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LIFE HISTORY AND LARVAL PERFORMANCE OF THE COMMON GULL BUTTERFLY *CEPORA NERISSA* (LEPIDOPTERA: RHOPALOCERA: PIERIDAE)

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ABSTRACT

The Common gull butterfly *Cepora nerissa* is multivoltine and breeds throughout the year with higher frequency during July-December in the vegetations of North costal Andhra Pradesh. The life cycle period completes in 21-28 days. The growth of larvae was directly correlated with the quality food consumed. Food utilization efficiencies across the instars indicated that the approximate index (AD) values and growth rate (GR) decreased among subsequent instars starting from the first, Consumption index (CI) showed a continuous decrease with the increasing age of the larvae. The efficiency of conversion of digested food (ECD) and efficiency of conversion of ingested food (ECI) values continuously increased. The adults utilized several floral species as nectar resources while *Caparis spinosa* served as a larval host.

INTRODUCTION

Butterflies are valuable pollinators of wild plants and thus contributing to the world's natural sustainability. Also the butterflies are increasingly attested as indicator of environmental quality. The common gull butterfly *Cepora nerissa* is splendid and showy with beautiful wing colours and wing span of 50-70 mm. Both sexes look alike. It is often reported to be very common in the plains of India (Kunte, 2000). But in several areas of north coastal Andhra Pradesh its number are not large (Gay *et al.*, 1972; Gunathilagaraj *et al.*, 1998, Atluri *et al.*, 2004; Venkata Ramana *et al.*, 2004; Venkata Ramana, 2010). In India life history studies of few butterflies like *Pericalia ricini* (Arctiidae) studied by Ghosh and Gonchaudhuri (1996) and *Colotis* butterflies by Larson (1988). Also some life history studies worked out in Papua New Guinea the World largest butterfly *Ornithoptera alexandrea* (Papilinoidae), Lycanids like *Philrris Helena*, *P.agatha, P. inlensa* and *P. zisk* etc., (Parsons 1984). Improving the population of larval hosts, rearing of the butterfly and releasing the same into the wild will help restocking their depleting populations, and also serve as a conservation measure of the species. This strategy requires complete knowledge of life history, larval performance in respect of food utilization and growth, and adult nectar resources, and other habitat conditions for its successful implementation. Hence the life cycle of the common gull butterfly *Cepora nerissa* has been reported in the paper.

MATERIALS AND METHODS

The common gull butterfly *Cepora nerissa* (Fabricious) of Pieridae lays eggs on the foliage of the bushy *Caparis spinosa* and forages on the floral nectar of the same plant. Leaves were plucked bearing the eggs, and brought to the laboratory and incubated. The hatching time and success rate, larval development and survival, pupal development and adult emergence were recorded. Observations were made throughout the flying season of *C. nerissa* activity. Larvae were fed with tender leaves daily, and studied instar wise performance in terms of growth rate (GR), consumption index, (CI), approximate digestibility (AD), efficiency of conversion of ingested food to body tissue, (ECI), and efficiency of conversion of digested food to the body tissue (ECD). These performance traits were computed using the formulae of Waldbauer (1968). Fresh weights were taken in all the computations. Each parameter was maintained in five replications. Karl Pearson's formula was applied to find out the correlation between food consumption and weight gain by larvae.

$$\text{CI (Consumption index)} = \frac{\text{Wt. of food consumed}}{\text{Wt. of instar x number of feeding days}}$$

$$\text{CI (Consumption index)} = \frac{\text{Wt. gain of instar}}{\text{Mean Wt. of instar x Number of feeding days}}$$

$$\text{AD (Approximate digestibility)} = \frac{\text{Wt. of food consumed - Wt. of faeces}}{\text{Wt. of food consumed}} \times 100$$

$$\text{ECD (Efficiency of conversion of digested food)} = \frac{\text{Wt. gain of instar}}{\text{Wt. of food consumed -- Wt. of faeces}} \times 100$$

$$\text{ECI (Efficiency of conversion of Ingested food)} = \frac{\text{Wt. gain of instar}}{\text{Wt. of food consumed}} \times 100$$

RESULTS AND DISCUSSION

Seasonal distribution

Month wise data on the frequency of eggs, larvae and pupae on the host plants indicated a distinct seasonality in the tropical distribution of *Cepora nerissa*. This season of distribution through the year with a higher frequency of the three life stages occurring during July- December correspond with the rainy season of this locality. This observation agrees with Wynter–Blyth's (1957) statement - that the distribution of butterflies at a locality mainly depends on the rainfall conditions of that locality and in south India the rainy season may vary from region to region and accordingly the exact period of *C. nerissa* distribution may vary from region to region. The period from July to December is the better time for *C. nerissa* reproduction is also attested by the higher development success of the different life cycle stages in the laboratory; eggs 80-90-%, larvae 75-94%, and pupae 83-94 % .

Life history and voltinism

Eggs

Courtship and mating occurred during daytime and pairing lasted for 2 – 3h. The breeding females laid eggs singly on the undersides and edges of the young leaves or more frequently on the spines of the host plant. In a single egg-laying bout, 4 – 10 eggs were laid each on different leaf or spine of *Caparis spinosa* (Capparadace). Oviposition took place mostly between 1100 – 1400 h of the day. The eggs were oval in shape, white in colour when oviposited, the colour turning to red on the second day. They were ridged and measured 0.90 – 1.30 (1.20 ± 1.30) mm in height and 0.40 - 0.60 (0.48 ± 0.07) mm in width at the broadest region. Hatching took place 3 days after incubation. The larvae passed through five distinct instars.

Larvae

Instar I: This stage lasted 2 – 3 days. The instar grew to a length of 2.80 – 3.30 (3.06 ±0.17) mm and a width of 0.2 – 0.4 (0.32 ± 0.07) mm. Its body was uniformly leafy green in colour and with minute hairs. Head was brown in colour.

Instar II: This stage lasted 2 – 3 days. The instar attained a length of 5.50 – 6.00 (0.70 ± 0.08) mm and a width of 0.06 – 0.80 (0.70 ± 0.08) mm. Head was 0.40 – 0.90 (0.68 ± 0.19) mm in length. It was greenish-brown in colour. Body became yellowish-green in colour.

Instar III: This stage lasted 2 – 3 days and the instar progressed to a length of 8.00 – 11.10 (9.50 ± 0.11) mm and a width of 1.00 – 1.30 (1.14 ± 0.12) mm. Body and head were light green in colour. Body became broad anteriorly and narrowed gradually towards the posterior end. Body segments were clear. Green coloured spots developed on the body, and black-coloured lines on each of lateral sides were also seen.

Instar IV: This stage lasted for 2- 3 days. The instar was 17.0 – 20.0 (18.20 ± 0.11) mm in length and 1.70 – 2.00 (1.40 ± 0.13) mm in width. Head increased in length to 1.50 – 2.00 (1.80 ± 0.18) mm. A black coloured line was present on each of the lateral sides of the body.

Instar V: This stage lasted 3 – 4 days. The instar grew to a length of 29.0 – 33.0 (31.20 ± 0.14) mm and a width of 3.20 – 3.50 (3.32 ± 0.11) mm. Head grew to 2.00 – 2.50 (2.26 ± 0.22) mm in size. It was little paler than the body. Body was turned green completely. There were minute cream coloured spots on both head and body; these spots later became yellowish-green in colour. There were minute, white hairs on entire body. Ventrally, the body was greenish-white and the legs were green in colour.

Pupa

The fully grown fifth instar prepared itself for pupation by stopping feeding and contracting its body. It then measured 20.0 – 25.0 (22.0 ± 0.16) mm in length. This process of shortening and thickening took place for a day. The pupal stage lasted 6 – 8 days. Pupa was green in colour with light green dots. Both ends were pointed, the anterior end being broader than the posterior end. On the dorsal side, there were two flat projections between thorax and abdomen each pointing outward on the sides. A short and curved projection was present in front of the head. Towards the posterior end there were five white spots present in the mid-dorsal line. Ventrally the pupa was light green in colour. The pupa measured 17.00 – 23.00 (20.30 ± 0.18) mm in length and 5.00 – 7.00 (6.30 ± 0.12) mm in width 4 Thus, the eggs had a 3-day life. The larval period extended for 11 – 16 days and, the prepupal and pupal period for 7 – 9 days. The development of the egg to emergence of adult from pupa thus required 21 - 28 days.

Food consumption and growth

The data gathered on the quantity of food consumed and weight gained by different instars is set out in Table 1. It was very difficult to collect the data for the first instar due to technical difficulties of handling the little larvae. Both these parameters showed a definite increasing trend as the larvae aged. The different instars differed in the quantity food consumed, the relative proportions in the total quantity food being 1.12, 2.25, 3.82, 26.57, and 67.36%. The proportions of weight gain showed a similar profile – 0.65, 0.85, 4.19, 28.97, and 65.99%. Thus, there was nearly 94% of the total food consumption enjoyed by the fourth and fifth instars with a similar increase in the weight gained in these instars. The weight gained by each instar was plotted against the quantity of food consumed by the respective instars (Fig. 1). The straight line drawn indicated a direct relationship between these two parameters. Growth rate and consumption index progressively decreased across the instars, the value of GR ranging from a high of 0.78 mg/day/mg to a low of 0.31 mg/day/mg and of CI from high of 10.08 mg/day/mg to a low of 1.77 mg/day/mg. In both cases, the highest value was associated with second instar and the lowest with fifth instar.

Table 1: Food consumption, growth and food utilization efficiencies of *Cepora nerissa* on *Caparis spinosa*

Instar No.	Wt. of food ingested (mg)	Wt. of faeces (mg)	Wt. gain by larva (mg)	GRmg/day	CImg/day	AD%	ECD%	ECI%
I	17.0 ± 0.21	0.5 ± 0.001	1.2 ± 0.08	0.78	10.80	97.0	7.45	7.20
II	24.25 ± 4.08	1.45 ± 0.08	1.70 ± 0.11	0.68	9.78	94.06	7.39	6.95
III	41.60 ± 6.23	5.30 ± 0.32	8.40 ± 1.01	0.63	3.12	87.25	23.14	20.19
IV	289.0 ± 20.54	48.05 ± 4.08	58.10 ± 2.21	0.47	2.36	83.37	24.11	20.10
V	732.60 ± 62.36	204.10 ± 13.36	132.35 ± 5.13	0.31	1.77	72.10	25.04	18.06

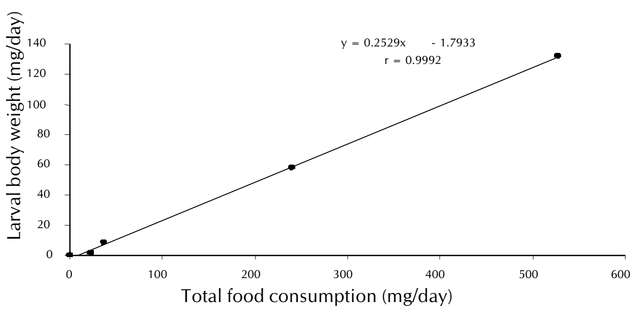

Figure 1: Relationship between food consumption and growth in *Cepora nerissa*

Indices of food utilization efficiencies

Table 1 also includes data on AD, ECD and ECI. While AD decreased progressively across the instars, ECD showed an increasing trend until the last instar. There was no definite trend with ECI. The values of AD varied from 72.1 – 97.0%, those of ECD from 7.45 – 25.04% and ECI from 7.20 – 18.06%. The life cycle passed through five instars over a period of 14-16 days after which the final instar undergoes pupation. Metamorphosis within the pupae takes place for 6-8 days after which the adult emerges. The total period taken for egg to emergence of adult is thus about 21-28 days. Higher frequency observed during July – December which period falls with in the rainy period. The behavior agrees with Owen (1971) who predicted that tropical butterflies breed throughout the year but with certain times of the year better for breeding than others. Most butterflies survive for 3-6 days (Opler and Krizek, 1984). Then at least 12-13 broods of *Cepora nerissa* are estimated to occur in a year.

The amount of food consumed increased from instar to instar with the exception of III instar, and the V instar consumed a greater amount (94 %). This tendency of greater consumption by the penultimate and/or ultimate instars has been reported for Lepidopterous larvae in general (Mathavan and Pandian, 1975; Selvansundaram, 1992; Venkata Ramana *et al.,* 2001; Venkta Ramana, 2010) and ilts facilitates accumulation of sufficient energy to tide over the non-feeding pupal stage (Pandian, 1973) Regression line of weight gained by larvae against the food consumed per day (Fig. 1) showed a straight line relationship between these two variables with r value (r= 0.99) greater than table value t= 0.78 at 1% level). The Approximate digestibility (AD) values decreased from first instar to last instar, the highest value being associated with first instar, and then the food intake of this larva is low and the lowest value is with the final instar when the food intake of this instar is high. The AD values of *C. nerissa* varied from 97.0 to 72.1. Higher ADs are expected when the food item is rich in nitrogen (and water) (Pandian and Marian, 1986).

The values of ECD tend to increase from early to late instars (Slansky and Scriber, 1985). The ECD values of *C. nerissa* increased from early to penultimate instars (7.45 to 25.04) but showed sharp decrease in the ultimate instars and the values generally agree with the range of values reported for another pierid butterfly *Catopsilia pyranthe* (Atluri *et al*., 2004) and *Graphium doson* of Papilionidae (Venkata Ramana *et al.,* 2002). ECI percentages may vary from 2-31 in tree foliage chewing Lepidopteron insects (Slansky and Scriber, 1985). The ECI values of *C. Nerissa* ranged from 7.20 to 18.06; the penultimate instar has the highest value. The pattern of variation in ECI was comparable with an increasing trend with the age of larvae up to IV instar and then a decline, in the V instar.

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