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Effect of salinity on the predatory performance of *Diplonychus rusticus* (Fabricius)

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Abstract: *Predatory efficiency of Diplonychus rusticus (Fabricius) was recorded at different prey density with different salinity ranges. When the salinity level (ppt) was increased, the predation rate of the bug decreased. Fifth nymphal stage showed higher predation in the 2, 4 and 6 ppt levels of salinity in both 1hr and 24 hr period of exposure at prey densities 50, 100, 150 and 200. At prey density 150, adult bugs killed more prey in the 2 ppt level of salinity in both 1hr and 24 hr treatments.*

Key words: *Salinity, Predatory performance, Diplonychus rusticus*
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Introduction

Importance of biota in assessment of water quality (Wynes and Wissing, 1981) and ecotoxicology in water quality management (Chawla *et al.,* 1989) are highly emphasized. Species diversity has been found very consistent in some of the tropical water bodies for biomonitoring water quality, which is eutrophic in nature (Laal *et al.,* 1984). In addition, limnology embraces a range of microhabitats often overlooked by casual observers (Alexander and Charles, 1994).

Salinity, as one of abiotic factors, affects oxygen consumption in the water bugs (Venkatesan *et al.,* 1993), and life cycle and ecology of aquatic organisms (Gelin *et al.,* 2001). Of the widely used biological methods estimating the water quality, Sharma *et al.* (1990) categorized the organisms based on tolerance to organic pollution. Relatively, aquatic insects are more adaptable to environmental changes than the terrestrial ones (Siegfried, 1993).

Considerable work has been focused on egg hatchability and larval survival among mosquito populations in breeding sites of varying salinity (Wallis, 1954). The precompetent period for many planktrophic larvae of marine invertebrates is influenced by food supply, temperature and salinity (Megan, 2000). A review of literature on the predatory efficiency of aquatic bugs (Arivoli *et al.,* 2005; Chandramohan *et al.,* 2005 a,b; Chandramohan *et al.,* 2006) raises a question as to whether various limiting factors influence their predation. This is verified in the present investigation with a study of salinity effect on the predatory performance of the belostomatid bug, *Diplonychus rusticus*.

Materials and Methods

Predator: The experimental nymphs and adults (male and female) of *Diplonychus rusticus* were collected from shore region of the pond at Manali, Chennai, India. Branches of the water hyacinth were brought to the shore and simultaneously a hand net was swept to collect the water bugs clinging to their rootlets. The bugs were then transported to the laboratory in plastic containers with pond water and a few twigs of *Hydrilla*. They were maintained in large aquaria (90 X 60 X 45 cm) containing tap water with twigs of *Hydrilla* and *Chara* as substrate for the bugs. The bugs were fed with culicine larvae regularly. The water in the aquarium was changed every other day to avoid fouling of the water (APHA, 2005). Nymphal stages (I-V) and adult bugs were chosen for the present study.

Prey: Larval *Culex quinquefasciatus* was selected as the prey. They were collected from stagnant water bodies in Chennai using long handled tea strainers. They were transported in plastic containers with clean water. Larvae were then transferred to large enamel tray (27 x 22 x 4.5 cm) in the laboratory and were provided yeast powder as food. The prey items were pipetted out for the experiments. Only third size class larval *Culex quinquefasciatus* was selected for the present investigation (Venkatesan and Sivaraman, 1984).

Each nymphal stage and both the sexes of *D. rusticus* were introduced separately into glass troughs having various prey densities - 50, 100, 150 and 200 and different salinity levels 2, 4, 6, 8, 10 and 12 ppt by using Refractometer (Ellis and Borden, 1970). Number of prey killed by each predator was counted for 1 hr and 24 hr. Simultaneously control was run by using distilled water and ten trials were carried out for each treatment. Mosquito larvae were survived in different salinity level for more than two days. Results were subjected to two way analysis of variance (ANOVA) to test the statistical significance of the predatory potential of *D. rusticus.*

Results and Discussion

Effect of salinity on the predatory performance :

Prey density 50: Number of prey killed by first nymph was 6.7 ± 3.40 at 1 hr and 23.3 ± 3.10 in 24 hr at 2 ppt. The number of prey killed by the II nymphal stage in 1 hr was 3.6 ± 1.43 in 6 ppt and 23.9 ± 5.34 in 24 hr at 2 ppt. In the III nymphal stage, the higher predation was recorded in 2 ppt at both 1 hr (7.2 ± 2.32) and 24 hr (29.3 ± 2.9). The same trend was also observed in the IV nymphal

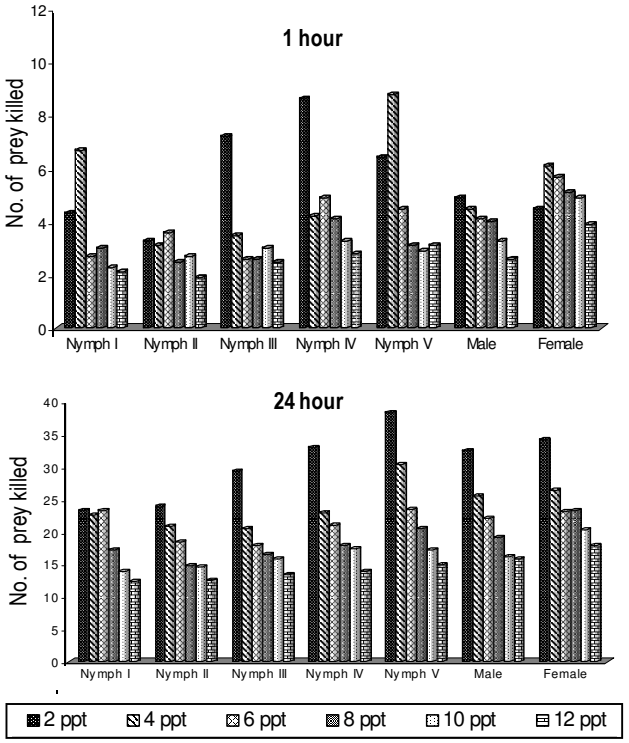

Fig. 1: Effect of salinity on the predatory performance of *Diplonychus rusticus* at prey density 50

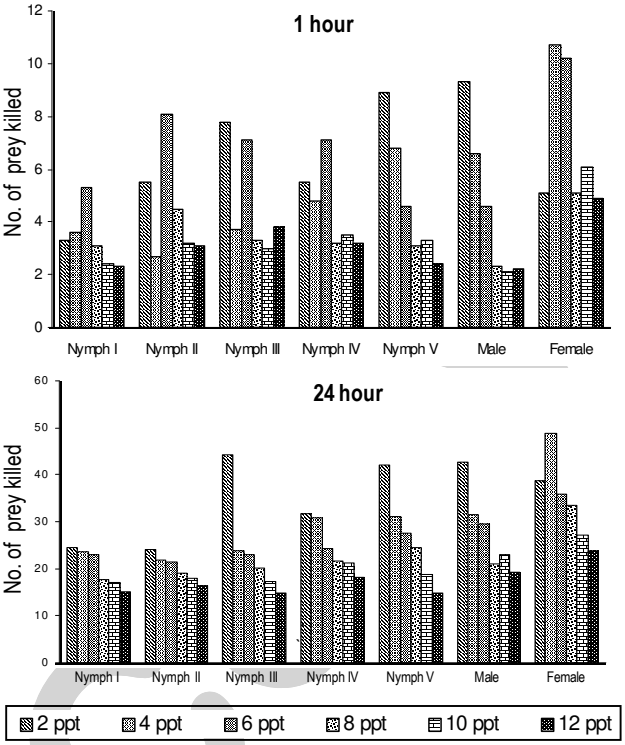

Fig. 2 : Effect of salinity on the predatory performance of *Diplonychus rusticus* at prey density 100

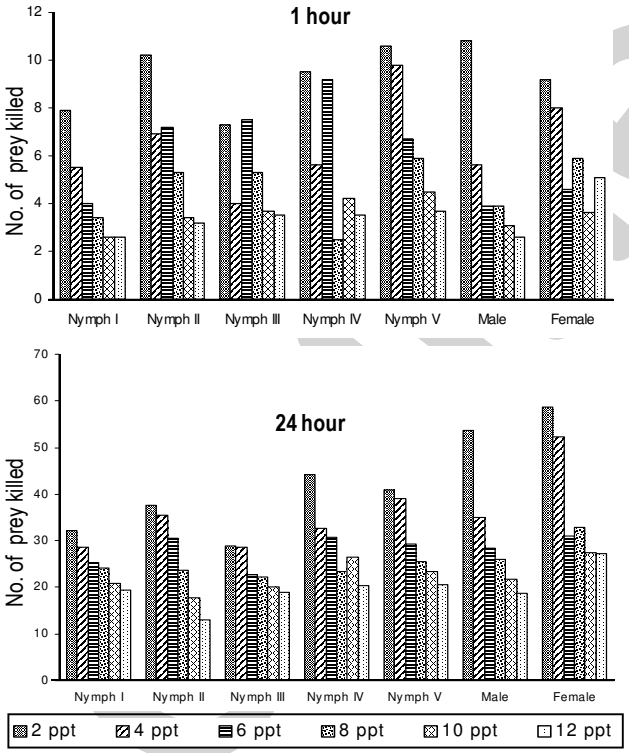

Fig. 3: Effect of salinity on the predatory performance of *Diplonychus rusticus* at prey density 150

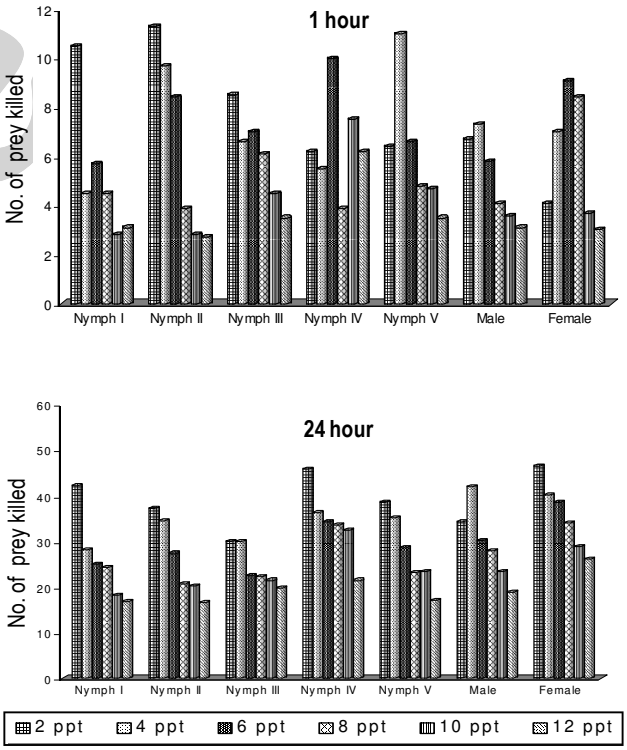

Fig. 4: Effect of salinity on the predatory performance of *Diplonychus rusticus* at prey density 200

Table - 1: Data on effect of salinity on the predatory performance of nymph and adult of *Diplonychus rusticus* subjected to ANOVA

Source of variation	Sum of squares	DF	Mean square	F- Ratio	p - Value
Main effects	92436.289	11	8403.299	131.664	0.000**
Nymp and adult	21426.714	6	3571.119	55.953	0.000**
ppt	71009.574	5	14201.915	222.517	0.000**
Interactions nymph, adult and ppt	3874.571	30	129.152	2.024	0.001**
Explained	96310.860	41	2349.045	36.805	0.000**
Residual	104543.425	1638	63.824		
Total	200854.285	1679	119.627		

Table - 2: Data on effect of salinity on the predatory efficiency of *Diplonychus rusticus* at varied prey density

Source of variation	Sum of squares	DF	Mean square	F- Ratio	p - Value
Main effects	89479.795	8	11184.974	169.164	0.000**
Density	18470.221	3	6156.740	93.116	0.000**
ppt	71009.574	5	14201.915	214.793	0.000**
Interactions density and ppt	1881.476	15	125.432	1.897	0.020*
Explained	91361.271	23	3972.229	60.077	0.000**
Residual	109493.014	1656	66.119		
Total	200854.285	1679	119.627		

** = Highly Significant * = Significant

stage. In V nymphal stage, more number of prey killed was recorded in 4 ppt salinity level at 1 hr (8.8 ± 2.36) and 2 ppt range of salinity at 24 hr (38.3 ± 6.08). Among adults, male killed more number of prey in 2 ppt at both 1 hr and 24 hr. In female the higher predation was in 1 hr (6.1 ± 3.17) in 4 ppt salinity level and at the end of 24 hr (34.2 ± 3.76) the higher number of prey killed was in the salinity level of 2 ppt (Fig. 1).

Prey density 100: I, II and IV nymphal stages killed more prey in 6 ppt salinity level in 1 hr and in 2 ppt in 24 hr. III nymphal stage showed higher predation rate in 2 ppt salinity range at 1 hr and 24 hr. V nymphal stage showed higher predation in 2 ppt level in both 1 hr (8.9 ± 2.77) and 24 hr (42 ± 3.81) of experiments. Among sexes, male showed high predation rate in 2 ppt level of salinity after 1 hr (9.3 ± 2.86) and after 24 hr (42.8 ± 9.16) and female in 4 ppt in both 1 hr (10.7 ± 2.49) and at 24 hr (48.9 ± 10.51) (Fig. 2).

Prey density 150: Except III, all other nymphal stages killed more number of prey in the salinity level of 2 ppt after 1 hr and after 24 hr. But in III nymphal stage, more number of prey killed after 1 hour in the salinity level of 6 ppt and at 24 hr in 2 ppt level. Both the sexes exhibited higher predation in 2 ppt level of salinity at both 1 hr and 24 hr of experiments (Fig. 3).

Prey density 200: I, II and III nymphal stages killed more number of prey in 2 ppt salinity level after 1 hr and 24 hr. In IV nymphal stage the higher predation was recorded in 6 ppt salinity level after 1 hr and 2 ppt level at 24 hr. The V nymphal stage showed higher predation rate was observed in 4 ppt salinity level after 1 hr and in 2 ppt level at 24 hr. While male killed more in the salinity level of 4 ppt after 1 hr and 24 hr, female showed in the salinity level of 6 ppt after 1 hr (9.1 ± 3.62) and in 2 ppt level at 24 hr (46.5 ± 6.36) (Fig. 4). Among five nymphal stages, the higher predation rate was observed in 2, 4 and 6 ppt levels of salinity ranges, and 2 ppt in adults (Table 1).

The present study reveals that among five nymphal stages higher predation was observed at 2, 4 and 6 ppt levels of salinity. Peak in predation in the 2 ppt level of salinity, in both 1 hr and 24 hr of exposure, in the prey densities of 50, 100, 150 and 200 was noted (Table 2). Both species showed a decline with reference to temperature and salinity with age (Reynolds *et al.,* 1976). Prolarval *L. sardina* are also more euryhaline than 30 day old prejuveniles. Prolarvae *L. sardina* prefer salinities of 15 - 24%. While juveniles prefer 45 - 54% (Reynolds and Thomson, 1974), Carpelan (1955), found that young of the closely related topsmelt, *Atherinops affinis* tolerate salinities upto 90% at 27°C in enclosed salt ponds bordering San Francisco Bay, just North of the limit of the range of *Leursthes tenuis*.

The larvae of *Anopheles albumins* are sometimes found in estuaries that are periodically flooded with salt water (Bailey, 1981). In the laboratory, females of this species prefer to oviposit in fresh water, but they will oviposit in salt concentrations as high as 33 ppt. Species normally found in salt marsh habitats are more tolerant of salinity at oviposition sites than species that oviposit in freshwater habitats (Petersen, 1969). Kimoto *et al.* (1986), reported that the growth of *Sinocalamus tenellus* in salinity range of 2.5 - 35 ppt and 5 - 30 ppt reported a marked effect of salinity on development time rather than on the body size of the animal. It is also of interest to know how the time of day alters the predatory performance of the bug.

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