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Predatory Efficiency of *Diplonychus annulatum* (Fabr.) (Hemiptera:Belostomatidae) on Developmental Stages of a Major Carp *Catla catla* (Ham.)

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Abstract
The paper deals with the result of predatory efficiency of fed and starved (5, 7 and 9 days) groups of water bug *Diplonychus annulatum* (Fabr.) On spawn and fry stages of *Catla catla* (Ham.), a major carp of freshwater system in laboratory. The highest predation capacity (N/hr) on maximum spawn (25) densities were recorded as 8.40 ± 1.13, 7.80 ± 1.17, 6.10 ± 0.99, 5.60 ± 0.87 for fed and 5, 7 and 9 days starved predatory aquatic bug respectively. The predation was highest on maximum prey density (25) while it was minimized as the size of prey increased. It was also found that the rate of predatory efficiency was found more in natural feeding hour than the starved condition of this aquatic bug.

Keywords: Predatory efficiency, *Diplonychus annulatum* (Fabr.), Spawn, Fry, *Catla catla* (Ham.)

Introduction

The study of food and feeding biology of *Diplonychus annulatum* (Fabr.) has special significance in order to known the piscicultural practices because they are feeder of the natural fish food organisms in nurseries and rearing fish tanks and ponds. They are common voracious predator on fish spawn and fry population capable of consuming food more then their body weight and also directly parasitoids on fish fry population and are spending their entire developmental period in the inland water. They usually found at the top of the aquatic food chain in freshwater ecosystem and occupying an important position in the food webs and energy flow pathway of the freshwater ecosystem.

Much has been observed and discussed about the role of predatory insects and their interaction with the fish spawn, fry and fingerlings by various fishery biologists as well as entomologist in India (Julka, 1965; Roy, 1990; Roy and Sinha, 2002; Ramanand, 2007). Practically no information is available on the prey destroying capacity and stage specific mortality caused to major carps by these predatory aquatic insects. For the successful excuection of various aquacultural operations, it is imperative for us to known the predatory efficiency of *Diplonychus annulatum* (Fabr.) on various developmental stages of *Catla catla* (Ham.). Considering these facts the present study has been undertaken to provide laboratory data on the predatory efficiency of this aquatic bug

Materials and methods

The experiment was conducted in the laboratory during rainy season of the year 2007, when spawn and fry of various economically important major carps are

available *Diplonychus annulatum* (Fabr.) was collected with the help of aquatic insect collection net from the local fish ponds of Bhagalpur. All the experimental stock brought live and maintained in the laboratory using three layers of 75×28×15 cm tray provided with 3.6 cm layer of mud at the bottom and 8.5 cm thickness of water above the substratum. The tray was provided with aquatic macro-vegetations making the medium as nearly natural as possible. After one week maintenance of this bug in the laboratory, the experiment was conducted by selected four adults of *Diplonychus annulatum* Fabr. For the observation of predatory efficiency these species were separately placed in various glass aquaria (20×20×15 cm) due to extreme cannabalism in this insect. All glass aquaria were filled with ponds water. One fresh glass aquarium has provided for selected species and the bugs were kept in aquarium without food and after 5, 7 and 9 days of starvation provided the prey. They were fed both spawn and fry of *Catla catla* (Ham.) at live of different prey densities (5, 10, 15, 20, 25). All predation trials were carried out at room temperature. The number of prey killed by *Diplonychus annulatum* (Fabr.) was noted for one hour. This experiment was repeated five times using the same process of predation trials. The predation trials were repeated after the gap of 24hrs and trials were observed for only one hour. The prey-predator relationships were studied following the pattern of Ellis and Bordan (1970) with some modifications.

Results and discussion

The predatory efficiency of *Diplonychus annulatum* (Fabr.) on different prey densities (5, 10, 15, 20, 25) of both spawn and fry of *Catla catla* (Ham.) in the laboratory were recorded and presented in Table 1 for spawn and Table 2 for fry respectively. The mean values of maximum spawn consumption (N/hr.) by fresh fed and 5, 7, and 9 days starved group of *Diplonychus annulatum* (Fabr.) on higher prey density (25) were recorded as 8.40 ± 1.13, 7.80 ± 1.17, 6.10 ± 0.99 and 5.60 ± 0.87 respectively. In case of fry, the mean values of consumption (N/hr) by same groups of these predator on higher prey density of fry (25) were recorded as 7.00 ± 1.41, 6.10 ± 0.99, 5.60 ± 0.87 and 5.10 ± 0.88 respectively.

It was observed that in almost all predation trials the predator insect species of different fed and starved (5, 7, 9 days) groups had different prey consumption capacity. The rate of predation was gradually increased as the density of prey increased. But the rate of predation was gradually decreased during starvation period (5, 7, 9 days). The result of mean values of consumption (N/hr) by fed and starved group of predator *Diplonychus annulatum* Fabr. on minimum and maximum (5 and 25) prey density of *Catla* spawn recorded were 3.00 ± 0.69, 2.60 ± 0.84, 2.40 ± 0.49, 1.50 ± 0.48 and 8.40 ± 1.13, 7.80 ± 1.17, 6.10 ± 0.99, and 5.60 ± 0.87 respectively. Some studies have been done on the possible prey/predator interactions in aquatic ecosystems (Kumar and Hwang, 2006; Waage and Greathead, 1988), have suggested that predatory efficiency should be based on potential of predator for unintended impacts, self-replicating capacity, climatic compatibility and their capacity to maintain very close interactions with target prey species. It was studied by Pramanic (2003) and Aditya *et. al.* (2004, 2005) that consumption of mosquito larvae

Table 1. Predatory efficiency (N/hr) of fresh fed and starved (5, 7, 9 days) condition of *Diplonychus annulatum* (Fabr.) on spawn density of *Catla catla* (Ham.).

Value Mean ± SD; No. of fish spawn consumed/hr. N' =5				
	Diplonychus annulatum (Fabr.)			
Prey density	**Fresh**	**5 days**	**7 days**	**9 days**
5	3.00±0.69	2.60±0.84	2.40±0.49	1.50±0.48
10	4.30±0.69	4.10±0.69	3.60±0.46	2.90±0.67
15	5.80±0.62	5.10±0.88	4.30±0.81	3.50±0.47
20	6.60±1.12	5.60±0.87	5.30±0.88	4.80±0.41
25	8.40±1.13	7.80±1.17	6.10±0.99	5.60±0.87

N' = Five predation trials.

Table 2. Predatory efficiency (N/hr) of fresh fed and starved (5, 7 and 9 days) condition of *Diplonychus annulatum* (Fabr.) on fry density of *Catla catla* (Ham.)

Value Mean± SD; No. of fish fry consumed/hr. N' =5				
	Diplonychus annulatum (Fabr.)			
Prey density	**Fresh**	**5 days**	**7 days**	**9 days**
5	2.60±0.84	2.40±0.49	2.20±0.79	1.30±0.61
10	3.90±0.59	3.50±0.47	2.90±0.67	2.40±0.49
15	4.60±0.81	4.20±0.79	3.40±0.49	3.00±0.69
20	5.80±0.78	5.10±0.88	4.80±0.41	4.20±0.79
25	7.00±1.41	6.10±0.99	5.60±0.87	5.10±0.88

N' = Five predation trials.

by *sphaerodema annulatum* and *S. rusticum* (Heteroptera: Belostomatidae) in dependent on the density of prey in the medium which is in conformity of the present laboratory study of predatory efficiency of *Diplonychuns annulatum* (Fabr.) and their interaction with spawn and fry prey species of major carps *Catla catla* (Ham.).

The predatory efficiency depends on: (i) density of prey in the habitat (ii) size of the prey (iii) physiological state of the prey (iv) mobility of the prey (v) behavioural adjustment and adaptability of prey predator in same habitat and (vi) the lack of predator detection mechanisms in prey species. Mechanisms for predator detection by insects may involve tactile, visual, or chemical clues and some chemically mediated avoidance in an adaptation used by prey to detect and evade predators. Such chemical are semiochemicals emitted form predators, normally used by prey to detect a predator's presence in the environment and the prey can thereby minimize such encounters (Kats and Dill, 1998). Several studies indicate that fish, amphibians, reptiles, mammals, birds and a broad away of invertebrates have evolved chemosensory mechanisms for detecting predators. Since spawn and fry of *Catla catla* are juveniles with less chemosensory response unable to detect predator and are thus, easily available natural diet for *Diplonychuns annulatum* (Fabr.).

The present observation on the fed and starved (5, 7, 9 days) groups of *Diplonychus annulatum* (Fabr.) predatory aquatic insect reveled some interesting results. It was observed that insects under fresh fed condition caused uniform destruction to prey population than the insects with gradually starved period. Peckrasky (1982) reported that a predator may responsible to variation in the prey density by also changing their density, growth rate, size and feeding rate. In the present study the rate of

predation by *Diplonychus annulatum* (Fabr.) increased as the density of prey also increased and maximum predatory efficiency was found on (25) prey density of the spawn and fry of *Catla*. The present computation of data on predatory efficiency and prey inhalation indicates that they prey consumption capacity is directly dependent upon their density in the habitat. As the density of prey higher the predation is maximum. Thus, depending upon the observation it may be concluded that the fish rearing ponds/tanks may be of larger size so that the spawn population may not congregate and the density will remain low in the habitat. Low density of spawn and fry population reduces predation through encounter with aquatic predatory insects.

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