AUTECOLOGY OF THE RED PIERROT BUTTERFLY *TALICADA NYSEUS* (LEPIDOPTERA: RHOPALOCERA: LYCAENIDAE) FROM THE LANKAMALA FOREST - ANDHRA PRADESH

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ABSTRACT *The Red pierrot is seasonal in its occurrence at Sri Lankamalleswara forest, Kadapa (14°45' to 15°12' N and 78°48' to 79°6' E)throughout the year. The succulent rockery plants Kalanchoepinnata (Lamk.) and K. laciniata (Linn.) are mostly the oviposition plants. Breeding was continuous Eggs are laid single; hatching period was 3-4 days after incubation. Larval period spans over 13-18 days. Pupal duration lasts 7-9 days. Changes from egg to adult formation are complete in 24-33 days.Egg hatching success rate high during February – April, larvae to pupae development rate high during March to May. Pupa to adult development rate is high in January – February. Nutritional indices CI, GR and AD decreased as the larvae aged, while those of ECD and ECI increased. The adults forage on nectar and in the process pollen is received on proboscis and transformed stigma which is a trait of psychophily.*

Keywords: *Talicadanyseus, Lankamala forest, Kalanchoepinnata, life cycle.*

Summary:
The population of this red pierrat butterfly was on the decline due to the rapid and continued destruction of natural areas particularly the scrub forests which form the natural habitat of this species. Hence as part of the conservation efforts, its population may be improved by undertaking captive breeding and releasing the adults in the wild. The necessary protocols for such efforts are provided by the present research study. It was suggested that the concept of flora and fauna may be applied while developing the parks and gardens in the urban environments for aesthetic benefits provided by the butterflies. Also, there was an urgent need to explore the migratory corridors of *T. nyseus* and identify the flowering waves along the corridors and determine the dependency on such flowering waves andvice – versa.

Introduction:
Insects by virtue of their large numbers from the major component of the world's biodiversity and they are the vital determinants of terrestrial ecological processes. Both qualitatively and quantitatively insects are important pointers for species rich geographical areas. However, conservation circles have given too little attention to the ecological significance of insects. (New et al., 1995)The subject of entomological discussion has recently gained a lot of significance as many of the insects are endangered and threatened in the ecosystem. It is a known fact that land management practices adversely about the insect population and their diversity. Now all the wildlife biologists, forestry and land managers can play a crucial role in reserving the adverse impacts of land management activities on imperilled insect population.
India credited for its richness in butterfly fauna is also witnessing the declines in butterfly populations, and small populations are more likely to become extinct (Wright, 1983). To improve the existing low population and to restock the species in the area of their total disappearance, butterfly farming is often suggested (Varshney, 1986). For the successful execution of such programs, a complete knowledge of the life history and requirements of butterflies in the wild is urgently required. Relevant knowledge is largely inadequate in India. We report here the related information for the red pierrat butterfly *Talicadanyseus*(Guerin) of Lycaenidaebased on a laboratory and field study.
This is a conspicuous polytypic butterfly endemic to the Oriental area (D'Abrera, 1986). This butterfly species is known so far through three sub-species: *T nyseusnyseus*, *T. n. khasiana*and *T. n. burmana*. It is alsorecognized in different parts of India & Sri Lanka (Karunaratne et al. 2002). It is usually found about semi-arid plains, degraded patches of evergreen forests and semi-evergreen forest, hill stations, gardens and forests. It is plentifully found near its nutrition plant *Kalanchoe* spp. The larvae of this species are known to feed on the mesophyll tissues of the leaves of its host plant *Kalanchoe* spp. without disturbing the upper and lower epidermis. An adult butterfly commonly feeds on nectar but is also known to feed on lichens (Karunaratne et al. 2002).

Material & Methods:

During the study on the diversity and reproduction of butterflies at Sri Lankamalleswara forest, Kadapa (14°45' to 15°12' N and 78°48' to 79°6' E) (Fig.01), the red pierrat butterfly *Talicadanuseus*(Guerin) was observed to lay eggs in singly on the succulent rockery plants *Kalanchoepinnata* (Lamk.) and *K. laciniata* (Linn.) (Capparaceae) inLankamala forest region. The leaves of oviposition host plants with the single egg were brought in petridishes (9 cm diameter) and incubated at the laboratory temperature (28 ± 2°C). The larvae fed with tender leaves of *K. pinnata.* Regular observations were made to study incubation period and hatching success, larval development and survival, pupal development and adult emergence. The length of each life stage (egg, larva, pupae) and the associated characters were recorded throughout the season of the adult activity. Based on the casting of skin, the number of instars was delineated. Growth and food utilization of each instar wereevaluated in terms of nutritional indices: GR (growth rate), CI (consumption index), AD (appropriate digestib*i*lity), and Efficiencieslike ECI (efficiency of conservation of ingested food body tissue)and ECD (efficiency of conversion of digested food of body tissue). The formulae of Waldbauer (1968) were used for estimating these indices using fresh weights. For each parameter, five replications were maintained in obtaining the basic data. In order to assess the population levels of eggs, larvae and pupae in each month, 10 *K.pinnata*plants frequently used by T. *nyseus*for oviposition were spotted, and observed once in every month to enumerate the said life stages.

Study Area:

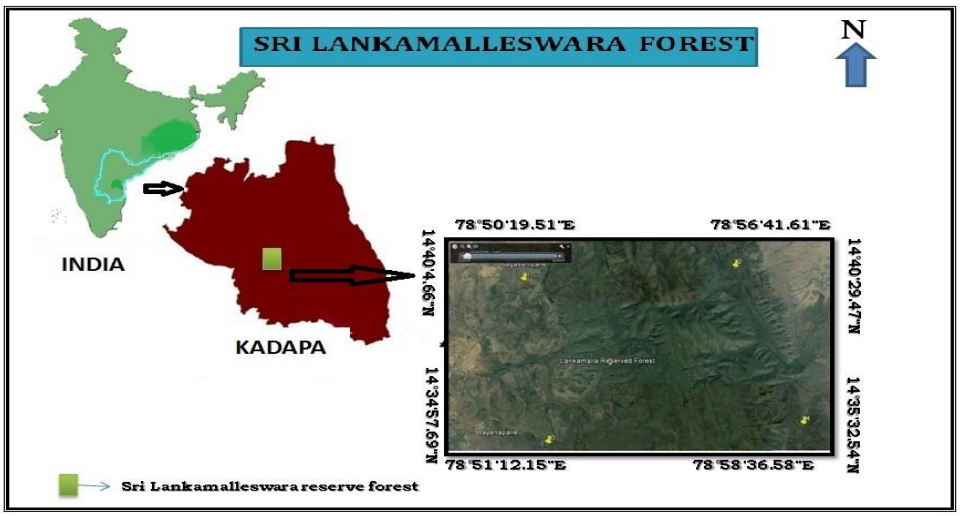

Fig. 01: Study Map - Sri Lankamalleswara Forest

Results and Discussion:

ADULT STAGE:

FIELD CHARACTERS:

Wingspan of adults varies between 30-37 mm. male and female individuals are morphologically identical. Body was dorsally black and ventrally white.

Dorsally forewings are completely black with small rectangular marks at the edges of the termen. Lower two-third portion of the hind wingwas orange in colour with very thin, black tail and the remaining upper part black in colour. Thin black line with small rectangular shaped marks was present on the edge of the termen.

Ventrally, half of the anterior side of the forewings are white with black spots and the posterior half black with white spots. About two- thirds of the anterior part of hind wingwas white with a row of white spots. In both the wings, the edges of the termen of both wings type have a thin black line with small white rectangular shaped marks.

HABIT:

It was found flying close to the ground in the shade, settling near its larval host plants, it was a weak flier. At rest, it moved its wings up and down.

FOOD RESOURCES:

It was found to forage on nectar at the flowers of *Cosmos sulphurous* Cav., *Croton bonplandianum*Baill.,*Gomphrenaglobosa* Linn., and *Tridoxprocumbens* Linn.

OVIPOSITION HOST PLANTS:

The studied host plants of this butterfly belong to the family Crassulaceae. In the study area, the succulent rockery plants *Kalanchoepinnata* (Lamk.) Pers., and *K. laciniata* (Linn.) Pers. Being grown in garden were the plants used for ovipositing. *Kalanchoepinnata* (Fig.02) was used in the study of life history and food consumption and utilization.

EGG STAGE:

Mating and egg laying mostly around 0830 – 1500 h. Mating lasted for an hour. The female lays eggs singly on the underside of the both young and matured leaves, also on stem, leaf petiole and floral parts. In a single egg – laying bout, 3-20 eggs were laid. The eggs were dorsoventrally flattened, circular or disk shaped pale copper blue in colour when oviposited: the colour turned to white before hatching. They measured 0.50 – 0.80 (0.60 ± 0.12) mm in diameter. Hatching took place in 3-4 days after incubation. The larva did not feed on its eggshell after hatching. It passed through five distinct instars in a span of 13-18 days.

LARVAL STAGE:

Instar – I: Stage continued 2-3 days andgrew to a length of 1.7 – 2.0 mm (1.8 ± 0.12 mm) & a width of 0.4 – 0.5 mm (0.43±0.04 mm). Its body was light green in colour. Its head was very small in size.

Instar – II: This instar develops up to 2-3 days. The instars reached a length of 2.50 – 2.70 mm (2.56 ± 0.09 mm) &a width of 0.6 - 0.8 mm (0.68 ± 0.08 mm). White hair appeared on the body. There were no changes in other characters from the previous instar.

Instars – III: This stage also lasted 2-3 daysand the instar progressed to a length of 3.5 – 4.0 mm (3.73 ± 0.20 mm)&a width of 0.80 -1.0 mm (0.86 ± 0.09 mm). There were no changes in other characters from the previous instar.

Instar – IV: This stage lasted 3-4 days. The instar was 7.0 – 10.0 mm (8.30 ± 0.12 mm)in length and 2.5 – 3.0 (2.73 ± 0.20) mm in width. Head became visible and measured 0.5 mm in diameter. Segmentation was clear. There were 8 pairs of black dots present on both lateral sides of the body on each segment except on the last segment. Body was hairy and turned to pale olive yellow in colour. The larvae were flattened posteriorly.

Instar – V: This stage lasted 4-5 days. Theinstar grew to a length of 15.0 – 20.0 mm (17.8 ± 0.20 mm) & a width of 4.8 – 6.0 mm (5.26 ± 0.52 mm). Head grew to 1.0 – 1.5 (1.24 ± 0.20) mm in diameter. Body was dorsoventrally flattened and turned to pinkish cream in colour. Mid dorsally there was pinkish line present longitudinal to the body. There were minute, white hairs on entire body. On the anterior segment there were 4 black dots present in a row. There were no changes in their characters from the previous instar.

Pupal stage:

Pre-pupa: The full grown fifth instar came out of the mined leaf, stopped feeding and contracted its body slowly. The dorsal became bulging. During this process, the black dots on the body disappeared. It then measured 10.0 – 11.8 mm (14.3 ± 0.32 mm) in length and 3.0 – 5.0 mm (4.3 ± 0.94 mm) in width. Its colour was creamish yellow. It was covered with hairs. Segmentation was still evident.

PUPA:

The Pupal stage lasted 7-9 days. Segmentation disappeared. Black spots reappeared. Black spots reappeared. The hair persisted on the pupa except on wing case. Pupal colour was pinkish cream. Mod-dorsal pink line was evident. This line and also lateral ends had black spots dorsally. The pupa measured 12. – 14.0 (13.0 ± 0.08) mm in length and 5.0 -6.0 (5.66 ± 0.47) mm in width. Ventral side was soft with no hairs and pale yellow in colour. It got attached to the substratum at some places from the ventral side by body – band. Before emergence of the adult, the narrow end of pupa became black. It weighed 185.2 mg.

DURATION OF LIFE CYCLE:

The time for the growth of egg to the formation of adult spanned over 24-33 days (egg 3-4; larva 13-18; and pupa 8-11) (Fig. 03)

Fig. 03 Life cycle stages of *Talikadanyseus*

DEVELOPMENT SUCCESS OF EGGS, LARVA AND PUPAE:

The eggs could be spotted from middle of January to early May. The hatching success rate of eggs varied from 60-91 % , it being high during February – April, the development success of the larvae to pupae varied from 67-100%, it being high during March – May, and of pupae to adult from 50-100%, it being high during January – February (Table: 01 and Fig. 03)

Table 01: Development success of eggs, larvae and pupae of *Talicadanyseus* on *Kalanchoepinnata* leaves in the laboratory during Sep. 2017 to Aug. 2018

Life cycle stage	Calendar Month											
	S	O	N	D	J	F	M	A	M	J	J	A
No. of eggs incubated	0	0	0	0	7	13	24	29	5	0	0	0
No. of larva hatched	0	0	0	0	5	11	22	26	4	0	0	0
No. of pupae formed	0	0	0	0	4	9	21	24	3	0	0	0
No. of adults emerged	0	0	0	0	2	8	19	21	2	0	0	0

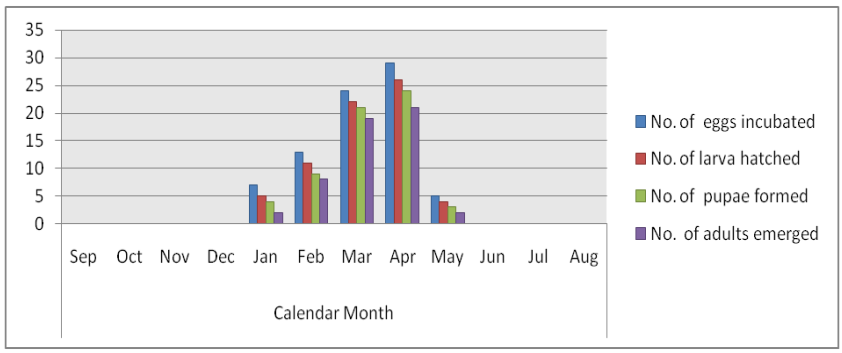

Fig. 03; Development success of eggs, larvae and pupae of *Talicadanyseus* on *Kalanchoepinnata* leaves in the laboratory during Sep. 2017 to Aug. 2018.

PUPATION INDEX:

Eggs, larvae and pupae distributed and enumerated on thirty host plants (*Kalanchoepinnata*) and adult abundance were given in table 02 and figure 04. The four life stages were evident in natural conditions during mid - January early May. However, there was a greater density of these four life stages during February – April.

Table 02: Population index of different life stages of *Talicadanyseus* on *Kalanchoepinnata*leaves in the field during Sep. 2017 to Aug. 2018

Life cycle stage	Calendar Month											
	S	O	N	D	J	F	M	A	M	J	J	A
eggs	0	0	0	0	8	20	29	36	5	8	0	0
larva	0	0	0	0	12	17	22	54	4	11	0	0
pupae	0	0	0	0	8	16	14	23	3	7	0	0
Adults abundance	A	A	A	A	R	C	C	C	R	R	A	A

Note: A: Abundance, C: Common, R: Rare

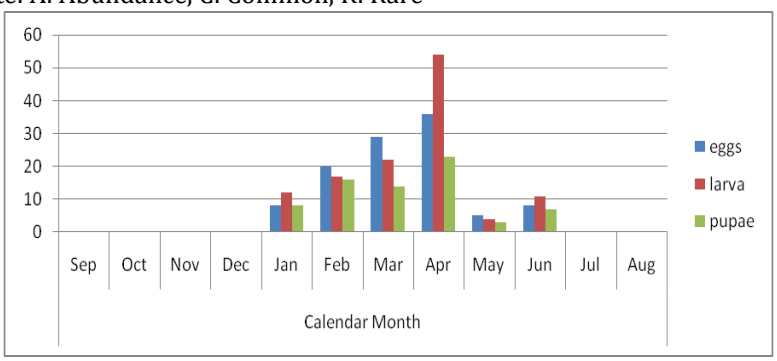

Fig. 05: Population index of different life stages of *Talicadanyseus* on *Kalanchoepinnata*leaves in the field during Sep. 2017 to Aug. 2018

FOOD CONSUMPTION AND GROWTH:

The newly hatched out larvae mined into the thick fleshy leaves *Kalanchoe*plant on which the eggs were laid, and started feeding on the Parenchymatous tissue. It moved inside the leaf by tunnelling the fleshy leaves without feeding the thin layers of upper and lower epidermis for protecting leaf itself. The larvae came out of the leaf only for pupation or to enter into another leaf when the feeding leaf was completed.

The data collected on the amount of food consumed & weight added by different instars was shown in Table 03.Both parameters revealed a definite growing trend as the larvae aged. The dissimilar instars varied in the amountof food consumed, the comparative proportions in the total quantity food consumed, the relative proportions in the total quantity food consumed& the relative proportions in the total quantity food being 1.03, 3.46, 18.28 and 77.21% from II to IV Instars. The proportions of weight gain showed a similar profile – 0.44, 2.11, 16.31, and 81.21 %. Thus there was approximately 95% of the total food ingesting enjoyed by the IV and V instars with a similar growth in the weight gained in these instars. The weight increased by instars was plotted against the quantity of food consumed by the respective instars (Fig. 03). The straight line drawn indicated a direct relationship between these two parameters. Growth rate and consumption index progressively decreased across the instars, but GR showed a slight increase from II to III instar. The values of Growth Rate varied between 0.37 – 0.69 mg/day/mg and those of Consumption Index between 4.36 – 19.60 mg/day/mg. (Pandian and Marian, 1986).

FOOD UTILIZATION INDICES:

Table 03 presents data on AD, ECD & ECI. While AD reduced progressively across the instars, ECD & ECI showeda growing trend until the final instar also recorded in *pericalliaricani* (Ghosh and Gonchaudhuri 1996) The values of AD varied from 62.4 – 98.6% those of ECD from 4.70 – 17.26 % and ECI from 4.30 – 8.94% agrees with Slanskly&Scriber 1985.

Table 03: food consumption, growth and food utilization efficiencies of *Talicadanyseus* larva fed with *kalanchoepinnata* leaves.

Instar no	Wt. of food ingested (mg)	Wt. of faeces (mg)	Wt. gained by larva (mg)	GR (mg/day /mg)	CI (mg/day /mg)	AD (%)	ECD (%)	ECI (%)
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II	32.14± 006.07	2.47± 000.39	0.94 ± 0.06	0.65	19.60	98.6	04.70	4.30
III	104.33±032.14	10.37±007.8	4.36 ± 0.37	0.69	15.83	87.8	08.55	6.25
IV	539.34±092.13	148.67±084.14	38.86 ± 0.68	0.48	07.37	71.2	13.00	7.36
V	2143.42±154.83	1042.67±393.33	172.40± 2.59	0.37	04.36	62.4	17.26	8.94

Note: --- Indicate no data due to small size of first instar.

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