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Biology and life cycle of *Euploea netscheri* Snellen, 1889 (Lepidoptera: Danainae) on Hoya host plants (Apocynaceae)

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ABSTRACT

Biological observations and life cycle studies of *Euploea netscheri* Snellen, 1899 on *Hoya* species were conducted at Yadikap Garden, Arso 2, Keerom, Papua, Indonesia, from June to August 2024. Eggs laid by female butterflies on *Hoya* leaves were observed to record hatching time and the duration of the egg stage. Additionally, the total number of larval instars, the duration of each instar, and the duration of the pupal stage until emergence of the imago were documented. Measurements of the length of eggs, larvae, pupae, and adult butterflies were carried out using a caliper. The behavior and morphological characteristics of each larval instar, as well as those of the pupae and adults, were observed and recorded. Female *E. netscheri* butterflies were found to lay eggs on the leaves of *Hoya globulifera* and *H. pachiphylla*. The species completed its life cycle in approximately 22–25 days, consisting of an egg stage of about 3 days, a larval stage of 12–14 days, a pre-pupal stage of 1 day, and a pupal stage lasting 6–7 days. The results of this study provide the first record of the distribution, biology, and life cycle of *E. netscheri* in Keerom, Papua. New information is also presented regarding its larval host plants, namely *H. globulifera* and *H. pachiphylla*.

Key words: Arso; Danainae; *Euploea*; Keerom; life cycle.

INTRODUCTION

Butterflies belong to the Order Lepidoptera, Suborder Rhopalocera, and Superfamily Papilionoidea. The superfamily Papilionoidea is a large clade within Lepidoptera that comprises about 19,000 species. This superfamily includes butterflies in the families Papilionidae, Pieridae, Nymphalidae, Lycaenidae, Riodinidae, and Hedylidae (Liu *et al.,* 2022). Papua has a very rich butterfly diversity, with about 819 species based on data from the insect collection of Br. Henk Van Mastrigt. Papua contributes 50% of Indonesia's total butterfly species richness, with around 2,000 species distributed across the country (Hengkengbala *et al*., 2020). The island of New Guinea, consisting of Indonesian Papua and Papua New Guinea, has approximately 1,000 butterfly species (Parsons, 1999).

The study of organisms based on morphology, habits, and habitat is very important, and even more important is their life cycle (Patil & Gaikwad, 2024). Biological and life cycle data are part of life history data that can be used to predi*ct species vul*nerability to extinction and have become an important focus in conservation biology. Life history data help conservation practitioners identify which species are more vulnerable to extinction.

Butterflies are excellent indicators of environmental change because of their high sensitivity to climatic conditions, habitat

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modification, and ecosystem disturbance. Through their complex life cycles, specific habitat requirements, and rapid generation turnover, butterfly populations respond quickly to environmental disturbances, making them valuable early warning systems for ecosystem degradation and the impacts of climate change (Yuki, 2025).

When ecosystems face disturbances in community dynamics and habitat loss, the idea of determining in advance which species may become extinct is an important subject in conservation biology. A species' vulnerability to extinction depends on intrinsic factors (life history and genetics) and extrinsic factors (environmental conditions and anthropogenic threats) (Ya'nez *et al*., 2022).

This study aimed to identify the larval host plants of *Euploea netscheri* Snellen, 1889 (Lepidoptera: Danainae). In addition, it aimed to determine the life cycle and morphological characteristics of each stage of metamorphosis, namely the egg, larva (several instars), chrysalis (pupa), and adult (imago) of *E. netscheri.* Butterfly diversity in Papua has been largely revealed by previous studies, but research on butterfly biology (life history), life cycles, and host plants is still very limited. Data on host plants and biology (life history) are highly useful for butterfly conservation and are also needed as supporting data for evolutionary and classification studies.

MATERIALS AND METHODS

Research period and location

The study of the biology, life cycle (metamorphosis), and host plants of *E. netscheri* was conducted at the Yayasan Pendidikan Alam Garden (Yadikap) in Yuwanain Village, Arso District, Keerom Regency, Papua. The study was carried out for three months, from June to August 2024.

Data collection method

The method used to study the host plants of Euploea netsche*ri* was the all-out search method (AOSM). Host plants are plants used by female butterflies to lay their eggs and serve as food sources for butterfly caterpillars (larvae).

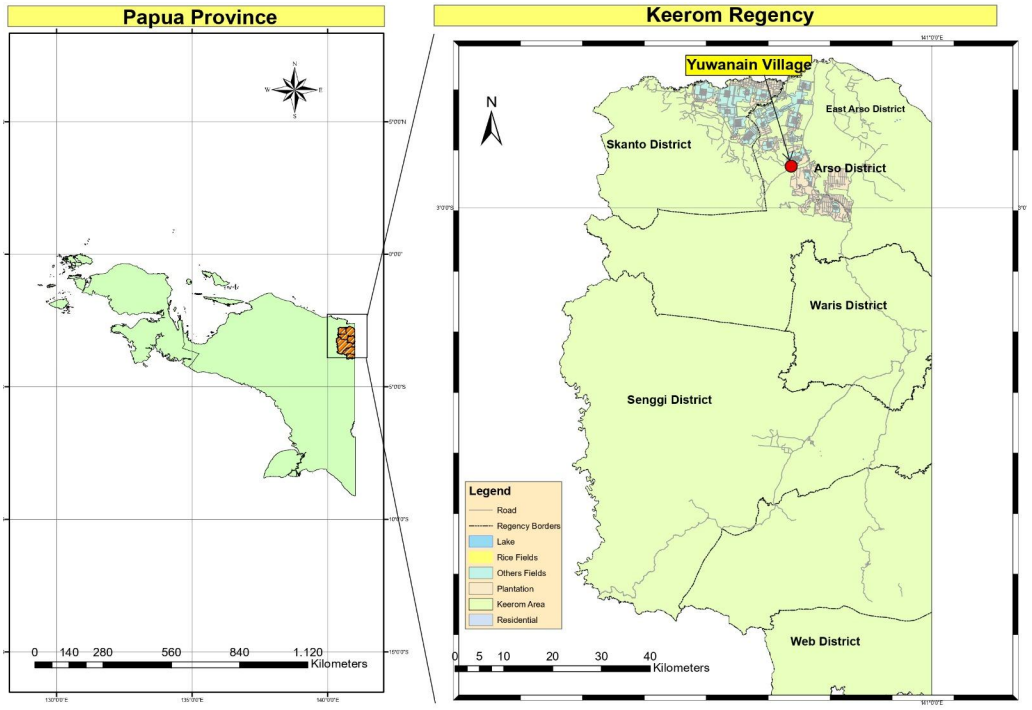

Figure 1. Map of the research location, Arso District, Keerom Regency, Papua.

Exploration was carried out at the study site while observing female *E. netscheri* laying their eggs on the leaves of host plants. A descriptive method was used to study the biology, life cycle, and metamorphosis of *E. netscheri*. This method focused on systematically observing, recording, and describing the development of butterfly eggs, larvae, pupae, and adults.

Daily observations were conducted to record the development and duration (number of days) of each metamorphic phase, namely the egg, larval, and pupal stages. During the larval phase, observations were made on the molting process to determine how many molts (instars) occurred and the duration of each instar. Measurements of eggs, larvae, pupae, and adults were also made using a caliper. In addition, changes in color, shape, and size from egg to caterpillar and then to pupa and adult (imago) were described. Photographs were taken to visually document the changes in form at each stage of metamorphosis.

Data analysis

Duration was analyzed quantitatively by calculating the average time (in days) required for each developmental stage, including the egg stage, the larval stage consisting of instars 1–5, and the pupal stage. Morphological analysis (qualitative descriptive analysis) was also conducted by describing changes in color, shape, and body length at each stage of metamorphosis.

RESULTS AND DISCUSSION

The results of this study add a new distribution record for *E. netscheri* in Papua, Indonesia, namely Arso District, Keerom Regency.

Figure 2. Early stages of the metamorphosis of *E. netscheri*: (a) egg; (b) newly hatched first instar larva; (c) two-day-old first instar larva; (d) second instar larva; (e) third instar larva; (f) fourth instar larva; (g) fifth instar larva; (h) prepupal stage; (i) pupal stage.

According to Ackery & Vane-Wright (1984), *E. netsche*ri is distributed in Gebe, Seram, Mysol, Salawati, Waigeo, Japen, and eastward to mainland Papua New Guinea (PNG). There are four subspecies of *netscheri,* but apparently only the race *erana* Fruhstorfer 1910 occurs in Papua New Guinea. In Papua New Guinea, *E. netscheri* is localized and appears to be restricted to certain sites in the western part. The distribution localities of this species in PNG are Lake Murray, Kiunga, Ambunti, Angoram, Maprik, Koinambe Mission, and Astrolabe Bay (Parsons, 1999).

Based on the results of this study, the life cycle of *E. netscheri* requires about 22–25 days, consisting of an egg stage of 3 days, a larval stage of 12–14 days, a pre-pupal stage of 1 day, and a pupal stage of 6–7 days. The larval stage passes through four molts, resulting in five instars, with the following durations: first instar 3 days, second instar 1.5–2 days, third instar 1.5–2 days, fourth instar 2–3 days, and fifth instar 3–4 days. The following is a description of each metamorphic phase and its duration, from the egg stage through the larval stage to the pupal stage:

1) Egg (Figure 2a)

The eggs are cream-colored, about 2 mm high and 1 mm in diameter. They are bullet- or barrel-shaped. The eggs are laid singly on the underside of leaves and require 3 days to hatch.

2) First instar larva (Figures 2b and 2c)

Immediately after hatching, the first instar larva consumes the egg fluid and eggshell. The newly hatched larva is about 3 mm long, pale green, with a smooth, cylindrical, and slightly translucent body surface. The head and anal end are black. One day later, abdominal segments 7 and 8 become yellow, and a pair of very short dorsolateral protuberances appear on the mesothorax, metathorax, and abdominal segments 2 and 8. The first instar lasts 3 days and reaches a body length of about 6 mm.

3) Second instar larva (Figure 2d)

The head is black and the body turns yellowish green. The prothorax, mesothorax, and abdominal segments 7 and 8 become yellow. The protuberances on the mesothorax, metathorax, and abdominal segments 2 and 8 develop into blunt black tentacles. All tentacles are shorter than the width of the body. The second instar lasts 1.5 to 2 days and reaches a body length of about 12 mm.

4) Third instar larva (Figure 2e)

The head is black with a narrow white band; the body is smooth and cylindrical; the basal and lateral regions, including the first mesothoracic segment and the anal segment, are yellowish green. The pairs of tentacles on the mesothorax, metathorax, and abdominal segments 2 and 8 grow longer and exceed the body width. The larva has alternating orange, black, and white stripes along the body. The third instar lasts about 1.5 to 2 days and reaches a body length of 17 mm.

5) Fourth instar larva (Figure 2f)

The fourth instar larva is similar to the third instar, with the only obvious change being the head capsule, which has several white markings on the face. The dorsal transverse white bands and the wavy white lateral lines are brighter. The fourth instar lasts about 2 to 3 days and reaches a body length of about 30 mm.

6) Fifth instar larva (Figure 2g)

The fifth instar larva is similar to the fourth instar, but the white markings on the head are broader and the transverse white lines are more distinct on all segments. The black spiracles on the lateral side are more conspicuous and the wavy white lateral lines are more prominent. The pairs of tentacles on the mesothorax, metathorax, and abdominal segments 2 and 8 become proportionally longer. White and dark transverse bands dominate the body surface, and the yellow color is restricted to the prothorax, small lateral spots, and posterior segments. Before the prepupal stage forms, the final instar larva changes color to

whitish gray. The fifth instar lasts 3 to 4 days and reaches a body length of 50 mm.

7) Prepupal stage (Figure 2h)

The final instar larva stops feeding on the last day, and its body shortens and hangs from the underside of the host plant. The larva spins a silk thread to hang vertically beneath the host plant. Its color fades to grayish white before the prepupa is formed. Prepupal formation takes several hours.

8) Pupal stage (Figures 2i and 3a)

The newly formed pupa is yellowish brown, and its surface gradually changes into shiny silvery gold with a metallic luster about one day later (Figure 2i). The pupa is somewhat rounded in shape with several small spots on the dorsal side. After about 7 days of development, the pupa turns black (Figure 3a). The pupa is about 20 mm long and lasts approximately 6–7 days.

9) Adult or imago stage (Figures 3b, 3c, and 3d)

Butterflies usually emerge from the pupa in the morning. Newly emerged butterflies hang on the pupal case for several hours with their wings closed. When they first come out of the pupa, the wings are very soft and wet and gradually dry. Male and female E. netscheri are very similar. The wings are dark brown with pale brown around the margins and several white spots on the underside. Females have a straighter inner margin of the forewing with a very dark brown ground color. The median area on the underside of both the forewing and hindwing bears clusters of pale blue spots (Figures 3b and 3c). In males, the upper side of the forewing has an elongated and slightly curved sex brand located below vein CuA2, and the inner margin of the forewing is convex (Figure 3d). The total life cycle duration is about 22–25 days.

Life history, which includes the complete life cycle with its various metamorphic stages from egg, larva, and pupa to adult, is an important foundation for developing accurate taxonomy and systematics and for formulating effective conservation strategies (Vega *et al*., 2025; Aguiar & Barbosa, 2025; Freitas, 2024; Zeng *et al*., 2025; Kawahara *et al*., 2023; Samantha *et al*., 2024; Durney *et al*., 2024).

Butterflies are a group of insects known as effective and sensitive bioindicators for monitoring environmental damage, habitat fragmentation, and climate change (Higuera-Díaz *et al*., 2025). Their rapid generation turnover (life cycle), specific larval diet, and high sensitivity to environmental change make them ideal for evaluating ecosystem health. Data on life history, including the life cycle and metamorphosis, are very important in supporting butterflies as bioindicators of environmental damage (Hill *et al*., 2021; Zola-Solis *et al*., 2025).

There are more than 10 Hoya species in Yadikap Garden, but only two species were used by E. netscheri *for ovip*osition. These two species were collected from secondary forest in Arso District, Keerom Regency, Papua, in 2018 and have been cultivated in Yadikap Garden. Female Euploea netscheri lay *their eggs on th*e young leaves of *Hoya globulifera* and *H. pachyphyl*la, which serve as host plants for Euploea netscheri. The descriptions of these *t*wo Hoya species are

Figure 3. Eclosion of *E. netscheri*. (a) Dark black pupa a few hours before eclosion; (b) newly emerged female imago drying its wings; (c) female imago of *E. netscheri*; (d) male imago of *E. netscheri* with an elongated and slightly curved sex brand on the forewing margin.

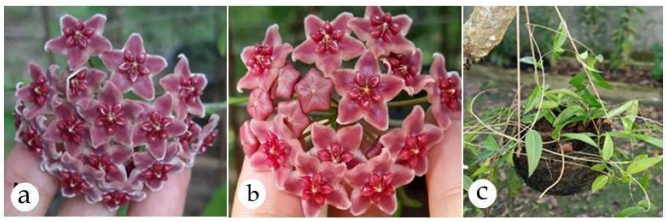

Figure 4. *Hoya globulifera*. (a) Fully open flower; (b) flower and several unopened buds; (c) habit.

presented below.

1) *Hoya globulifera* Blume 1850.

Stem cylindrical, rigid, 2 to 3 m long, 1.5 to 3 mm in diameter, greenish brown, glabrous, bark rarely peeling, internodes 5–10 cm. Leaves petiolate; petiole terete, 1 to 2 mm in diameter, 5 to 7 mm long, grayish green, glabrous; lamina linear-lanceolate, 1 to 2 mm thick, fleshy, 2.5 to 3 cm wide, 4 to 8 cm long, dark green on the adaxial surface and light green on the abaxial surface; apex acute, base tapered, venation pinnate. Inflorescence one per node, 10–30 flowers, peduncle terete, 2 to 7 cm long and 2 to 5 mm in diameter. Corolla fleshy, finely hairy, light purplish red with dense whitish hairs along the inner margin of the petals. The inner angles of the petals are acute and dark maroon, while the outer angles are acute and pinkish white. Flowers of Hoya globulifera are shown in Figures 4a and 4b, while the habit is shown in Figure 4c.

2) *Hoya pachyphylla* K. Schum & Lauterb.

Stem cylindrical, rigid, 2–4 m long, 2–5 mm in diameter, green to greenish brown, glabrous; internodes 10 to 25 cm. Leaves petiolate; petiole 1–2 cm long and 3–5 mm in diameter, grayish green; lamina ovate, fleshy, with wavy margins, 6.5 to 12 cm long and 3.5 to 7.5 cm wide, light green to red on the abaxial surface and light green on the adaxial surface, apex acute, base rounded; venation palmate, veins visible on the adaxial surface, young leaves often reddish purple and turning light green when mature. Inflorescence one per node, positively geotropic, 30–40 flowers per umbel; peduncle terete, 5 to 10 cm long and 2 to 3 mm in diameter. Corolla pale creamy yellow. Crown pale pinkish white with a darker pink center. Flowers of *H. pachyphylla* are shown in Figures 5a and 5b, while the habit is shown in Figure 5c.

This study provides the first record of the distribution, biology, and life cycle of E. netscheri in Keerom Regency, Papua, Indonesia. It also reveals new information on the host plants or larval food plants of *E. netscheri*, namely *Hoya globulifera* and *H. pachyphylla*.

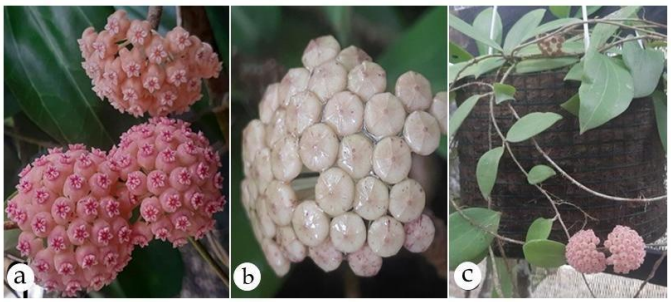

Figure 5. *Hoya pachyphylla.* (a) flower, (b) flower bud, and (c) habit.

Based on the study of Kawahara *et al.* (2023), analysis of larval host plant datasets and global distribution records indicated that butterfly larvae likely first fed on leaves of the family Fabaceae originating from the region now known as the Americas. Shortly after the Cretaceous thermal maximum, butterflies crossed Beringia and diversified in the Paleotropics. The study also revealed that most butterfly species are specialists that feed on only one family of larval host plants. However, generalist butterflies that consume two or more plant families usually feed on closely related plants.

Larvae of *Euploea* species are polyphagous and feed on latex-containing leaves, such as those of plants in the families Moraceae, Apocynaceae, and Asclepiadaceae (Common & Waterhouse, 1981; Scheermeyer & Zalucki, 1985). Parsons (1999) also reported Moraceae, Apocynaceae, and Asclepiadaceae as larval food plants of *Euploea* species in Papua New Guinea. More specifically, Parsons (1999) recorded several genera of Apocynaceae used as larval food plants by *Euploea* species in Papua New Guinea. Larvae of *E. wallacei* feed on the extensive climber *Parsonsia* sp. (Apocynaceae). *E. phaenareta* was also recorded feeding on leaves of *Cerbera floribunda* (Apocynaceae). *Ichnocarpus frutescens* (Apocynaceae) was observed as a food plant of *E. algea* and *E. eurianassa*. *Euploea treitschkei* was also reported feeding on *Parsonsia spiralis* (Apocynaceae). Only *Euploea batesii* and *E. nechos* were reported feeding on *Hoya* sp. (Parsons, 1999). *Euploea sylvester* sylvester was reported to be a specialist whose larvae feed only on leaves of

Gymnema R.Br. (Apocynaceae), and earlier data indicating larval food sources on *Ichnocarpus frutescens* (Apocynaceae) and *Ficus* species (Moraceae) may in fact be erroneous (Lambkin, 2025). *Euploea midamus atossa* was reported feeding on leaves of *Strophanthus* sp. (Apocynaceae) (Lambkin, 2024).

It is important to note that within widely distributed butterfly genera, there can be considerable interspecific variation in the number of host plants used as larval food sources (Taberer, 2024). Data on host plants, biology, life history, and the life cycle of Euploea netscheri are very useful for conservation efforts and are also needed as supporting data for evolutionary and classification studies.

CONCLUSION

Female *Euploea netscheri* lay eggs on the leaves of *Hoya globulifera* and *H. pachiphylla. E. netscheri* completes its life cycle in about 22–25 days (egg duration 3 days, larval duration 12–14 days with 5 instars, prepupal duration 1 day, and pupal duration 6–7 days). This study provides the first record of the distribution, biology, life history, and life cycle of *E. netscheri* in Keerom, Papua. New information on the larval host plants of *E. netscheri* was also recorded, namely *H. globulifera* and *H. pachyphyla*.

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