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On *Photinia*-associated *Chrysozephyrus* Hairstreaks, with Description of a New Species (Lepidoptera: Theclinae: Theclini)

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Yu-Feng Hsu and Wenping Liu (2002) On *Photinia*-associated *Chrysozephyrus* hairstreaks, with description of a new species (Lepidoptera: Theclinae: Theclini). *Zoological Studies* **41**(3): 263-270. While plants in the Rosaceae have recently been recognized as important hosts for *Chrysozephyrus*, the most diverse genus within the tribe Theclini sensu Eliot (1974), hitherto *Photinia* has not been known as a larval host for this genus. An investigation of various *Photinia* species revealed 2 *Chrysozephyrus* species associated with this fairly diverse group of trees, namely *C. shimizui* Yoshino and an undescribed species. The new species is described herein, and information on the immature morphology and biology of both species is also provided. The 2 *Chrysozephyrus* species occur sympatrically, but each is specialized in choice of microhabitat. The morphology of the immatures suggests that the 2 species do not form immediate sister groups to each other, thus their host usages might not be of a single origin. http://www.sinica.edu.tw/zool/zoolstud/41.3/263.pdf

Key words: Host association, Rosaceae, China.

With approximately 50 described species (Fujioka 1993), the genus *Chrysozephyrus* Shirôzu & Yamamoto represents the most diverse group within the tribe Theclini sensu Eliot (1973). Species in this genus are similar to one another in appearance, and correct identification of species largely relies on characters of the genitalia. In addition, the extent of metallic scaling on the wing uppersides can also be of some assistance (Howarth 1957). Approximately 35 *Chrysozephyrus* species are currently listed in the fauna of China (Watanabe 1998). Of these, quite a few were reported in recent years (e.g., Sugiyama 1992 1994, Koiwaya 1993, Yoshino 1997). Larvae of *Chrysozephyrus* generally specialize to the generic or specific level of plants of the Fagaceae, Rosaceae, and Ericaceae (Shirôzu 1961). While the Fagaceae are predominentely utilized as larval hosts by *Chrysozephyrus* in Japan and Taiwan, where altogether 10 of 12 species are associated with the Fagaceae, larvae of the remaining 2 species feed on *Prunus* species of the Rosaceae (Shirôzu and Saigusa 1980, Uchida 1999). An investigation of the life histories of Theclini hairstreaks in China by Koiwaya (1996), however, revealed that tree species of the Rosaceae are also extensively utilized, with 4 of 6 hosts of previously unknown *Chrysozephyrus* species associated with the the Rosaceae. Larvae of 3 of these species feed on *Prunus* species, with the remainder on a *Malus* species (Koiwaya 1996). As a diverse tree group in the Rosaceae, the genus *Photinia* represents another widespread tree group of the Rosaceae in eastern and southern Asia, including approximately 60 species of trees or bushes (Kuan and Yü 1974), which have so far not been checked for lycaenid associations. The diversity of Photinia is comparable to that of *Prunus* (more than 200 species worldwide, Hiroyoshi 1993) and *Malus* (approximately 55 species worldwide, Hiroyoshi 1993), genera previously known to have *Chrysozephyrus* associations, suggesting that it might be a candidate as a larval host for this hairstreak genus. An investiga-

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tion of various *Photinia* spp. across southern continental China and Taiwan discovered 2 species of *Chrysozephyrus* associated with these plants, with 1 being the recently described species *C. shimizui* and the other being undescribed. The latter is described herein, with a discussion provided on the host usage of *Photinia* by *Chrysozephyrus* hairstreaks.

MATERIALS AND METHODS

Dissection of genitalia was performed by first removing the entire abdomen, which was placed in 10% KOH at room temperature for 24 h to dissolve the soft tissues, then transferred to cellusolve for another 24 h for descaling, and finally placed in 70% ETOH for dissection. The dissected parts were preserved in 70% ETOH.

An ISI ABT DS-130S, NTNU was used for scanning electron microscopy (SEM) illustrations.

Primary types are deposited in the following collections: Department of Entomology, the Natural History Museum, England (BMNH); Institute of Zoology, Academia Sinica, Beijing (IOZ); Department of Biology, National Taiwan Normal Univ., Taipei (NTNU); and Tomoo Fujioka Collection, Tokyo (TF).

Measurements are defined and abbreviated as follows: forewing length (FL), distance from the base of the forewing to the apex; antennal length (AL), distance from the base to the distal tip of the antenna; dark margin of forewing (FM), distance between the termen and the distal edge of the metallic-green scaling in cell Cu_1 of forewing; and dark margin of hindwing (HM), distance between the termen and the distal edge of the metallic-green scaling in cell Cu_1 of the hindwing.

Terminology of wing patterns follow that of Nijhout (1991), and genitalia that of Klots (1970).

SYSTEMATICS

According to Eliot (1973), the Thecla section of Theclini is characterized by the vein M_1 forked with R_{4+5}, the 2nd segment of palpi clothed with hair-like scaling, and the hindwing not produced. The undescribed species appears to have all these characters. Moreover, this species evidently should be assigned to *Chrysozephyrus*, as it possesses strongly bent-over, serrate, L-shaped brachia (Fig. 9) and disc-like signa (Fig. 12), the features Shirôzu and Yamamoto (1956) used to define this genus.

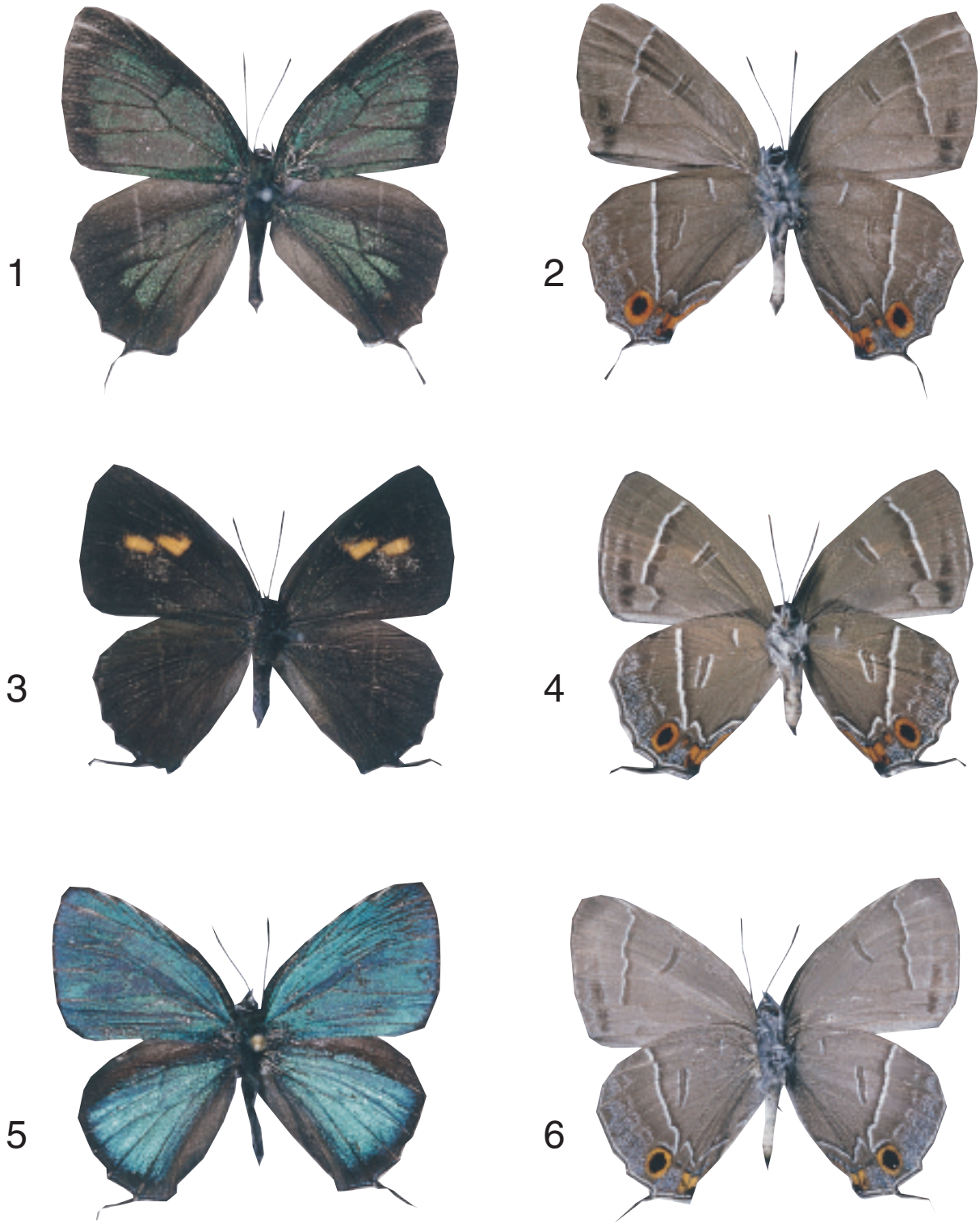
Chrysozephyrus obscurus Hsu and Liu, sp. nov.
(Figs. 1-4, 7-15)

Holotype ♂: China: Guizhou Prov., Tongren Pref., Jiangkou Xian, Fangjingshan, 1200-1700 m, 17/19 Jun 1997 (IOZ).

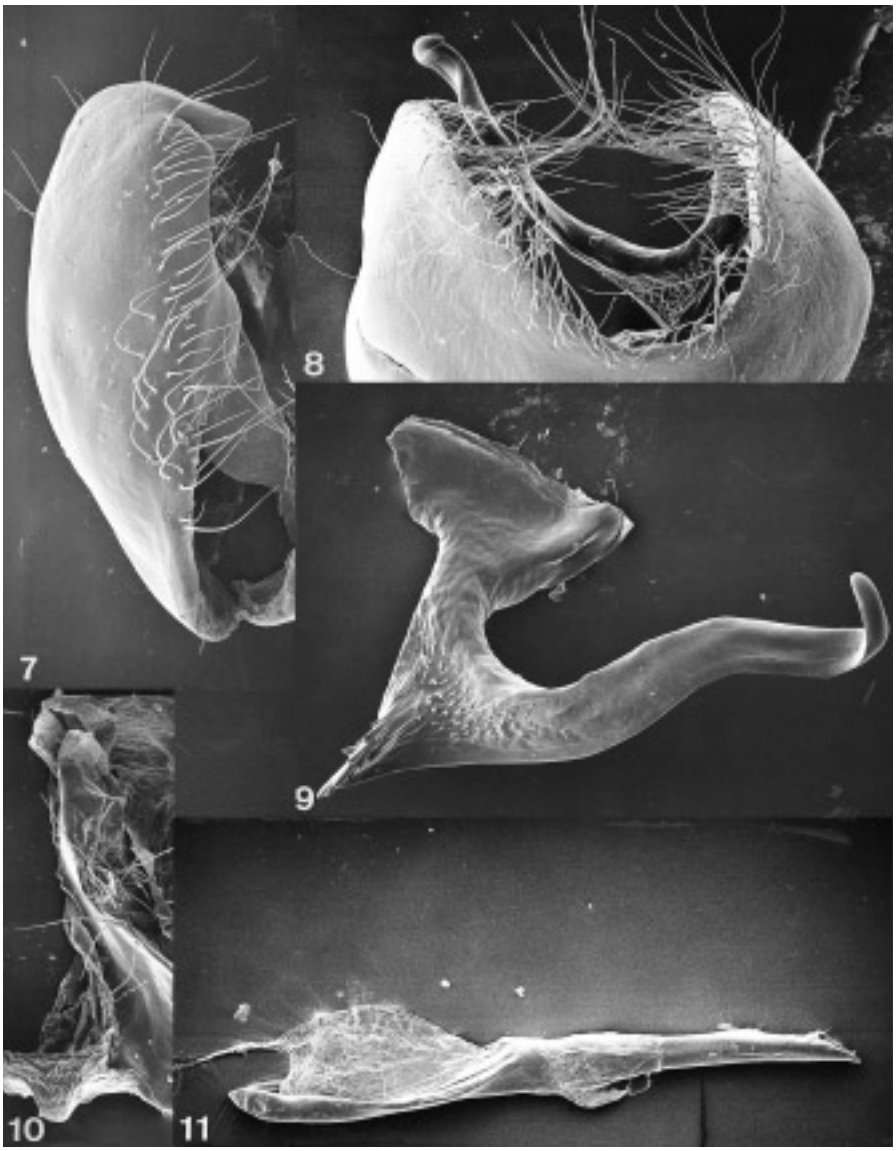
Paratypes: 10 ♂ ♂: same data as for holotype (3 dissected, genitalia YFH 1122, 1158, 1159) (BMNH, IOZ, NTNU, TF); 1 ♂, same locality as holotype, 18/19 Jun 1995 (NTNU); 2 ♂ ♂: same locality as holotype, 900 m, 24 Apr 1999, emgd. 9 May 1999, 1 ♂ 2 ♀ ♀, emgd. 13 May 1999, reared from *Photinia schneideriana* (HSU 00D15)(NTNU, IOZ); 1 ♀, same locality as holotype, 1300 m, 24 Apr 1999, emgd. 28 May 1999, reared from *P. parvifolia* (HSU 00D28)(NTNU).

Diagnosis: In terms of wing patterns, *Chrysozephyrus obscurus* is similar to the Thai *C. inthanonensis* (Kimura and Murayama 1990), which was also reported from Hainan Island of southern China (Koiwaya 1993, Gu and Chen 1997). Both species have metallic-green scaling at the distal end of discal cells diminished on the upperside of both wings, forming dark, narrow bars on a green background. Valva of both species carries a distal, digitate process and a lobe immediately proximal to the process (Fig. 7; Koiwaya 1993), suggesting they are the immediate sister species to each other. The valva of *C. obscurus*, nevertheless, is more slender with the posterior edge of the distal process straight in contrast to a shorter and slightly curved valva in *C. inthanonensis*. Metallic-green scaling on the wing upperside of the male is reduced along the forewing costa, forming a broad, dark, costal margin in *C. obscurus* (Fig. 1), while the scaling extends to forewing costa in *C. inthanonensis* (Kimura and Murayama 1990, Koiwaya 1993). Orange scaling on the forewing upperside of the female is represented by 2 disjunct spots in *C. obscurus* (Fig. 3), whereas it forms a prominent patch in *C. inthanonensis* (Kimura and Murayama 1990, Koiwaya 1993). Both bands of the central symmetry system on the wing underside form distinct white lines in both sexes of *C. obscurus* (Figs. 2, 4), in contrast to inconspicuous, narrow lines found in *C. inthanonensis* (Kimura and Murayama 1990, Koiwaya 1993).

Description: *Male* (Figs. 1-2, 7-11): FL 18.2-21.5 mm (mean, 20.0 ± 0.9 mm, *n* = 15); AL 8.9-9.6 mm (mean, 9.6 ± 0.5 mm, *n* = 15). Head:



Figs. 1-6. Adults of *Photinia*-associated *Chrysozephyrus*. 1. Upperside of *C. obscurus* sp. nov., holotype male. 2. Underside of *C. obscurus* sp. nov., holotype male. 3. Upperside of *C. obscurus* sp. nov., paratype female. 4. Underside of *C. obscurus* sp. nov., paratype female. 5. Upperside of *C. shimizui* Yoshino, male. 6. Underside of *C. shimizui* Yoshino, male.



Figs. 7-11. Male genitalia of *Chrysozephyrus obscurus* sp. nov. 7. Ventral view of left valva. 8. Dorsal view of sclerites of 9+10 genitalic segment with left socius attached. 9. Right socius. 10. Left half of juxta. 11. Lateral view of phallus.

hairy, vertex, frons dark brown but with white mesad; a white, narrow rim surrounding eye; eye semi-oval, densely covered with long, buff setae; labial palpus porrect, with 3rd segment pointed downwards, covered with dark brown scaling mottled with white laterally; maxillary palpus reduced, invisible; proboscis unscaled; antenna smoothly scaled, naked at terminal end of nudum. Thorax: dark brown dorsad, white ventrad; legs white, mottled with brown on tarsi. Forewing: FM 2.7 $\pm$ 0.3 mm (*n* = 15). Termen, costa slightly concave, dorsum straight. Ground color of upperside dark brown, overlaid with metallic dull-green scaling proximally, green scaling tinged with yellow or blue and absent from distal end of discoidal cell. Ground color of underside buff gray. Discal spot forming brown bar edged with white. Distal band of central symmetry system represented as tilted white line edged with brown proximally. Submarginal band and "g"-element as defined by Nijhout (1991) fused into prominent, dark brown band edged with white, abruptly attenuate towards apex. Fringe with dark brown inner cilia, white outer cilia. Hindwing: HM 3.4 $\pm$ 0.3 mm (*n* = 15). Contour of wing slightly produced at distal end of M_1 and Cu_1; Cu_2 bearing long, "tail"-like projection

distad. Ground color of upperside dark brown, overlaid with metallic dull-green scaling proximally, less intense than that of forewing, covering less than 1/2 of hindwing surface. Ground color of underside buff. Discal spot forming brown bar edged with white. Distal band of central symmetry system forming prominent white line edged with brown proximally, straight from dorsum to vein Cu_2, forming S-shaped short line in cell Cu_2, rebent into straight line in cell 2A, and becoming a slightly curved line in cell 1A. Proximal band of central symmetry system only represented as short white bar edged with brown distally near base of cell Rs. Submarginal band consisting of faint, broad white band mixed with black, a black dot enclosed within orange circle in cell Cu_1, and a tornal orange patch edged by black and metallic-blue scaling anteriorly and posteriorly. "g"-element consisting of a string of arch-like, faint white markings. Fringe with dark brown inner cilia, white outer cilia except in cell Cu_1 and Cu_2, where outer cilia forming proximal white layer and distal dark brown layer. Abdomen: dark brown dorsad, white ventrad. Male genitalia (Figs. 7-11): ring-shaped sclerites of 9+10 segments with posterior end straight; saccus rod-like, approximately 0.3x tegumen height; brachium abruptly bent over, forming sharp angle bearing elongate, serrate lobe ventrad, caudal end strongly upcurved; valva bearing curved, distal process with terminal end tapering, harpe setose, forming weak lobe distally. Phallus robust, nearly straight with truncated caudal end; aedeagus 0.8x phallobase, cornuti present, forming a cluster of small sclerotized patches at caudal end. Juxta V-shaped, thickened dorsad, attenuate ventrad, setose on posterior surface.

Female (Figs. 3-4, 12): FL 18.0-19.5 mm (*n* = 3); AL 8.5-9.2 mm (*n* = 3). Body, wing patterns of underside as described for male except scaling with buff tone. Wing upperside uniformly brown with a couple of orange spots present on forewing. A trace of metallic-green scaling present near tornus of hindwing. Genitalia (Fig. 12): Apophyses posteriores enlarged, flattened, shovel-like at base, truncated distad. Sterigma a broad, triangular heavily sclerotized plate with a prominent medial cleft. End of medial cleft forming a shriveled conical bump with a medial slit leading to ductus bursae. Ductus bursae swollen, with ductus seminalis joining mid-way ventrad. Corpus bursae oblong, bearing a pair of small, invaginated, pointed signa.

Immatures: Ovum (Fig. 13) approximately 0.9 mm in diameter, 0.5 mm in height (*n* = 1), spherical but compressed, white, with 33 vertical rows of serrate fringe-like extensions. Last instar larva (Fig. 14): Head brown on upper half, black on lower half. Body generally of typical lycainid form with A8 produced laterally, attenuated caudally. Coloration of body cream yellow tinged with green laterally, turning into thoroughly green when full-grown, yellow chevrons present subdorsally. A deep green medial, longitudinal line present dorsally. T1 shield and anal lobe prominent, cream white. Spiracles brown. Full-grown larva approximately 17.0 mm in body length (*n* = 5). Pupa (Fig. 15): generally of typical lycaenid form, brown tinged with yellow, mottled with dark brown dorsally, a dark brown medial line present dorsad on abdomen; wings dark brown; spiracles cream white. Pupal length approximately 12.0 mm (*n* = 5).

Phenology: Adults occur in June.

Etymology: An adjective from the Latin *obscurus* = indistinct, dim, dark, referring to the dull-green scaling on the forewing upperside of the male of the species.

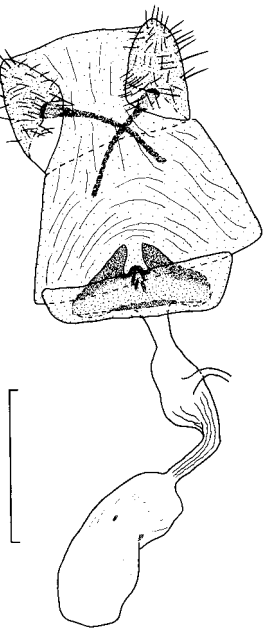


Fig. 12. Female genitalia of C*hrysozephyrus obscurus* sp. nov. (scale bar = 1 mm).

DISCUSSION

Immatures of *Chrysozephyrus shimizui*

Immatures of 2 species of *Chrysozephyrus*

Figs. 13-18. Immatures of *Photinia*-associated *Chrysozephyrus*. 13. Ovum of *C. obscurus* sp. nov. 14. Last instar larva of *C. obscurus* sp. nov. 15. Pupa of *C. obscurus* sp. nov. 16. Egg shells of *C. shimizui* Yoshino. 17. Last instar larva of *C. shimizui* Yoshino. 18. Pupa of *C. shimizui* Yoshino.

were observed on *Photinia*, namely *C. obscurus* described above and *C. shimizui* Yoshino (1997) (Figs. 5-6). *C. shimizui* was described based on male adults with no information on immatures given (Yoshino 1997). Observations on immatures are given as follows: Ovum (only shells available, Fig. 16): approximately 0.8 mm in diameter, 0.4 mm in height (*n* = 2), spherical but compressed, with irregularly arranged, white conical projections on chorion. Last instar larva (Fig. 17): head black; body generally of typical lycainid form with A8 produced laterally, but body not attenuated caudally as in *C. obscurus*; coloration of body bright yellow; 2 longitudinal, narrow brown lines present laterally; a prominent brown, medial, longitudinal line present dorsally; T1 shield and anal lobe prominent, cream white; spiracles black. Full-grown larva approximately 18.0 mm in body length (*n* = 4). Pupa (Fig. 18): generally of typical lycaenid form, cream yellow mottled with dark brown dorsally, a series of dark brown medial dots present dorsad on abdomen; wings pale brown with dark shades; spiracles white. Pupal length approximately 14.5 mm (*n* = 4).

Materials examined: 1 ♂: China: Guizhou Prov.: Tongren Pref., Jiangkou Xian, Fangjingshan, 800 m, 16 May 1999 (NTNU). 1 ♂: same locality, 850 m, 3 Apr 1999, emgd. 21 Apr 1999 (distorted), reared from *Photinia schneideriana* (HSU 99D5).

Association of *Chrysozephyrus* lycaenids with *Photinia*

Although *Chrysozephyrus obscurus* and *C. shimizui* utilize the same hosts sympatrically, their usage of these hosts seems differentiated in terms of microhabitat. Late instar larvae of *C. obscurus* were found on the underside of leaves of *Photinia schneideriana* (*n* = 6, HSU 00D15) and *P. parvifolia* (*n* = 1, HSU 00D28). The larvae preferred shadier spots, such as the lower part of the canopy of full-grown trees, or on small trees on the shady side opposite to the direction of sunshine. The larvae make a small hole in the midrib of full-grown but soft leaves, then devour the leaves. Egg shells and an unhatched egg were observed on the under surfaces of horizontally stretched twigs. The eggs appeared to be laid singly. Subultimate instar larvae of *C. shimizui* were observed on a seedling of *Photinia schneideriana* (*n* = 4, HSU 99D5) less than a meter in height, growing on a rocky cliff. The larvae rest on the under surface of soft leaves, producing prominent feeding holes in the leaves. Two small clusters of egg shells, 1 with 3 and the other with 2, were found on the stem of a seedling, suggesting that the female of this species oviposits ova in clusters. Under laboratory conditions, pupation of both species occurred in debris.

The morphology of immatures and adults of *C. obscurus* and *C. shimizui* differ considerably from each other, suggesting that the 2 species might not be immediate sister taxa. Ovum and larva of *C. obscurus* resemble those of *Prunus*-specialized *C. linae* distributed in western China (Koiwaya 1996), whereas the morphology of the larva of *C. shimizui* is generally similar to that of another *Prunus*-feeding species, *C. smaragdinus*, which occurs from western China to Japan (Fukuda et al. 1984, Koiwaya 1996). As a matter of fact, the larvae of *C. shimizui* and *C. smaragdinus* are the only 2 known species of *Chrysozephyrus* with a uniformly yellow body form, suggesting this body form might be a synapomorphy shared by the 2 species. Whether evolutionary colonization of *Photinia* occurred more than once during the evolutionary history of *Chrysozephyrus* awaits a thorough phylogenetic analysis of this species-rich genus of hairstreaks.

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以石楠屬植物為寄主的*Chrysozephyrus*屬灰蝶及其一新種

徐堉峰[1] 劉文萍[2]

雖然近年來薔薇科植物被發現是鱗翅目灰蝶科Theclinae亞科Theclini族之中多樣性最高的*Chrysozephyrus*屬的重要幼蟲寄主，但是在薔薇科中種類甚多的石楠屬*Photinia*植物迄今尚未有所研究。本研究以石楠屬植物為幼蟲寄主之*Chrysozephyrus*屬兩種，包括一新種，並述及其幼期形態與生物學。此兩種灰蝶呈同域分布，但幼期微棲所相異。形態資料亦顯示兩者親緣關係不近，因此其利用石楠屬植物為寄主可能並非來自同一起源。

關鍵詞：寄主使用，薔薇科，中國。

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