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Research Article

Life Cycle of *Cethosia hypsea* Doubleday (Lepidoptera: Nymphalidae) Reared on *Adenia macrophylla* Blume (Passifloraceae)

¹Dahelmi, ¹Evy Sriganti and ²Suwarno

¹Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, 25163 Padang, Indonesia

²Department of Biology, Faculty of Mathematics and Natural Sciences, Syiah Kuala University, 23111 Banda Aceh, Indonesia

Abstract

Background and Objective: Larvae of the genus *Cethosia* is known associate with plants of the family Passifloraceae. The aim of this study was to obtain preliminary data on the life cycle of *Cethosia hypsea* that reared on *Adenia macrophylla*. **Methodology:** The immature stages (egg, larvae and pupae) were reared in the laboratory condition at temperature ranging between 26-30°C and relative humidity of 65-75%. **Results:** The incubation period of egg was 6-7 days. There are five instars stage of larva, the duration of instar 1st, 2nd, 3rd, 4th and 5th are 3, 3, 3, 3 and 4 days, respectively. Total larval phase is about 16 days, pupae formed after 1 day of the pre pupa period. Pupa period is about 7 days. **Conclusion:** The larvae of *C. hypsea* passed through five instars. The total development time from egg to adult eclosion ranged between 30-31 days. The life cycle duration of *C. hypsea* was about 34-35 days. This is the first study describing life cycle of *Chetosia* in Indonesia and this species capable of producing multiple generations per year.

Key words: *Cethosia hypsea*, life cycle, *Adenia macrophylla*, egg stage, butterflies

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Corresponding Author: Dahelmi, Department of Biology, Faculty of Mathematics and Natural Sciences, Andalas University, 25163 Padang, Indonesia

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Butterflies of the genus *Cethosia* can be found in nearly all tropical habitats and lowland rain forest. This genus was distributed throughout the Indo-Australian region, from Sri Lanka to China, Lesser Sunda islands, Sulawesi region, Maluku, New Guinea region and Northern Australia¹. One of species that found in Sumatra is *Cethosia hypsea*. This species was distributed in nine National Parks of Sumatra, Ujung Kulon National Park² and Krakatau islands³. In Singapore and the Malay Peninsula, it is found from low mountains 700 m a.s.l. In Thailand it is also found from 200-500 m a.s.l.⁴.

Larvae of the *Cethosia hypsea* is known to associate with plants from the family of Passifloraceae. At Air Tapah on the Western coast of Malay Peninsula and Chiang Mai in Northern Thailand, this species was observed feeding on *Adenia cordifolia* (Passifloraceae). In Borneo, larvae feeding on *A. macrophylla* were observed⁴. In West Sumatra, larvae of *Cethosia hypsea* are found in plants *Adenia macrophylla* (Passifloraceae), local people call the plant as siriah-siriah. In the last study, Dahelmi *et al.*⁵ studied on duration of immature stage of eleven swallowtail butterflies (Papilionidae) in West Sumatra. Muller and Beheregaray⁶ explore the biogeographic history of the Indo-Pacific butterfly genus *Cethosia* using all known species and many distinctive subspecies. Observations on early stages and the life cycle of *Cethosia hypsea* that reared on *Adenia macrophylla* have not been done in Indonesia. The immature stages of butterflies are increasing importance as sources of systematic characters and often give important clues as to the placement of species in major groups⁷. This study was intended to obtain preliminary data on the life cycle of *Cethosia hypsea* that feed on *Adenia macrophylla*. This study is expected to provide basic information on life history of *Cethosia hypsea* reared in the laboratory condition. The present data may be profitably utilized in the conservation management of this butterfly species either in parks and butterfly houses or in the field.

MATERIALS AND METHODS

The eggs were collected in the field around Lembah Harau Nature Reserve, West Sumatra where females laid their egg on *Adenia macrophylla* (Fig. 1j) and brought to the laboratory where they were reared in plastic container with host plants leaves. They were observed to daily between 8-11 am. After eggs hatched, the larvae were reared in plastic container measuring 20×14×9 cm (for 1st, 2nd and 3rd instars), 26.5×19×9 cm (for 4th and 5th instars). Containers were cleaned daily and were provided with fresh plant material every 2 days.

Morphology of larvae was observed in 10 larvae. Observation was conducted from March-June, 2015 at Animal Taxonomy Laboratory, Department of Biology of Andalas University. Larvae were observed daily from the hatching of larvae to the emergence of adults. The container were also examined at this time for the presence of head capsule to determine the duration of each instar. Data were taken on development times for all stages and the head capsules and pupal exuviae were preserved. During the observation of immature stage of butterfly, the room temperature range from 26 and 30°C, respectively, with relative humidity ranging from 65 and 75%.

RESULTS

Egg stage: Eggs laid are laid a moderately large cluster on under of a young leaf or even a tendril. The newly eggs were bright yellow until 3rd day, after 4th day eggs become brownish yellow with a ribbed surface. Egg height is 1.38 ± 0.04 mm. The incubation period was 6-7 (6.4 ± 0.55) days (Table 1, Fig. 1a).

Larval stage

First instar: The 1st instar larva lasted for 3 (3.0 ± 0.0) days, head capsule width is 0.88 ± 0.04 mm and body length is 4.56 ± 1.06 mm (Table 1). The earlier stages live gregariously. The first instar larva is pale brown with a black head capsule. Cylindrical shaped larvae with 6 dark brown smooth setae on each abdominal segment. After a day, the color of the 6th abdominal segment of larvae change become paler than others that overall reddish-brown (Fig. 1b).

Second instars: The 2nd instar larva attained a length of 8.3-12.5 (10.53 ± 2.10) mm, head capsule width is 1.48 ± 0.06 mm and body length is 10.53 ± 2.10 mm (Table 1). The larva is pale brown with a black head capsule (Fig. 1c). Cylindrical shaped larvae with 6 dark brown smooth setae on

Table 1: Duration, body length and head capsule wide of *Cethosia hypsea* immature stages

Stages	Duration (days) (Mean±SD)	Body length (mm) (Mean±SD)	Head capsule (mm) (Mean±SD)
Incubation	6.2±0.5	NA	NA
1st instar	3.0±0.0	4.56±1.06	0.88±0.04
2nd instar	3.0±0.0	10.53±2.10	1.48±0.06
3rd instar	3.0±0.0	17.03±1.66	2.12±0.09
4th instar	3.0±0.0	25.64±3.84	3.08±0.15
5th instar	4.0±0.0	34.85±2.82	3.83±0.12
Pre pupa	1.0±0.0	NA	NA
Pupa	7.0±0.0	33.71±0.32	NA

NA: Not available

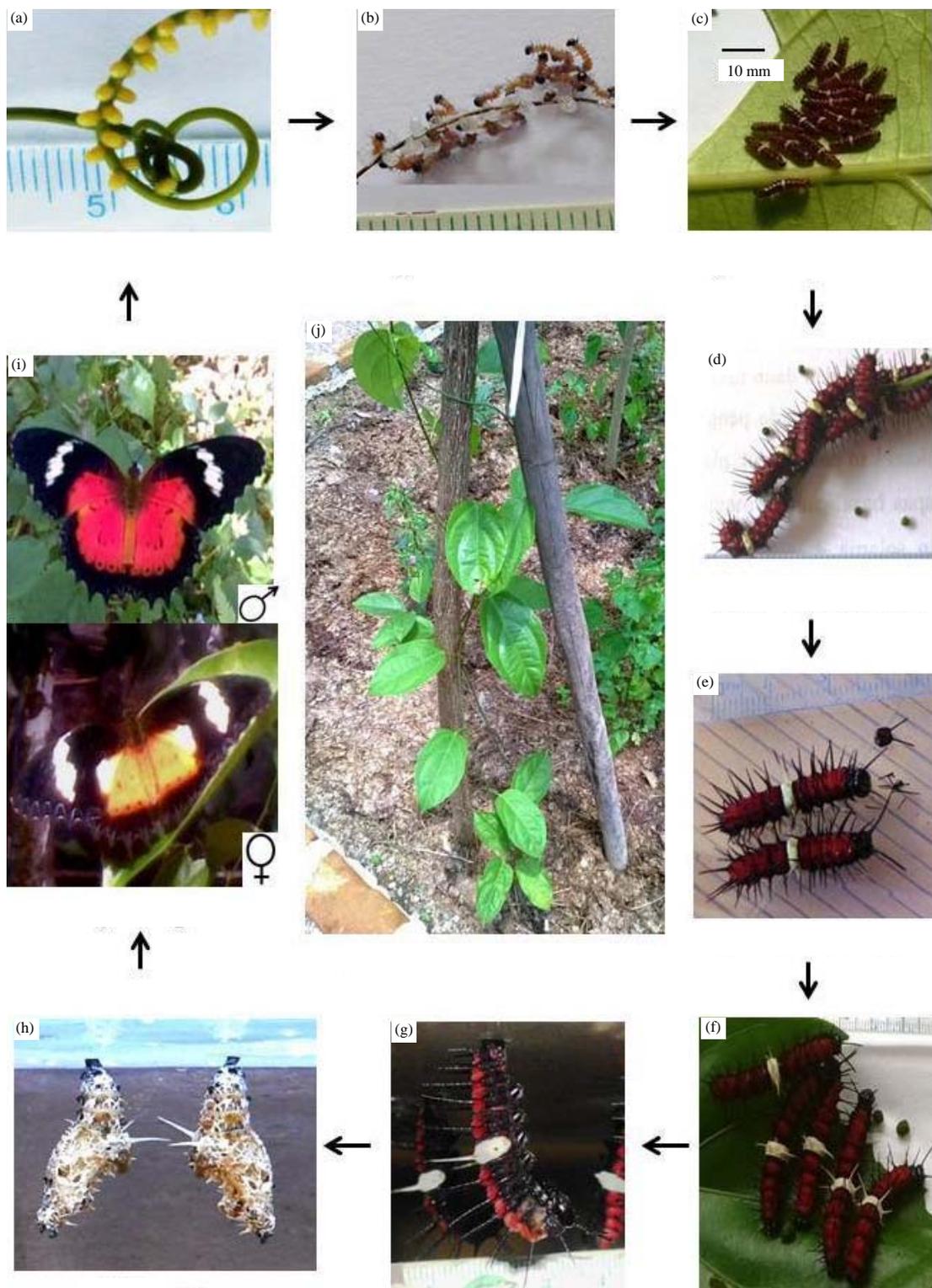


Fig. 1(a-j): Life cycle of *Cethosia hypsea* on the host plant *Adenia macrophylla*, (a) Egg, (b) 1st instar larva, (c) 2nd instar larva, (d) 3rd instar larva, (e) 4th instar larva, (f) 5th instar larva, (g) Pre-pupae, (h) Pupae, (i) Imago and (j) *Adenia macrophylla*

each abdominal segment. After a day, the color of the 6th abdominal become paler than others that overall reddish-brown. A pair of short and black coronal spine appears on the head. The white saddle is prominently marked. The 2nd instar larva lasted for 3 days (Table 1).

Third instars: The 3rd instar larva lasted for 3 (3.0 ± 0.0) days, head capsule width is 2.12 ± 0.09 mm, body length is 8.3-18.4 (17.03 ± 1.66) mm (Table 1). The color of the larvae was dominated by dark red color (Fig. 1d).

Fourth instars: The 4th instar larva lasted for 3 (3.0 ± 0.0) days, head capsule width is 3.08 ± 0.15 mm and body length is 25.64 ± 3.84 mm (Table 1). The coronal spines are longer proportionately with the length of each spine about equal to the 1.5x height of the head capsule. Abdominal 6th segments become to bright white, except at the end of seta is dark red dot (Fig. 1e).

Fifth instars: The 5th instar larva lasted for 4 (4.0 ± 0.0) days, head capsule width is 3.83 ± 0.12 and body length is 34.85 ± 2.82 mm (Table 1). The caterpillar retains the same body feature as in the 4th instar. The larva reduced feeding activity and will stop feeding before entering the pre-pupa. The larva moves around in search of a pupation site (Fig. 1f).

Pre pupa and Pupal stage: Pre pupa lasted one day and pupal stage lasted for 6-7 (7.88 ± 0.98) days. The newly formed pupae light brown, wet and will dry completely after 3-4 days. Pupa length range between 33.26-34.18 (33.71 ± 0.32) mm (Table 1). A pair of black foliaceous adorn the head. Body color of pupa is pale brown with random white and black patches on the dorsal. Seta on 6th segment of abdominal are remain on the pupa, the pupa size enlarges in this section (Fig. 1g, h).

Imago: Male wing span is 76.77 ± 2.79 mm and female is 80.38 ± 1.93 mm (Table 2). Females and males can be distinguished from the wing color pattern of the dorsal direction. The dorsally side of male have a black base color pattern with white patches and bright orange, while females have a black base color pattern, white and red patches (Fig. 1i). From the ventral direction both male and female have the same color pattern with a combination of bright brown color, white, red-orange and black spots. In the ventral part also V shape pattern on the edge of the wing looks very clear with the pattern of black and white scales. Beside the color pattern, males and females can be distinguished from the wingspan, males are smaller than females. The new butterfly started flying 4 h after emergence. Mating occurs 3 days after

Table 2: Size of wing span and abdomen length of adult *Cethosia hypsea*

Gender	Wing span (mm) (Mean \pm SD)	Abdomen length (mm) (Mean \pm SD)
Male	76.77 ± 2.79	23.46 ± 0.54
Female	80.38 ± 1.93	24.66 ± 0.69

emergence. Two days after mating, females start laying eggs. Therefore, the life cycle duration of *C. hypsea* is about 34-35 days.

DISCUSSION

Total development time from egg to adult eclosion ranged between 30-31 days. The incubation period of egg was about 6-7 days. The larvae passed through five instars in 16 days. The pre pupa and pupal period lasted for 8 days. In general, some larvae of Nymphalid butterflies passed through five instars, such as *Phycoides phaor*⁸, *Junonia almana*⁹ and *Euthalia acanthea*¹⁰. Kunte¹¹ stated that development inside the egg of *Cethosia nietneri* (Tamil Lacewing) is slow and caterpillar hatches only after a minimum of 6 days. The pupal stage lasts slightly over a week. The caterpillar feed on a big climber *Adenia hondala* and also reported to feed on cultivated passion flower: *Passiflora edulis* and *P. sulphurata*.

Hall¹² briefly describes the life history of *Cethosia penthesilea* paksha Fruhstorfer including the first report of an Australian food plant. This larvae of this species feed on *Adenia heterophylla australis* (Passifloraceae). The larvae were gregarious, feeding, moulting and pupating together.

The present study provides information on the early stages and life cycle from egg to adult eclosion of *C. hypsea* (Malay Lacewing butterfly). Detailed descriptions of immatures are of great value in allowing identification of early stages in the field, as well as in providing adequate information to extract characters for taxonomic and phylogenetic studies¹³. This study renders ample of knowledge on the duration of the life cycle stages from egg to adult. It is a small step in the conservation of butterflies.

CONCLUSION

The larvae of *C. hypsea* passed through five instars. The total development time from egg to adult eclosion ranged between 30-31 days. The life cycle duration of *C. hypsea* was around 34-35 days. This species capable of producing multiple generations per year.

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