Chapter-2

Impact of rearing space on the predatory efficiency of D.indicus
Impact of rearing space on the predatory efficiency of *D. indicus*

2.1 Introduction

The space available for occupancy may be an important factor that determines feeding in aquatic insects. In a culture system space can play an important role in the predatory efficiency. In many terrestrial heteropterans reduction in space enhanced the prey capturing efficiency. The effect of rearing space on the predatory behaviour of the assassin bug *Rhynocoris marginatus* was studied by Ambrose *et al* (1985c) and they found that space influenced all phases of the predatory behaviour like arousal, capturing and duration of feeding Vennison and Ambrose (1988b) found that rearing space had a direct impact on the stadial period, adult longevity, oviposition, hatchability and prey capture in *R. marginatus*. The prey capture was quicker in small containers and the adult longevity was higher in assassin bugs reared in larger containers.

Pastorok (1980) found that the physical distance between the prey and the predator was crucial in predation. Kumar and Kumar (1997) based on their study on the effect of space on the predatory behaviour of the assassin bug *Rhynocoris kumarii* found that the difference in the spatial separation between the predator and prey was crucial in predation. Mathavan and Nambirajan (1976) studied the influence of space on the feeding rate of *Catopsila crocale* and reported that the reduction in space decreased the feeding rate. Further Feweke (1960) and Waldbauer (1968) also found that rearing space was of considerable importance regarding food utilization.

Cockrell (1984) studied the effects of water depth on choice of spatially separated prey, namely the surface dwelling *Culicine* mosquito larvae and the bottom
inhabiting isopod, *Asellus aquaticus* by the predator *Notonecta glauca*. They found that *N. glauca* captured more *Asellus* in shallow water than in deep water. Their predation on *Asellus* may be simply a consequence of a high encounter rate with this prey type, reflecting habitat use, as both of them are bottom dwellers especially in shallow water.

2.2 Materials and Methods

The encumbered males of *D. indicus* were collected from the Puthan pond and maintained in the laboratory in glass aquaria with aged tap water. They were fed with the third size class larvae of *Culex* sp. The eggs were allowed to hatch and the I instar larvae were removed to the experimental containers of varying volumes, namely 1 litre, 2 litres, 5 litres, 10 litres and 20 litres with one predator in each container. Ten replicates were maintained for each volume. The predators were exposed to a density of 50 third size class larvae of *Culex* sp and the number of dead prey items were replaced every 12 hours and the density was always maintained at 50. The instars were reared in the same conditions till they became adults. The total number of *Culex* larvae fed by each group of predators in varying volumes for their entire developmental period were noted and tabulated. The stadial period of *D. indicus* reared in different volumes was noted and tabulated.

2.3 Results

The predatory efficiency of all the instars of *D. indicus* in six different volumes of rearing space was summarized and tabulated. (Table -1 and Figure -1)

1 litre rearing volume

In 1 litre rearing volume the I instar predated 10.6 ± 0.44 *Culex* larvae followed by 19.6 ± 0.98, 42.3 ± 2.72, 136.1 ± 6.7, 202.6 ± 8.72 by the II, III, IV and
Table-1

Influence of space on the predation by the instars of *D.indicus* during the entire developmental period

<table>
<thead>
<tr>
<th>Volume of the container (litre)</th>
<th>Prey intake during the developmental period</th>
<th>Total prey intake (number)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1</td>
<td>10.6±0.44</td>
<td>19.6±0.98</td>
</tr>
<tr>
<td>2</td>
<td>9.33±0.42</td>
<td>17.3±0.92</td>
</tr>
<tr>
<td>5</td>
<td>8.3±0.62</td>
<td>12.6±0.82</td>
</tr>
<tr>
<td>10</td>
<td>7.33±0.70</td>
<td>7.33±0.75</td>
</tr>
<tr>
<td>15</td>
<td>7.33±0.52</td>
<td>9.5±0.64</td>
</tr>
<tr>
<td>20</td>
<td>8.33±0.48</td>
<td>9.33±0.26</td>
</tr>
</tbody>
</table>

Means followed by the same alphabet across a column are not statistically significant at 0.05% by one way classification (ANOVA).
Figure -1 Graph showing the influence of space on the Culex predation by the instars of D.indicus during the entire developmental period.

Figure-2 Graph showing the influence of space on stadial period of D.indicus at 1-20 litre rearing volume.
V instars respectively. The total prey intake during the entire developmental period in 1 litre volume was 411.2 ± 8.76.

2 litres rearing volume

In 2 litres rearing volume the I instar predated 9.33 ± 0.42 *Culex* larvae followed by 17.3 ± 0.92, 35.8 ± 3.2, 123.5 ± 8.72 and 180.6 ± 9.5 by the II, III, IV and V instars respectively. The total prey intake during the entire developmental period in 2 litres rearing volume was 366.53 ± 8.92.

5 litres rearing volume

In 5 litre rearing volume the I instar predated 8.3 ± 0.62 *Culex* larvae followed by 12.6 ± 0.82, 31.5 ± 2.84, 112.5 ± 6.7, 202.3 ± 10.5 by II, III, IV and V instars respectively. The total prey intake during the entire developmental period in 5 litres rearing volume was 367.2 ± 9.3.

10 litres rearing volume

In 10 litres rearing volume the I instar predated 7.33 ± 0.70 *Culex* larvae followed by 7.33 ± 0.75, 28.2 ± 2.52, 122.1 ± 6.2, 148.8 ± 9.4 by the II, III, IV and V instars respectively. The total prey intake during the entire developmental period in 10 litres rearing volume was 314.36 ± 9.2.

15 litres rearing volume

In 15 litres rearing volume the I instar predated 7.33 ± 0.52 *Culex* larvae followed by 9.5 ± 0.64, 33.8 ± 2.12, 112.1 ± 6.8, 126.6 ± 7.2 by the II, III, IV and V instars respectively. The total prey intake during the entire developmental period in 15 litres rearing volume was 289.33 ± 88.
Table-2
Influence of space on the stadial period of the instars of *D.indicus*

<table>
<thead>
<tr>
<th>Volume of the container (litre)</th>
<th>Stadial period (days)</th>
<th>Total stadial period (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I- II</td>
<td>II- III</td>
</tr>
<tr>
<td>1</td>
<td>4.16±0.28</td>
<td>4.3±0.34</td>
</tr>
<tr>
<td>2</td>
<td>4.26±0.54</td>
<td>4.16±0.18</td>
</tr>
<tr>
<td>5</td>
<td>4.16±0.27</td>
<td>4.16±0.36</td>
</tr>
<tr>
<td>10</td>
<td>4.3±0.72</td>
<td>4.3±0.82</td>
</tr>
<tr>
<td>15</td>
<td>4.16±0.30</td>
<td>5.16±0.63</td>
</tr>
<tr>
<td>20</td>
<td>5.3±0.55</td>
<td>6.3±0.52</td>
</tr>
</tbody>
</table>
Figure -3 Regression analysis depicting the relationship between number of larvae predated by the instars of *D.indicus* in 1 litre rearing volume

\[ y = 42.47x - 60.33 \]

\[ R^2 = 0.7371 \]
20 litres rearing volume

In 20 litres rearing volume the I instar predated $8.33 \pm 0.48$ Culex larvae followed by $9.33 \pm 0.26$, $40.16 \pm 2.28$, $109.3 \pm 5.3$, $143.8.88$ by the II, III, IV and V instars respectively. The total prey intake during the entire developmental period in 15 litres rearing volume was $310.92 \pm 9.4$.

In all the rearing volumes the V stadium showed the maximum prey intake $202.6 \pm 8.72$, $180.6 \pm 9.5$, $202.3 \pm 10.5$, $148.8 \pm 9.4$, $126.6 \pm 7.2$, $143.8 \pm 8.8$ in the 1, 2, 5, 10, 15 and 20 litre containers respectively.

Rearing space and stadial period

The present study on the influence of rearing space on the stadial period showed that the, maximum stadial period was in 20 litres rearing volume ($40.56 \pm 3.42$ days) followed by 15 litres rearing volume ($37.4.2 \pm 2.82$ day). The lowest stadial period was observed in D. indicus reared in 1 litre rearing volume ($27.56 \pm 2.86$ days) (Table -2 and Figure -2).

The results showed that as the volume of the rearing space increased there was a corresponding decrease in feeding in all the instars of D.indicus. Further there was a significant impact on the stadial period. The data was subjected to ANOVA and the results were tabulated (Table- 1). The regression analysis showed a positive relationship between the number of larvae predated by the instars of D.indicus in 1litre rearing volume (Figure - 3).

2.4 Discussion

The reduction of rearing space enhanced the prey capturing efficiency in all the instars of D.indicus. The prey intake had a positive relation with the rearing
space. This was in agreement with the findings of Ambrose et al (1985c) in *R. marginatus*, Kumar (1993) in *R. longifrons* and Kumar and Kumar (1997) in *R. kumarii*. The prey capture was efficient when the volume of the rearing space was small. According to Feweke (1960) and Waldbauer (1968) the size of the rearing container was of considerable importance regarding food utilization. Thus the spatial separation between the predator and the prey was crucial in predation. In small rearing volume where the predator *D. indicus* was in close proximity with the prey, it showed higher efficiency of prey capture than in a larger containers where the physical distance separating the prey and the predator was larger. This type of predation was observed by Cockrell (1984) in the studies on the effects of water depth on choice of spatially separated prey by *Notonecta glauca*. When *N. glauca* was offered simultaneously two types of prey namely *Ascellus*, which has a bottom dwelling habit and *Culex* which has a surface dwelling habit, they fed more *Ascellus* than *Culex*. This was due to the high encounter rate of *N. glauca* with *Ascellus* because *N. glauca* spent more time submerged in shallow water than in deep water. In shallow water the proximity of *N. glauca* and *Ascellus* was more leading to increased predation.

In *M. lineatus* the number of mosquito larvae predated increased with increase in volume of water. But in the present study when the volume of rearing container decreased, the feeding rate increased in all the instars of *D. indicus*.

Further Mathavan and Nambirajan (1976) reported a decrease in the feeding rate of *Catopsila crocale* due to reduction in space. This might be due to the fact that the increase in rearing space provided ample areas for the escape of prey from the predator which led to decrease in prey capturing.
Studies of Sivagnaname (2000) showed that it might be possible to control *Aedes* mosquitoes by attracting them to breed in automobile tyres of smaller volume and releasing the larva of *D.indicus* into the tyres. In this there was 90% control of *Aedes* larvae facilitated by the smaller volume of the tyres.

The stadial period also showed variation when the bugs were reared in varying volumes of water. There was marked increase in the stadial period when the volume of rearing space increased.

The present study showed that the prey capturing efficiency was maximum in 1 litre volume. Further the stadial period was also less in the bugs reared in 1 litre volume.