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Food Requirement of *Rhynocoris kumarii* Ambrose & Livingstone (Heteroptera, Reduviidae)

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Rhynocoris kumarii Ambrose & Living stone was reported as a potential predator of various insects such as *Achaea janata* Linnaeus, *Anomis flava* Fabricius, *Calacoris angustatus* Lethierry, *Corcyra cephalonica* Stainton, *Dysdercus cingulatus* Fabricius, *Earias insulana* Biosdual, *Earias vitella* Fabricius, *Ergolis merione* Costa, *Euproctis fraterna* Moore, *Euproctis scintillans* Walker, *Eupterote mollifera* Walker, *Helicoverpa armigera* Hubner, *Tribolium castaneum (Herbst)*, *Mylabris pustulata* Thunberg, *Oxycarenus hyalinipennis* Costa, *Papilio demoleus* Linnaeus, *Patanga succinota* (Linnaeus), *Pectinophora gossypiella* Saunders and *Spodoptera litura* Fabricius (Ambrose, 1985, 1988, 1995). It inhabits concealed micro habitats especially underneath the stones (Ambrose and Livingstone, 1987). Efforts are being made to mass rear this reduviid predator for large scale release and to evaluate its biocontrol potential. Knowledge on the nutritional and ecophysiological aspects are essential to formulate sound strategies for mass rearing and laboratory colonization. This prompted the authors to investigate the food requirement of life stages of *R.kumarii.* Ambrose and Kumaraswami (1993) evaluated the food requirements of a sister species *Rhynocoris fuscipes* Fabricius on *Corcyra cephalonic* Stainton (Lepidoptera, Pyralidae). But the microhabitat and the prey record of *R.fuscipes* (Ambrose and Livingstone 1986; Ambrose, 1995) differ from those of *R.kumarii.* It is also interesting to report here that these two species were never found sharing a particular microhabitat. This paper reports the food requirements of *R.kumarii* on ground grasshopper *Dittopternis venusta* (Walker) a staple prey of this predator.

Food requirement was assessed in terms of predatory value (Fewkes, 1960). The predatory value and conversion ratio were taken as indices to determine whether there was a characteristic fixed value or variable range for different life stages of this predator, wherein quicker control of the pest can be achieved after releasing them in the field.

Fifth nymphal instars and adults of *R. kumarii* were collected from Maruthuvazhmalai scrub jungle ($77^{o}.55'$ .E and $8^{o}.7'$.N) near Kanyakumari, South India. They were reared in the laboratory (Temperature 30-35°C; Photoperiod 11-13; RH 75-85%) on nymphal instars of *D. venusta*. Different life stages emerged from the laboratory stock culture were utilized for the experimental studies.

Life stages were weighed immediately after tanning during eclosion and ecdysis. They were maintained stagewise (I, II, III, IV and V nymphal instars) and adults comprising equal number of males and females in isolation on *D. venusta* in plastic containers. The predator was supplied with prey till it got satiated. The weight of the unfed and the satiated predator was recorded daily. The experiment was carried out during the entire nymphal period for the nymphal instars and 21 days for the adult after imaginal moult. Thus the cumulative weight of prey consumed by the life stages of predators was calculated.

The values of conversion ratio and predatory value were calculated using the following expression of Fewkes (1960).

$$\text{Conversion ratio} = \frac{\text{Weight gained}}{\text{Weight consumed}} \times 100$$

$$\text{Predatory value} = \frac{\text{Weight consumed}}{\text{Duration of instars}}$$

where all weight are fresh weights.

Table 1. Food requirement of life stages of *R. kumarii* fed on the nymphal instars of *D. venusta* ($\overline{X} \pm SD$)

Parameters	Nymphal instars					Adult
	I	II	III	IV	V	
Initial weight (mg)	0.74±0.03	2.71±0.19	7.19±0.22	23.06±0.06	50.44±1.24	106.74±4.64
Initial weight next instar (mg)	2.84±0.17	7.15±0.17	21.23±0.55	59.27±1.04	106.02±2.49	156.52±7.71
Weight gained (mg)	2.06±0.16	4.46±0.27	14.23±0.61	36.26±0.97	55.58±2.54	49.71±5.49
Weight of food consumed (mg)	4.46±0.21	8.34±0.51	18.30±0.34	61.07±1.60	113.85±5.17	146.71±10.20
Conversion ratio (%)	48.82±2.92	54.69±3.92	83.34±3.67	60.19±1.38	49.47±2.09	33.20±2.29
Duration of instar (days)	10.86±0.54	7.29±0.29	10.00±.0.00	14.05±1.60	21.38±0.30	21.00±0.00
Predatory value (mg/days)	0.41±0.02	1.17±0.06	1.89±0.11	4.36±0.13	5.27±0.23	6.98±0.49
Number of meals	0.74±0.03	2.95±0.18	2.71±0.22	4.30±0.25	5.44±0.16	6.44±0.27
Number of observations	21	21	21	20	16	16

The initial weight recorded for the nymphal instars steadily increased from the first instar to the adult (Table 1). A remarkable 3.7 fold increase was observed between the initial weight of the first and the second nymphal instars. But the weight increase from the second to the third instar, from fourth to fifth instar and from the fifth instar to the adult was only two-fold and that of third to fourth instar was three-fold. The highest weight gained was observed in the fifth nymphal instar. As the age of the predator increased, the weight gained also increased, which is evident from the positive correlation (Y=19x - 37.09; r= 0.8956) obtained. Baumgaertner *et al.* (1981) stated that the weight gain of the predator could be described as a function of age. Similarly, the amount of food consumed also increased as a function of aging. In the fourth nymphal instar, a three-fold increase was recorded. In all the other nymphal instars, two-fold increase in consumption was observed (Y=8.85x - 1.84; r = 0.7251). Two fold increase in food consumption was observed in IV and V nymphal instars of *R.fuscipes* (Ambrose and Livingstone, 1993). Prey consumption was similar in III and IV instars of *Pristhesancus plagipennis* Walker (Heteroptera, Reduviidae) (James, 1994). The consumption of food had indirect correlation to the body weight. The food consumed by the I,II, III, IV and V nymphal instars and adults were 6.0, 3.1, 2.6, 2.7, 2.3 and 1.4 times greater than those of their initial body weight, respectively. However, Ambrose and Rajan (1992) found an exactly opposite trend in the haematophagous assassin bug *Triatoma rubrofasciata* (De Geer) (Heteroptera, Reduviidae). Prey consumption by reduviids is likely to vary considerably according to species size.

The conversion ratio of *R. kumarii* was comparatively higher in the younger instars than in the older instars and the adults. Johnson (1960) and Kasting and McGinnis (1959) observed that the conversion ratio varied between the instars and the younger instars were more efficient than older ones. However, Fewkes (1960) found an exactly opposite trend in Nabids. The reason for decreased conversion efficiency of older instar and adult is not clearly known. Gordon (1959) observed that the conversion efficiency of the German roach *Blatella germanica* (Linnaeus) (Dictyoptera, Blattellidae) decreased as the body weight increased and suggested that if the weight of German roach increased two times then the absorption surface area of the gut increased only 1.8 times. The same suggestion might be true for *R.kumarii*. When looking at the conversion ratio and the weight of food consumed for the nymphal instars of *R. kumarii* (Table 1), *Phonoctonus nigrofasciatus* Stal (Heteroptera, Reduviidae) (Evans 1962), *Rhodnius prolixus* Stal (Heteroptera, Reduviidae) (Buxton, 1930), *R. fuscipes* (Ambrose and Kumaraswami, 1993) and *T. rubrofasciatus* (Ambrose and Rajan, 1992), it was found that there was no negative correlation between these two parameters in all the five insects. Hence, it was suggested that the decrease in the food consumption of the later instars and the adults are due to some more fundamental physical or metabolic limiting factors.

The duration of the stadia gradually increased as the age of the predator increased (Y=4.39 + 2.77x; r=0.8784). The predatory value also increased as the predator grew older (Y= 1.36x -1.41; r= 0.989874). Evans (1962) obtained similar results in another assassin bug *P.nigrofasciatus*. He considered the predatory value as a general guide to measure the potential value of the predator. During the course of its development from first nymphal instar to adult, each *R.kumarii* consumed about 206 mg of *D. venusta*. Evans (1962) calculated the food requirement of *P.nigrofasciatus* for its development from first instar to adult as 500-574 mg of *Dysdercus* sp. and of *R. fuscipes* as 69 mg of *C. cephalonica* (Ambrose and Kumaraswami, 1993). The food requirement of *R.kumarii* could be attributed to the size of its adult and genetic fitness. The intermediate food requirement of *R.kumarii* when compared to that of *P. nigrofasciatus* and *R. fuscipes* could be attributed to its intermediate size. It weighed only 106 mg whereas the adult weight of *P.nigrofasciatus* was 219.2 mg (two times heavier) and that of *R.fuscipes* was 38.18 mg (three times lighter).

KEY WORDS : *R.kumarii, D. venusta* reduviid predator, food requirement, predatory value, conversion ratio.

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