*2012 International Conference on Biological and Life Sciences*
*IPCBEE vol.40 (2012) © (2012) IACSIT Press, Singapore*

# Feeding Behavior of *Diplonychus rusticus* Fabricius (Hemiptera, Belostomatidae) on Fish and Fish Food

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**Abstract.** *Diplonychus rusticus* Fabricius (Hemiptera, Belostomatidae) is one of the common aquatic insects inhabiting the freshwater habitats of Assam, India. An experimental approach has been used to study the predatory efficiency and feeding behavior of this aquatic bug in relation to individual density of 7 prey individuals of different size, namely fish species- *Catla catla and Puntius sp.*, mosquito larvae- *Culex quinquefasciatus* (Diptera), Chironomus larvae- *Tendipes sp.* (Diptera), mayfly- *Baetis sp.* (Ephemeroptera), small aquatic beetle- *Amhiops pedestris* Sharp (Coleoptera) and Damsel fly nymph- *Ischnura sp.*(Odonata) by separate feeding in aquaria in laboratory condition. The mean rank of consumption is calculated against each of the prey organism. Of the small size class the most consumed taxa is recorded as living spawn of *Catla catla* followed by the *Baetis sp.* Within the medium size class the most used taxa is the living forms of mosquito larvae which is closely followed by the living spawn of *Catla catla.* The results of the present laboratory experiments indicate the possible use of the aquatic bug as a biological control agent of mosquito vector under agro-climatic conditions of Assam, India. On the other hand, it shows significant negative role in the nurseries and rearing ponds of fish aquaculture system.

**Keywords:** Aquatic, Feeding, Predator, Biological control

## 1. Introduction

Aquatic insects serves not only as natural food of fishes but also responsible for the destruction of fish larvae, fry and fingerlings (Julka, 1965; Bisht and Das, 1981; Roy, 1990; Roy and Sinha, 2002; Ramanand and Roy, 2008). They interact with other organisms inhabiting the same water body and modify the community structure and food web in water. Predatory action of a large number of aquatic insects belonging to Order Hemiptera and Coleoptera have been recorded from India and other countries that predate upon various forms of natural food of fishes ( Ohba and Nakasuji, 2006; Velasco and Millan, 1998; Gilinsky, 1984; Saha et al., 2007; Aditya et al. 2006; Chandra et al. 2008). Direct observation of feeding behavior is necessary to distinguish between the consumption of more than one prey item of each type, their size, living or dead status of food in addition to the predatory efficiency which demands long periods of observation. Such a detail account of feeding behavior of aquatic insects and field trials are still wanting especially in the Northeastern part of India.

A series of laboratory experiments has been conducted during the period of May-July, 2010 to study the feeding behavior of the aquatic bug, Diplonychus rusticus Fabricius ( Order- Hemiptera, Family- Belostomatidae), a large sized species of aquatic insects ( about 13-22mm in body length). The species is a common inhabitants of the freshwater bodies of Assam (Hazarika and Goswami, 2009) and abundant in the wetlands of the state. It is a good swimmer but frequently remain clinging to aquatic vegetation at the water surface.

## 2. Methodology

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The aquatic bug Diplonychus rusticus, has been collected from the ponds of UGC-SAP (DRS) Project, Dept. of Zoology, Gauhati University, Kamrup (Metro), Assam, India. Adult morphs (irrespective of sex) are segregated and maintained in a glass aquaria (46 Cm × 20 Cm × 26 Cm = 23920 Cm3 in volume) containing pond water up to 18 Cm height in the laboratory. A few specimens of aquatic plants such as Hydrilla verticillata, and Lemna sp. are placed inside the aquarium to simulate the natural conditions. The insect is collected 15 days before the commencement of the experiments and maintained in the laboratory for acclimatization with selected prey species. Different prey individuals inhabiting the same habitats are selected and categorized under 3 size class- small (3-6mm, body length), medium (7-12mm body length) and large (>12mm body length) as shown below:

**Small size class (3-6 mm)**
*Baetis sp*. Ephemeroptera, Nymph
*Amhiops* pedestris Sharp, Coleoptera, Adult
*Catla* catla, Ham Pisces, Spawn
**Medium** size **Class (7-12mm)**
*Culex* quinquefasciatus Diptera, Mosquito Larvae
*Tendipes sp.* Diptera, Chironomus larvae
*Catla* catla Ham. Pisces
**Large** size **class (> 12mm)**
*Catla* catla, Ham Pisces, Fry
*Puntius sp.* Pisces, Fry
Ischnura *sp*. Odonata, Damsel fly nymph

Mosquito and chironomus larvae are collected from the drains of the Gauhati University campus. The same size larvae to be used in the experiment are separated from the heterogeneous mixture containing different size classes of larvae by appropriate sieving and kept in earthen tubs covered with nylon net. Hatchery bred spawn and fry of Catla catla used in the feeding experiments are collected from UGC-SAP (DRS) Project, Dept. of Zoology, and Gauhati University. The other prey species such as the fish species Puntius, mayfly nymphs, damselfly nymphs and the coleopteran species Amhiops pedestris are collected from the same ponds inhabiting the predators and required size class is physically selected and provided as and when needed.

After acclimatization of the predator in aquaria with different types of prey species, a single predator individual is placed in the observational arena, consisting of a 3.5 lit capacity glass aquarium containing clean sand as a bottom substrate and water from the pond. The depth of water is maintained at 9cm above the bottom substrate. All the experiments have been conducted under artificial light. One wooden dowel is placed in each aquarium as a perch site for the predator. Predator is starved for 48 hours before the start of the experiment and subjected to different treatments according to size of prey. In each size treatment three different taxa are selected as potential prey and are simultaneously offered to the predator (10 live and 10 dead specimens). Taxa selected by the predator, status (living or dead), foraging strategy, feeding mechanism, number of captured prey are recorded during continuous observation over 6 hr. Six replicates are tested for the predator at each prey size. Differences between number of living and dead prey consumed in each size class is tested following Velasko and Milan, 1998 with necessary modification to calculate the mean rank of consumption. Statistical calculations are performed using statistical software SPSS (Version- 9.1) and PAST (Version 2.15).

## 3. Results and Discussion

In the preliminary laboratory observation in aquaria before commencement of the experiment, it is noticed that D. rusticus is predominantly predatory in feeding habit. However, it also feeds occasionally on dead organisms. The present experimental observation displays that the selected aquatic bug uses primarily the “sit and wait” strategy for pursuing and attacking prey from the submerged objects. However, sometime, it also searches actively for prey. It hunts fiercely for their prey. After a successful encounter, the predator grasps the prey with its pro and mesothoracic legs. The aquatic bug has a great ability to make successful attacks because of its strength and tenacity. While feeding it can capture another prey item and reserve it to

eat later. The beak is introduced into the prey through the soft parts of its body and extracts the liquefied contents. The dead remain of the prey is discarded and the predator hunts for next prey.

Feeding on different size class organisms by D. rusticus shows the importance of both living and dead organisms. However, it prefers living prey of small and medium size, but selects mainly the dead prey of the large size class (Figure 1).

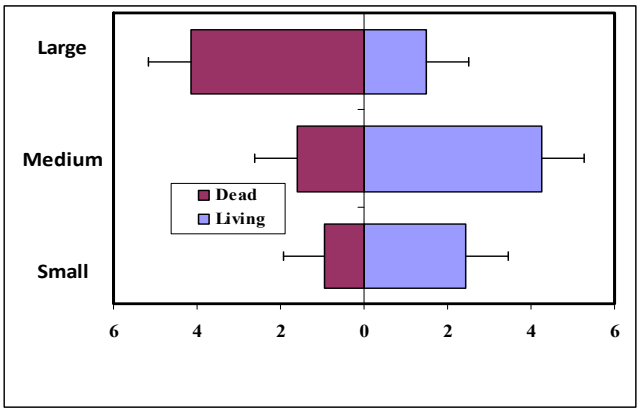


Fig. 1: Mean number (± SD) of living and dead organisms captured by D. rusticus for each size class treatment (n = 6 predation trial)

Table 1: Mean Rank Consumption of Diplonychus rusticus for each size class living/dead organisms observed during the experiment (I = Immature, A = Adult, L= Living, D= Dead)

| SMALL CLASS (3-6 mm) | | | |
|---|---|---|---|
| Species | Adult/Immature | Living/Dead | Mean rank |
| *Catla catla* | I (Spawn) | L | 5.08 |
| *Catla catla* | I (Spawn) | D | 3.16 |
| *Baetis sp.* | I | L | 4.91 |
| *Baetis sp.* | I | D | 3.08 |
| *Amphiops pedestris* | A | L | 2.91 |
| *Amphiops pedestris* | A | D | 1.83 |
| MEDIUM CLASS (7-12mm) | | | |
| Species | Adult/Immature | Living/Dead | Mean rank |
| *Culex quinquefasciatus* | I | L | 5 |
| *Culex quinquefasciatus* | I | D | 2.83 |
| *Tendipes sp.* | I | L | 3.66 |
| *Tendipes sp.* | I | D | 1.75 |
| *Catla catla,* | I (Spawn) | L | 4.91 |
| *Catla catla* | I (Spawn) | D | 2.83 |
| LARGE CLASS (> 12mm) | | | |
| Species | Adult/Immature | Living/Dead | Mean rank |
| *Ischnura sp.* | I | L | 1.66 |
| *Ischnura sp.* | I | D | 3.91 |
| *Puntius sp.* | I (Fry) | L | 2.25 |
| *Puntius sp.* | I (Fry) | D | 5.5 |
| *Catla catla* | I (Fry) | L | 3 |
| *Catla catla* | I (Fry) | D | 4.66 |

Note. The highest values indicate the most consumed taxa

The mean rank of consumption of prey within each size class for the aquatic bug species is depicted in Table 1. In the small size class, the most consumed taxa is recorded as living spawn of Catla catla followed by the nymph of Ephemeroptera, the Baetis sp. (Living). In the small size class, the predator mainly prefers the living forms of the entire prey individual. Within the medium size class the most used taxa is the living forms of mosquito larvae Culex quinquefasciatus which is closely followed by the living spawn of Catla catla while the dead specimens Chironomus larvae, Tendipes sp. is the less consumed taxa. For the large size class the most selected taxa are dead fry of Puntius sp. followed by the fry of Catla catla.

A large number of aquatic insects are opportunistic feeders, while others select certain sizes and types of prey. In the present study, direct observation of feeding behavior in controlled experimental conditions reveals that D. rusticus, despite their predominantly predatory nature, are also scavengers of large dead organisms (Figure 1). It prefers mostly the living prey of medium size category but choose mainly dead individual in the large size classes.

In the present observation, it is found that the D. rusticus prefer to consume only the dead individuals of large size category (>12mm). Small (3-6mm) and medium sized (7-12mm) individuals can be captured but capturing large living individuals involves high energy cost. Bailey (1986) has opined that capturing and handling costs of Ranatra dispar Montadon (Hemiptera), another sit and wait predator, tends to increase with prey size. Formanowicz (1984) while studying anuran tadpole-aquatic insect predator–prey interaction also found that tadpole vulnerability decreases with increasing tadpole size and is raised by increasing size of larvae of the predaceous diving beetle Dytiscus verticalis Say. However, the aquatic bug does not show preference to consume the adult individual of the small aquatic beetle Amphiops pedestris belonging to small sized category (3-6mm) in the present study, which may be due to the difficulty in catching and to retain in their claws.

Of the medium sized prey individuals, the bug shows more preference to kill the Mosquito larvae, Culex quinquefasciatus followed by living forms of Catla catla spawn and Chironomus larvae, Tendipes sp., which gives some significant information of using this bug as biological control agents of mosquito while playing significant negative role in aquaculture practices.

Predator-prey interaction are important in shaping the community and population structure in freshwater aquatic systems. The habitat heterogeneity, owing to the presence of macrophytes and other physical barriers generates spatial complexity and influence the predator-prey interactions in aquatic bodies. From the result of feeding behavior study, it is evident that the predatory water bug D. rusticus is an efficient predator of mosquito larvae and also linked to different preys though the rate of consumption varies significantly between smaller and larger prey sizes. Marshes, swamps, ponds and temporary pools are the known habitat of predatory aquatic bug D. rusticus. The experimental observations on the predation of the Hemipteran species by Saha et al. (2007) have already established its competence as biological control agent of mosquito population. The present observation also highlights the possible employment of the aquatic bug as an efficient biological control agent aimed at mosquito vector.

## 4. Acknowledgements

The authors are thankful to the University Grants Commission, New Delhi, Government of India for providing financial support in the form of Research Fellowship in Science for Meritorious Students; Zoological Survey of India, Kolkata for identification of some species and the Programme Coordinator of the UGC-SAP (DRS), Department of Zoology, Gauhati University for providing necessary laboratory facilities.

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