

## Notes on Immature Biology and Distribution of *Rapala takasagonis* Matsumura (Lepidoptera: Lycaenidae: Theclinae)

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### ABSTRACT

*Rapala takasagonis* Matsumura is a lycaenid butterfly endemic to Taiwan. Its immature biology was poorly understood, with only one host plant reported in the past. No information on the habits or morphology of *R. takasagonis* was available in literature. In the present study, two additional host plants are recorded, and an account on the bionomics, immature morphology and distribution is also given.

**Key words:** host plant, *Eucorymbus cavaleirei*, *Lagerstroemia subcostata*, Sapindaceae, Lythraceae

### Introduction

*Rapala takasagonis* Matsumura (Figure 1A) is a "hairstreak" lycaenid butterfly originally described from Taiwan (Matsumura, 1929). It was considered rare and confined to higher elevations of the island by Shirôzu (1960) and Chen (1974), but later records suggest that this hairstreak also occurs on lowland Taiwan (Yamanaka, 1980). The life history and immature biology of *R. takasagonis* is poorly understood, with only a brief rearing report made by Uchida (1988, 1991), but no details on the immature morphology and habits were given. We discovered two additional larval host plants during the present study. An account on the species' life history and larval associations are given herein. The samples of the present study also produced a long series of specimens useful to clarify the distribution of *R. takasagonis*, which has many unconfirmed collecting or observational records from mainland China in recent years.

### Material and Methods

Immatures of *R. takasagonis* were collected from Wulai, Taipei Co., 200 m alt. and Taipingshan, Ilan Co., 1400 m alt., northern Taiwan. Collected immatures were brought back to a laboratory in the

campus of National Taiwan Normal University at Taipei and assigned rearing records, which adopted the system used by Powell & De Benedictis (1995). Each collection of immatures was labelled according to the collecting year and month: e.g. 05G2 refers the second collection in July 2005. This system employs alphabetical letters to represent months in sequence. Immatures were reared in plastic containers (15 X 8 X 4.5 cm). Observation of immatures were based on the following rearing lots: HSU 03D33, 04D55, 04G18, 05E1, 05G2. Vouchers are deposited at Department of Life Sciences, National Taiwan Normal University, Taipei (NTNU). A total of 20♂33♀ of *R. takasagonis* were produced from the samples. In addition to the samples of *R. takasagonis*, 38♂20♀ (1♂, Fujian; 15♂12♀, Jiangsu; 10♂1♀, Jiangxi; 1♂, Guangdong; 1♀, Guangxi; 5♂3♀, Sichuan; 1♂, Gansu; 5♂4♀, Taiwan) of *R. nissa* were available for comparison to clarify the distribution of *R. takasagonis*.

Terminology follows Stehr (1987) for chaetotaxy of larvae and Fiedler (1991) for myrmecophilous organs.

### Results

#### *Morphology of immature stages*

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Ovum (Figure 1B): approximately 0.55 mm in diameter and 0.31 mm in height ( $n = 3$ ); pale green in color but turning to gray upon hatching; disc-shaped with glossy surface, chorion covered with reticulated pattern of fine ridges; short, truncated projections present at junctions of ridges.

Body length of 1st instar larva about 0.89 mm first hatched; body vermiform with posterior edge of anal lobe circular; head nearly circular in shape, dark brown, glossy; body pale gray with prominent dark brown, transverse, dorsal patches on A1 and A7, cream white patches on mesothorax, metathorax and A2 through A6; brown chevrons present from A2 through A6 dorsally; a narrow, brown, longitudinal line present mesodorsally. Anal plate small, nearly circular in shape, dark brown. T1 shield a prominent transverse band, dark brown, glossy. Spiracles dark brown. On T1, XD1 and XD2 equal in length but shorter than D1 and D2; SD1 below and anterior to SD 2; L1 longer than and between L2 and L3. On T2 and T3, D1 equal to D2 in length and above D2 in position; on A1 through A6, D1 equal to D2 in length and anterior to D2; on A7, D1 much shorter than D2 and in front of D2. SD group obsolete on T2 and T3, SD1 and SD2 short, with SD2 anterior to SD1 on A1 through A7. L3 longer than and posterior to L1 and L2 on T2, T3, and A1 through A7. SV bisetose on T1 through T3, A1 through A7. Ground color of body turning cream yellow toward 1st moult.

2nd instar: Brown secondary setae replacing primary setae. Posterior edge of anal lobe turning rectangular in shape. Head turning pale brown in color. T1 shield turning diamond-shaped, pale brown in color. Anal shield obsolete.

3<sup>rd</sup> instar: Similar to 4<sup>th</sup> instar but body densely covered with secondary setae as in 2nd instar. No dorsal nectary organ (DNO) or eversible tentacle organs (TOs) present. Prominent brown markings present on A1 and A7. Secondary setae represented as simple chalazae.

4th instar (Figure 1C): Head dark brown, glossy. Body vermiform, surface sparsely covered with short setae. T1 shield diamond-shaped, white mottled with brown markings. Prominent, fleshy, paired, dorsal processes on T2, T2 and A1 through A6, each bearing a pair of long setae apically, similar single, lateral processes on all segments except T1. DNO and TOs present. Body bright green tinged with olive; white chevrons present dorsally. Brown dash present on fleshy processes on

A1. Spiracles pale brown. Legs, prolegs pale green. Secondary setae consisted of long, simple spine-like bristles laterally and at terminal ends of fleshy processes and short chalazae with asteroid bases throughout body.

Pupa (Figure 1D): Of regular lycaenid form but with intersegment between A5 and A6 movable; with body thickest at A3; a shallow medial depression present on vertex. Body surface wrinkled, setaceous, bearing short, pale brown setae. Body glossy, color brown tinged with yellow, mottled with dark brown, forming two dark brown, longitudinal bands dorsally on abdomen; wings slightly tinged with olive. All spiracles cream white; thoracic spiracle on a black pad at edge of T2. Pupal length  $10.94 \pm 0.47$  mm ( $n = 18$ ).

#### Host associations

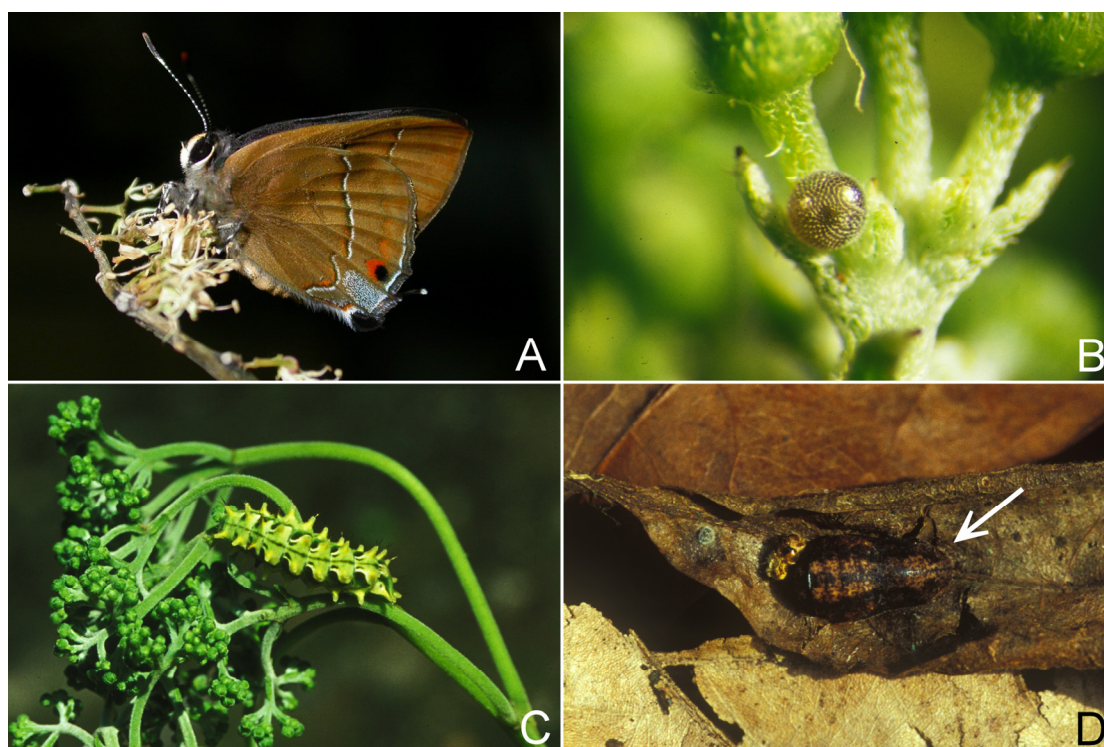
*Eucorymbus cavaleirei* (Levl.) Rehd. & Hand.-Mazz (Sapindaceae) (HSU 03D33, 04D55, 05E1) and *Lagerstroemia subcostata* Koehne (Lythraceae) (HSU 04G18, 05G2) are confirmed larval host plants of *R. takasagonis* in the present study. Uchida (1988, 1991) reported *Piper kadsura* (Piperaceae) as a larval host.

#### Immature biology

Ovum was found attached singly on inflorescence (HSU 04D55), upon which the larva exclusively feeds on flower buds and young fruits (HSU 03D33, 04D55, 04G18, 05E1, 05G2), suggesting that the larva of *R. takasagonis* is an obligatory feeder on the reproductive organs of its host plants. Larva left inflorescence to pupate in cavity.

#### Reared-out vouchers

1♀, TAIWAN: TAIPEI Co., Wulai, ca 200 m, IV. 23. 2003, emgd. V. 27. 2003, reared from *Eucorymbus cavaleriei*, HSU 03D33, 1♀, V. 2. 2005, emgd. V. 23. 2005, reared from *E. cavaleriei*, HSU 05E1; 4♂3♀, TAIWAN: YILAN Co., Datong, Bailing, ca 1400 m, VII. 11. 2004, Coll. L. H. Wang, J. R. Chen & C. T. Chaung, emgd. VIII. 1/5. 2004, reared from *Lagerstroemia subcostata*, HSU 04G18; 16♂27♀, VII. 3. 2005, Coll. L. H. Wang, emgd. VII. 21/VIII. 1. 2005, reared from *L. subcostata*, HSU 05G2; 1♀, TAIWAN: TAOYUAN Co., Fuxing, Daman – Xuanyuan, 700-900 m, VI. 16. 2005, Coll. L. H. Wang, emgd. VII. 6. 2005, reared from *L. subcostata*, HSU 05F41.



**Figure 1.** Various stages of *Rapala takasagoensis*. (A) adult, (B) ovum attached on inflorescence of *Eucorymbus cavaleirei*, (C) mature larva, and (D) Pupa (indicated by an arrow).

## Discussion

*Rapala takasagonis* was considered a species inhabiting only higher elevations of Taiwan (Shirôzu, 1960; Chen, 1974). However, later collecting records established that it also occurs on lowland Taiwan (e. g. Yamanaka, 1980; Hamano, 1986; Chang, 1994). The fact that we discovered immatures repeatedly in different years at a site as low as 200 m in elevation and at another site at moderate elevation of 1400 m suggests appropriate breeding elevations for *R. takasagonis* vary considerable within Taiwan.

*R. takasagonis* is superficially similar to *R. nissa*, which has a much wider distributional range (Shirôzu 1960, Wang and Fan 2002). Shirôzu (1960) was the first author who pointed out that *R. takasagonis* possesses features on wing patterns and male genitalia distinct from those of *R. nissa*, and *R. takasagonis* is a species endemic to Taiwan. A few diagnostic characters for *R. takasagonis* was given by him, rephrased as the follows: 1) the wing size of *R. takasagonis* is larger than that of *R. nissa*; 2) blue scaling on the wing uppersides of *R. takasagonis* is duller than that of *R. nissa*; 3) the

ground color of wing underside of *R. takasagonis* is darker than that of *R. nissa*; 4) a prominent white line is present on both wings in *R. takasagonis*, in contrast to a dark brown line edged by ill-defined white line in *R. nissa*; 5) the tail-like projection of the hindwing of *R. takasagonis* is longer than that of *R. nissa*; 6) the saccus of *R. takasagonis* is short, whereas that of *R. nissa* is quite long; 7) distal tip of valva is blunt in *R. takasagonis*, whereas that of *R. nissa* is rounded. His treatment has been followed by subsequent authors, such as Yamanaka (1980), Hamano (1987), and Hsu (2002). However, some recent literature reported *R. takasagonis* from continental China (e. g. Chou, 1994; Zhang, 1994; Jiang *et al.* 2001; Zhang *et al.* 2002; Yang *et al.* 2004). After reviewing all literature that reported this hairstreak outside Taiwan, we came to the conclusion that none had shown any specimen conforming to diagnostic characters of *R. takasagonis* provided by Shirôzu (1960). Moreover, we examined 33 males and 17 females of *Rapala* samples from southern China, all of which possess characters conforming with *R. nissa* instead of those of *R. takasagonis*. Thus it seems more appropriate to regard *R. takasagonis* a species

endemic to Taiwan based on the data available for the present. In a monograph on Chinese lycaenid butterflies, Wang and Fan (2002) expressed the same view point by listing only Taiwan as the distributional range of *R. takasagonis*.

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## 高砂燕灰蝶之幼期生物學與分布

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### 摘 要

高砂燕灰蝶是一臺灣特有蝶種，過去其幼生期資料極其欠缺，除了一筆寄主植物記錄之外，往昔文獻中完全沒有其他相關資料。本研究發現兩種高砂燕灰蝶之新寄主植物、提供幼期習性與形態資料，並討論其分布。

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