



## Influence of temperature on the feeding behavior of the *Diplonychus rusticus fabricius* (1871) (Heteroptera: Belostomatidae)

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### Abstract

Giant water bugs (Heteroptera: Belostomatidae) are dominant group of aquatic predators of freshwater habitats, have received little attention in the Oriental region. These aquatic carnivorous bugs feed on dipterans larvae, small fishes, aquatic snails and tadpoles. Present Study was conducted to check the influence of temperature on feeding behavior of all the instars of the widespread Oriental belostomatid species, *Diplonychus rusticus* (Fabricius). To check feeding behavior Chironomus larvae provided and result is observed at five different temperatures conditions including 15°C, 20°C, 30°C, 35°C and 37.5 °C respectively. The temperature for the control was 25°C. The feeding efficiency of each nymphal instar was calculated in terms of the average number of larvae consumed per hour. Present study suggested that when the temperature is decreased to 15°C and 20°C the rate of feeding is decreased and when temperature increased at 30°C, 35°C the rate of feeding behavior increased. Below 11°C and above 37.5°C the bug was unable to survive. This variation in the temperature influences the feeding behaviour of the *Diplonychus rusticus* Fabricius.

**Keywords:** *Diplonychus rusticus*, temperature, feeding behavior

### 1. Introduction

*Diplonychus rusticus* Fabricius is a very common belostomatid which inhabits a variety of lentic habitats with profuse aquatic vegetation. These bugs are abundant in large, permanent ponds. It is known to prefer floating aquatic vegetation for perching (Ping-ping C. *et al.*, 2005). They are aquatic carnivorous bugs; feed on some dipterans larvae, small fishes, aquatic snails and tadpoles. The bugs oviposit on tiny plant leaves. The egg is attached to the leaf or stem and in some species the eggs are laid on the back of the male which is a characteristic feature of parental care. They lay eggs in large numbers. After eggs lying, during the incubation till the brooding period the male protects all eggs from predators (Dnyaneshwar D. *et al.* 2017). Female *Diplonychus rusticus* Fabricius deposit their eggs on the dorsal side of the male bug and then the male broods the egg in various way.

The oviposition occurs during the day as well as at night but the duration of oviposition during the day time is less as compared to that night time. During egg laying female produced slimy mucilage which help the adhesion of the eggs on dorsal side of male (Venkatesan P.1983) [10]. The potential of this species as an efficient predator of mosquito larvae has been well documented (Nabaneeta S. *et al.*, 2007; Nabaneeta S. *et al.*, 2010) [4, 5]. Predation rate of *Diplonychus rusticus* Fabricius increase during the

Day time and decrease at night (Bhattacharya K. D., 1995) [1].

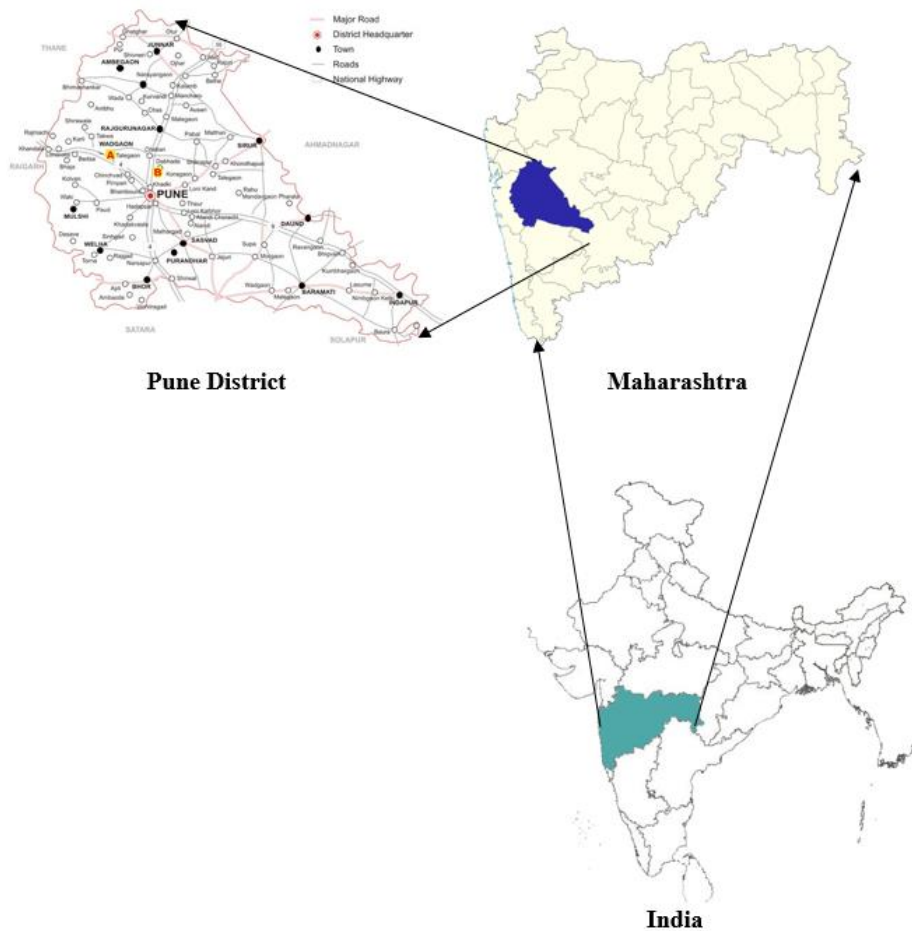
### 2. Materials and Methods

#### a. Collection Site

The nymphs of the bug were collected from two different localities, Talegaon Sanskruti Lake and Indrayani River, Moshi. The selected localities had high vegetation of *Echhornia* and *Pistia*. The nymphs were collected monthly from different places of the Talegaon Sanskruti Lake and Indrayani River, Moshi.

#### b. Laboratory rearing of *Diplonychus rusticus* Fabricius

Adult male carrying eggs were collected from the area of Talegaon Sanskruti Lake and Indrayani River, Moshi and were brought to the laboratory for rearing. Aquarium was set up and the bugs were released in it. The aquarium was also provided with vegetation like *Echornia* and *Pistia* in order to make an acquainted surrounding for the bugs to live and grow. *Chironomus* larvae were provided as food to the bugs. The adult male and female bugs were allowed for breeding. The population of the bug, *Diplonychus rusticus* Fabricius increased rapidly and were equally distributed in the other aquarium having similar surrounding. Continuous oxygen supply for aeration was provided with the help of aerator and a source of light was also arranged.



(Google map images source from google)

**Google Map 1:** Map of all collection sites A – Collection Site I (Talegaon Sanskruti Lake) B- Collection Site II (Indrayani River Moshi)

### c. Influence of temperature on feeding behaviour

Influence of temperature on feeding behaviour was studied where seven beakers filled with 200ml tap water were taken and kept in incubator at fixed temperature. The temperature for the control group was 25°C. To investigate influence of temperature five constant temperature of 15°C and 20°C, 30°C, 35°C, 37.5 were maintained and the results were monitored. During the experiment *Chironomus* larvae were provided to each instar of *Diplonychus rusticus* Fabricius as per table (Table – 1) at the given temperature. These nymphs were starved for 18 hrs before feeding (*Chironomus* larvae) at the respective temperature. The total number of larvae consumed was recorded after 12 hours and 24 hours. The feeding efficiency of each nymphal instar was calculated in terms of the average number of larvae consumed per hour.

### 3. Result

The present study indicates influence of temperature on feeding behaviour of *Diplonychus rusticus* Fabricius. It feeds on *Chironomus* larvae, mosquito larvae and tadpole, small fishes. Mouth part of *Diplonychus rusticus* Fabricius is piercing and sucking type. During day time predation rate is more and decreases at night time (Bhattacharya K. D., 1995) [1] and it depends on the availability of prey, vegetation on water surface, water depth and temperature.

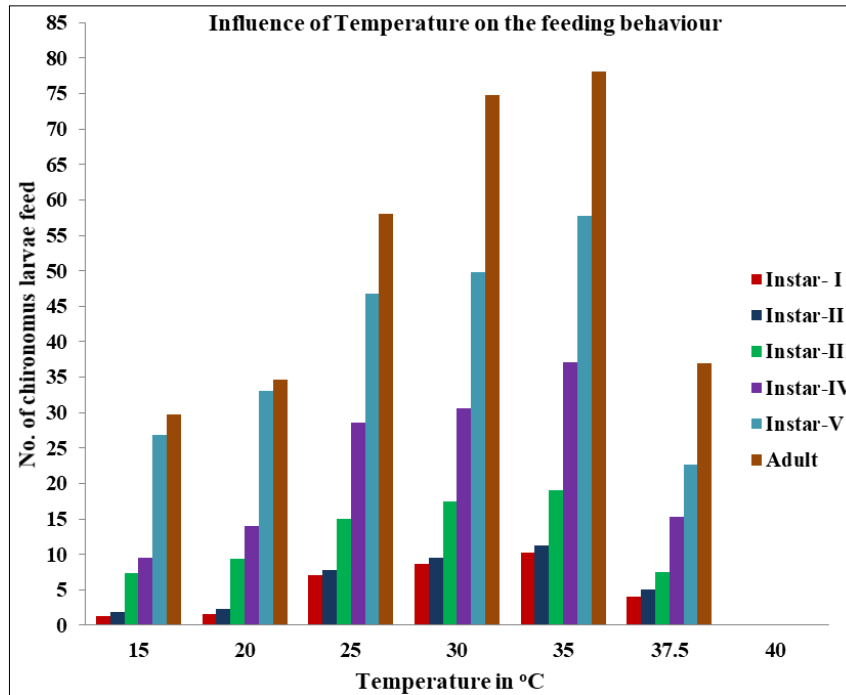
The increase in environmental temperature due to climate change affects the growth rate of the nymph, feeding behaviour and reproduction (Rakshitha M., *et al.*, 2018, Rui-Ting J., *et al.*, 2011) [7, 8].

For the experiment seven beakers were taken, each beaker filled with 200ml tap water and labelled appropriately. Incubators were used to keep the set at the desired temperature during the experiment. The constant predatory rate was taken in normal water kept at room temperature. To investigate the effect of temperature on feeding behaviour range of four temperatures Viz. 15°C, 20°C, 30°C, and 35°C were set. The predatory rate of each instar was recorded separately. Seven beakers were kept in the incubator up to 12 hours for adjusting the water temperature with incubator temperature. *Chironomus* larvae were provided as food to each larvae as indicated in table 1. The results of this experiment revealed that the feeding increases as the temperature increases from 15°C to 35°C.

It was also noted that the bugs could not survive at temperature below 11°C and above 40°C. This is because at a low temperature the body growth, food consumption and development of the insect is arrested (Usha rani P., 1992; Ismael S. R., 2015) [9, 3]. The table 11 shows that feeding rate of instars at different stage. The collected data has been analysed by bar chart.

**Table 1:** Feeding rate of Instars of *Diplonychus rusticus* Fabricius at different temperature.

Instars Temperature	I	II	III	IV	V	Adult
	1.3 ± 0.47	1.8 ± 0.68	7.3 ± 0.47	9.5 ± 0.50	26.8 ± 0.68	29.8 ± 0.68
20	1.6 ± 0.47	2.3 ± 0.47	9.3 ± 0.74	14 ± 0.81	33 ± 1.0	34.6 ± 0.94
25	7 ± 0.81	7.8 ± 0.68	15 ± 0.81	24.6 ± 1.10	46.8 ± 0.81	58.1 ± 1.06
30	8.6 ± 0.47	9.3 ± 0.50	17.5 ± 0.74	27.6 ± 0.74	49.8 ± 1.06	63.8 ± 0.68
35	8.3 ± 0.47	9.4 ± 0.74	19.1 ± 0.68	27.3 ± 0.89	57.8 ± 2.1	65.1 ± 0.68
37.5	4 ± 0.48	5 ± 0.55	7.5 ± 0.35	15.3 ± 0.60	22.6 ± 1.2	36.9 ± 0.61

**Fig 1:** Influence of temperature on I<sup>ST</sup> Instar of *Diplonychus rusticus* Fabricius at different temperature.

When temperature decreases it adversely affects the feeding behaviour of *Diplonychus rusticus* Fabricius which is shown in figure 1. It can be seen from the figure that lower temperature of 15 °C and 20 °C the predatory rate of *Diplonychus rusticus* Fabricius decreases. In spring vegetation increases and source of food increases but the environmental temperature is low at that time so the feeding rate decreases. When temperature of the water increases up to 30 °C and 35 °C, it accelerates the feeding rate in various instars and adult which is shown in figure 1. At 37.5°C feeding rate of *Diplonychus rusticus* Fabricius has dropped significantly. At 40 °C survival of the bugs is not seen.

The feeding rate of the 1<sup>st</sup> instar at a 15 °C is 1.3 (4%) and at a 35 °C is 10.3 (36 %) up to 24 hours show in figure 11. The feeding rate of the 2<sup>nd</sup> instar at a 15 °C is 1.8 (5%) and at 35 °C is 11.3 (35%) while in 3<sup>rd</sup> instar at a 15 °C is 7.3 (11%) and at 35 °C is 19.1 (28%). The feeding rate of the 4<sup>th</sup> instar at 15 °C is 9.5 (8%) and at 35 °C is 37.1 (31%). The 5<sup>th</sup> instar at 15°C is 26.8 (13%) and at 35 °C is 57.8 (27%). while the feeding rate of the adult at 15 °C is 29.8 (11%) and at 35 °C is 78.1 (28%).

### Discussion

*Diplonychus rusticus* Fabricius is a Biological Control Agent as it feed on the *Chironomus* larvae and mosquito larvae- *Culex quinquefasciatus*. The feeding rate of the species depends on the percentage of vegetation, Environmental temperature, growth pattern and development. The I<sup>ST</sup> and II<sup>nd</sup> instars are highly active. Body

size is small and foreleg claws are used to grip the prey. It can be concluded from the experiment of feeding behaviour that the feeding efficiency increases as the development advances starting from just over 6 larvae a day by the 1<sup>st</sup> instar nymph to 62 larvae a day by the adult. The experiments conducted to assess the effect of the temperature on the feeding efficacy revealed a direct relation of temperature on the feeding of this bug. As the temperature was increased from 15°C to 35°C the feeding increased further at 37.5°C the feeding decreased and below 11°C the bug was unable to survive. The variation in the temperature also affected the life cycle, growth pattern and development of the *Diplonychus rusticus* Fabricius.

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