anisoptera) the percentage composition of Rotifera (except pre-monsoon), Copepoda, Rizopoda and other aquatic insect were found lower than environment. The percentage composition of Cladocera was found more in gut than in environmental water. It is also found that Cladocera is the most preferred food for both dragonfly and damselfly. Although, dragonfly nymph seems to have some preference Cladocera as food than the damselfly nymph. The damselfly nymph seems to have some preference for Rizopoda as food than dragonfly nymph. Odonate nymphs' diet may vary from season to season depending on abundance of particular prey types (Tables-1 & Table-2). The availability of food also affects the rate of larval development of Odonate.

Macrophytes also provide hiding places for prey (Hassan, 1976). In this condition nymphs have very hard time to find their specific food prey. Due to unavailability of proper food during the active period of development or body growth retards the emergence of adults in such water bodies. It is also found that the Odonate nymphal populations are largely regulated in numbers by the supply of food available to them in their habitat. Similar observations have been made by Hassan (1976).

The switchover to an algal diet by Odonate nymphs did not appear to be related to a decline in numbers of potential animal prey. Rather, it was probably a response to an increased availability of an alternative, apparently suitable food source which was only present in these seasons. However, Hynes (1972) suggested that food may never become the factor limiting kinds of insects present in an aquatic habitat, since within certain broad limitations. Most species can use a variety of food materials for nutrition during the active period of body growth. Present study also did not show any definite correlation between food and population density of Odonate nymph. This ability to use a range of materials probably encourages exploitation of the aquatic environment to full extent.

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