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Notes on the Life History of *Sibataniazephyrus kuafui* Hsu & Lin, 1994 (Lepidoptera: Lycaenidae) 【Research report】

插天山綠小灰蝶 (鱗翅目：小灰蝶科) 之生活史【研究報告】

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Abstract

Morphological description of immature stages and field observations of *Sibataniazephyrus kuafui* Hsu & Lin, 1994 from Taiwan are reported for the first time. Eggs and larvae were collected from Taiwan Beech, *Fagus hayatae* Palib. ex Hayata (Fagaceae). The larval stage is composed of four instars, and the entire larval, plus pupal stages took approximately 40 days in laboratory condition. The length of the life cycle in field is estimated approximately 280-330 days. Slight but consistent morphological differences are found between larvae and pupae of *S. kuafui* and the most closely species Japanese *S. fujisanus* (Matsumura, 1910) in coloration and size. Besides, the senior author found egg shells of *S. kuafui* from the specimens of Taiwan Beech deposited in herbarium, this discovery suggests the presence of this butterfly from other localities. Furthermore, brief description of habitat, hostplant and discussion on problems in conservation of this new species are also given.

摘要

本文首次描述臺灣產插天山綠小灰蝶 *Sibataniazephyrus kuafui* Hsu & Lin, 1994 之幼生期形態及成蟲之野外生態觀察。卵及幼蟲皆採自殼斗科之臺灣山毛櫸 *Fagus hayatae* Palib. ex Hayata。幼蟲期共有四齡，於實驗室中，自卵孵化至成蝶羽化約40天，並推測於野外之生活史約280-330天。插天山綠小灰蝶與其產於日本之最近緣種富士綠小灰蝶 *S. fujisanus* 之幼蟲及蛹在顏色和大小上具有細微之差異。而作者於國立臺灣大學植物學系植本館所藏，採自宜蘭縣三星山及桃園縣拉拉山之臺灣山毛櫸標本中發現插天山綠小灰蝶之卵殼，顯示本種蝶類至少曾分布於該區域。此外，本文並提供簡短之棲地觀察，寄主植物描述及本種於保育上之問題。

Key words: *Sibataniazephyrus kuafui*; *S. fujisanus*; immature stages; *Fagus hayatae*; Cha-Tien-Shan Nature Preserve.

關鍵詞: 插天山綠小灰蝶、富士綠小灰蝶、幼生期、臺灣山毛櫸、插天山自然保留區。

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Notes on the Life History of *Sibatanozephyrus kuafui* Hsu & Lin, 1994 (Lepidoptera: Lycaenidae)

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ABSTRACT

Morphological description of immature stages and field observations of *Sibatanozephyrus kuafui* Hsu & Lin, 1994 from Taiwan are reported for the first time. Eggs and larvae were collected from Taiwan Beech, *Fagus hayatae* Palib. ex Hayata (Fagaceae). The larval stage is composed of four instars, and the entire larval, plus pupal stages took approximately 40 days in laboratory condition. The length of the life cycle in field is estimated approximately 280-330 days. Slight but consistent morphological differences are found between larvae and pupae of *S. kuafui* and the most closely species Japanese *S. fujisanus* (Matsumura, 1910) in coloration and size. Besides, the senior author found egg shells of *S. kuafui* from the specimens of Taiwan Beech deposited in herbarium, this discovery suggests the presence of this butterfly from other localities. Furthermore, brief description of habitat, hostplant and discussion on problems in conservation of this new species are also given.

Key Words: *Sibatanozephyrus kuafui*; *S. fujisanus*; immature stages; *Fagus hayatae*; Cha-Tien-Shan Nature Preserve

Introduction

The genus *Sibatanozephyrus* Inomata, 1986 previously included only one species, *S. fujisanus* (Matsumura, 1910) from Japan. Hsu and Lin (1994) recently reported this genus from Taiwan with a new species *S. kuafui* Hsu & Lin, 1994. This discovery was resulted from observation that incongruity exists between distribution of *Fagus* and *Sibatanozephyrus* (Hsu and Lin, 1994).

Sibatanozephyrus represents the *Fagus*-feeding member of Theclini lycaenid

butterfly. Considering the distribution centers of *Fagus* and Theclini are located in China, where the *Fagus*-feeding behavior likely evolved, Hsu concluded that the absence of *Sibatanozephyrus* from Taiwan was unusual. Hsu and Lin had visited the Pei-Cha-Tein-Shan area for many times searching for this expected Theclini butterfly since 1986. In 1992, their efforts finally led to the discovery of *S. kuafui*. meanwhile, Tanikado (1994) demonstrated that this species was discovered with a single female collected in 1993 from the same locality. Although

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Hsu and Lin (1994) pointed out that this new Theclini butterfly undoubtedly utilizes Taiwan Beech as its larval host in Taiwan because it is associated exclusively with this plant, the life history and morphology of immature stages remain to be investigated.

In the present paper, the authors describe the immature stages and adult behavior of *S. kuafui* for the first time. Conservation of this butterfly is also discussed.

Materials and Methods

In December of 1993, Ming-Yao Lin led the senior author and Yunn-Jyr Liao visited the Pei-Cha-Tein-Shan Nature Preserve, the type locality of *S. kuafui*, for observation. Later, on the 12th of February, the authors revisited the habitat and successfully collected one hatched egg shells and four 2nd instar larvae from the buds of Taiwan Beech. Material was brought back to laboratory and reared under room temperatures. Larvae were reared in a 10.0×5.0×3.0cm plastic container with full supply of the leaves of Taiwan Beech.

Flight period and behavior of adults were based on observations conducted at the habitat on May 1, 11-12, 21-22, and June 4-5 in 1994. The date, sex, activity, time and physical condition of each netted specimen were recorded for estimation of flight period of adults. The rating system of physical condition for each individual followed Watt et al. (1977) as follows:

1. Very Fresh (**VF**): recently emerged, wings still shining, soft.
2. Fresh (**F**): wings and other cuticle dry and hard, with no visible damage.
3. Slightly Worn (**SW**): noticeable wear of scales from wings or body.
4. Worn (**W**): wings showing fraying or tearing in their cuticle.
5. Very Worn (**VW**): wings with extensive scale wear and cuticle damage.

Wing-wear rating is employed to estimate the flight period of adults.

Additionally, Onodera of Japan provided us an unhatched egg, four pupae and photographs for the final-instar larvae of *S. fujisanus* (Matsumura, 1910), the most related species of *S. kuafui* from Hosokubodani, Chichibu city, Saitama Pref., Japan, in 1993, for morphological comparison.

Results

Morphology and Biology of Immature Stages and Adults

Eggs (Fig.1)

Diameter 1.00-1.03 mm, height 0.55 mm. White, dome-shaped, of typical Lycaenine shape; rounded in upper view and echinoid in lateral view, the upper surface slightly convex, bottom surface flattened. Reticulum of the outer chorion pitted. The depressed pits present within a network of intersecting chorionic ridges. Size larger than other Theclini species from Taiwan. No obvious difference from *S. fujisanus* in size (1.00-1.02 mm) (Shirozu and Hara, 1960; Fukuda et al., 1984) and color. (Fig.2)

Larvae (Fig.3-8)

Final instar larvae onisciform, dorsoventrally compressed, attenuated at both ends, apparently broader in prothoracic segment. Length 13.0 mm at the beginning and 16.0-19.0 mm before entering prepupal quiescence. Prior to pupating, prepupal larva contracted considerably in length (10.0-11.0 mm), rounded into a broad axial arch. Very similar to *S. fujisanus* (Fig.8) but slightly larger in size (16.0 mm) (Shirozu and Hara, 1960; Fukuda et al., 1984). **HEAD**: hypognathous, black, surface smooth with several minute setae. **THORAX**: surface brown, relatively smooth with numerous minute secondary setae, each at the center of a black circular spot; center of spiracle brilliant white, surrounded by a



Fig.1 Egg of *S. kuafui* on *Fagus hayatae*; Fig.2 Egg of *S. fujisanus* on *Fagus crenata*; Fig.3 Lateral view of the 3rd instar larva; Fig.4 Dorsal view of the 3rd instar larva; Fig.5 A simple nest built by a 2nd instar larva; Fig.6 Lateral view of the final (4th) instar larva; Fig.7 Dorsal view of the final instar larva; Fig.8 Dorsal view of the final instar larva of *S. fujisanus*.

brown spiracular ring, spiracle visible in prothorax but absent in meso- and meta-thorax; prothorax more compressed than other segments, several black-based setae present along the anterior ridge and white setae distributed to the lateral margin; prothoracic shield black, composed of two triangle sclerotized parts with six setae on each part; mesothorax shorter than prothorax, two white arrow-like markings present between supra-spiracular line and subdorsal line; meta-thorax similar to mesothorax in general but with white markings relatively slender. **ABDOMEN:** A1 to A5 similar to metathorax in size and color; the white marking expanded into a triangular area at A6; A7 to A9 more flattened than others, attenuated; a continuous white line visible dorsally on A7 to A9; an black circular area present on urogomphi with several black-based setae. Crochets of ventral proleg arranged in an interrupted mesoseries.

Pupae (Figs.9-12)

Length 10.0-12.2 mm, width 0.35-0.40 mm. Brown dorsolaterally and dark brown on wings. Single brown dorsal line present between two rows of abdominal spiracles. surface smooth with numerous minute hairs. Body short and plump. Wing cases straight laterally except for a slight enlargement at A4, width reaching 0.40 mm. Head and cranial appendages located on the ventral surface. Thorax slightly tapered in front of the bases anteriorly. Abdomen elliptical and well-rounded posterior, strongly arched and rounded, reaching maximum height at A4 (3.8 mm). Last segment reduced, becoming nearly perpendicular to the ventral surface. Color varied. Generally very similar to *S. fujisanus* in size (10.0 mm) (Shirozu and Hara, 1960; Fukuda et al., 1984), shape and color (Fig.12).

Biology of Immature Stages

Emergence of diapausing eggs was

possibly synchronized with the end of dormancy of Taiwan Beech because the second instar larvae were found inside youngleaves in February, the beginning of budding and blooming period of Taiwan Beech. No further feeding on the eggshell was noted. Based upon the observations that spawning by a female was on May 21, 1994 and time of egg hatched in February, 1994, incubation of eggs is estimated to be at least 240 days.

Larvae were present from early February. The first and second instar larvae built simple nests with the terminal young leaves, then bored and fed insides (Fig.5). While the third and fourth instar larvae were usually found on the surface of leaves. The young leaves readily provide yellowish green ground color and reddish green veins similar to the markings of cryptically colored larvae.

In laboratory, the fourth instar larvae spent about 3 days in the prepupal stage on the underside of fallen leaves of Taiwan Beech from March 10 to 12, 1994. They were motionless during the period and shortened considerably. Initially the pupae were light-brown, but soon became dark brown with linear patterns. Pupal stage lasted 11-15 days from March 12 to 21-27, 1994.

Adults (Fig.13)

Male: Forewing length 16.0-18.6 mm (mean=17.03mm, n=9); antennal length 8.2-9.0 mm (mean=8.5mm, n=9). Forewing upperside metallic dark blue or purple tinged with green, margin black; underside ground color white with sub-marginal spots dark black, other markings dark gray, proximal transverse line very slim. Hindwing upperside with metallic area greenish blue with a purplish outline, margin black, terminal outline distinct, forming a white line through entire termen; upperside with same ground color as of forewing, discal band and discoidal bar always completely merged, not distinguishable from each other,

tornal patch orange or yellowish orange.

Female: Forewing length 16.2 mm (n=16); antennal length 7.0mm (n=16). Both wings with upperside ground color dark brown and upperside markings more developed than those in the male, otherwise similar to the male.

In laboratory, two females emerged on March 25 and 27, and two males on March 21 and 24.

Flight Period

The flight period of adults was observed on May 1, 14-15, 21-22 and June 4-5, 1994. On May 1, the authors netted 2 SW, 13W males and 4 VF females. Two weeks later, 16 W to VW males, and 18 F to SW female were observed. During the last two trips, only W to VW females were observed. The authors suspected that the flight period could last until late June. In Japan, however, the flight period of *S. fujisanus* ranges from June to September (Kawazoe and Wakabayashi, 1976; Fukuda et al., 1984; Inomata et al., 1986; Kurita, 1993), such difference evidently is resulted from the different growth periods between Japanese Beeche and Taiwan Beech.

Adult Behavior (Fig.14)

Observed daily adult behaviors include foraging for nectar, perching, flying, mating, and oviposition. During the period of peak activity, adults spent most of time perching and flying. Compared to other related Theclini butterflies in Taiwan such as *Chrysozephyrus* and *Neozephyrus*, *S. kuafui*'s flight was slower. They usually flight above the canopy of Taiwan Beech or spread their wings on leaves at sunshine. They nectared almost exclusively on flowers of *Trochodendron aralioides* Sieb. & Zucc. (Trochodendraceae) from 9:00 to 15:00 hrs. and sometimes they also absorbed the water on leave surface.

Courtship and mating were observed on May 21, and these behaviors took

place in the vicinity of Taiwan Beech. In order to search for potential mates, males perched and darted out to investigate passing objects. Taiwan Beech was the preferred perching plant. Both males and females began early morning basking around 9:00. following this, males generally began to perch about 10:00-11:00 with many of them continuing to bask simultaneously as they perched. Peak perching activity took place in the early afternoon and gradually attenuated around 15:00-16:00.

Oviposition was observed during the last three trips. Females selected suitable trees to land, then walked down along branches. Following this behavior, the white, oblate spherical eggs were singly laid on the branches or inside of scales of Taiwan Beech of about 2.0-3.0 m tall.

Length of Life Cycle

S. kuafui is univoltine. The estimated length of the life cycle took approximately 280-330 days from time of oviposition of the egg to emergence of the adult. From time of hatching to emergence of the adult spent approximately 40 days.

Habitat (Fig.15)

S. kuafui is hitherto only known from the beech of Cha-Tien-Shan Nature Preserve. This area was designated by The Council of Agriculture in accordance with the Cultural Heritage Preservation law, and now the management agency is Taiwan Forestry Bureau. The Taiwan Beech forests consist of about 200 vascular plant species and are generally in a three-layered structure. The canopy is around 15 meters in height and mainly consists of Taiwan Beech; the sub-canopy, shrub layer, from 2-5 meters, mainly consist of *Trochodendron*, *Illicium*, *Malonia*, *Adinandra*, *Daphniphyllum* and *Rhododendron* etc.; and in addition. *Yushania niitakayamensis* (Poaceae) is dominant on the herbaceous layer (Hsieh, 1989; Yang and Lu, 1991).

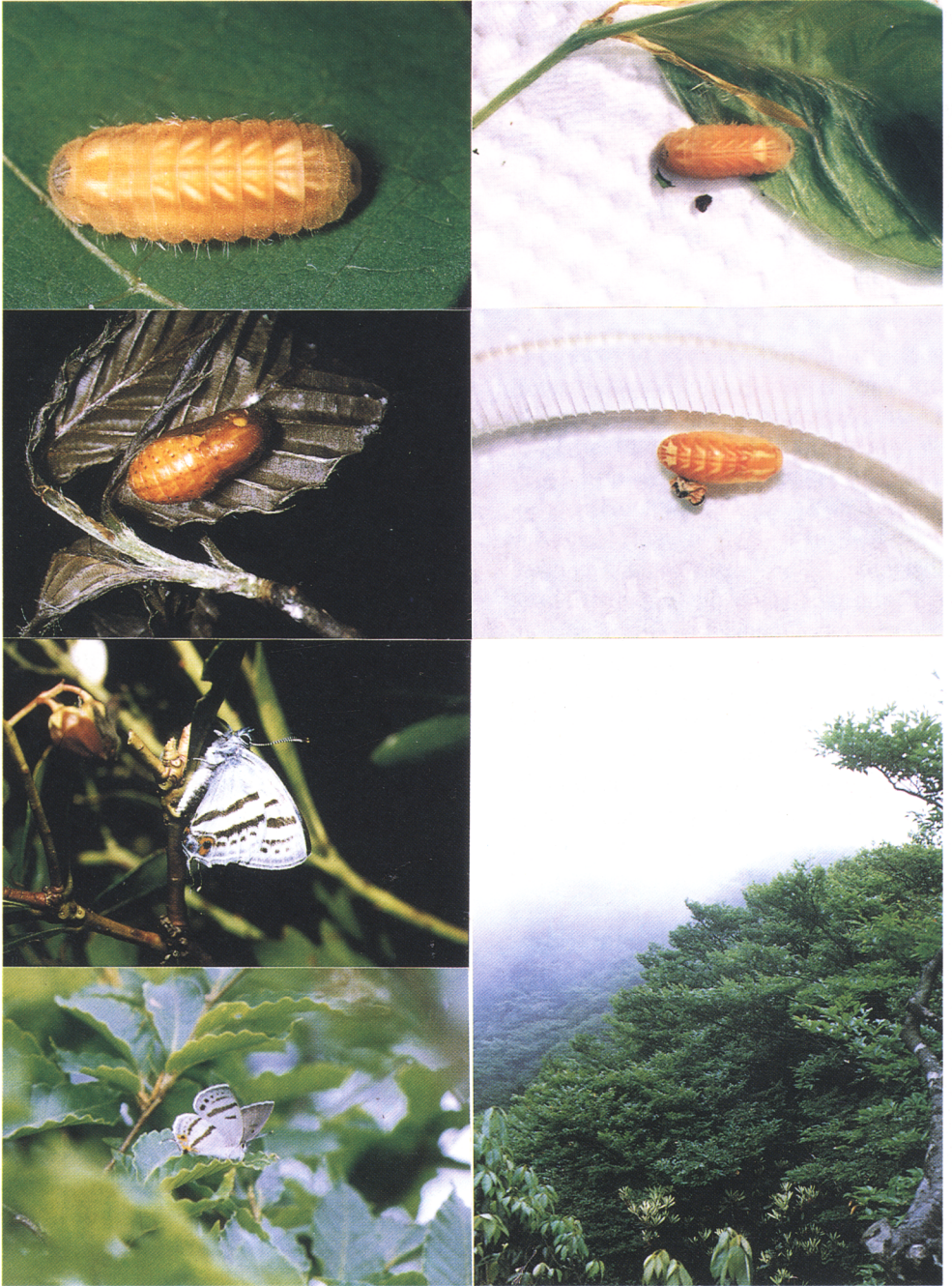


Fig.9 Dorsal view of the prepupa of *S. fujisanus*; Fig.10 Dorsal view of prepupa of *S. fujisanus*; Fig.11 Dorsal view of the pupa of *S. fujisanus*; Fig.12 Dorsal view of the pupa of *S. fujisanus*; Fig.13 A newly emerged male of *S. kuafui*; Fig.14 A females *S. kuafui* perching on Taiwan Beech; Fig.15 Landscape of Pei Cha-Tein-Shan Nature Preserve during the budding period of Taiwan Beech.

Discussion

Fagus hayatae and Distribution of *Sibatanoiozephyrus kuafui*

Taiwan Beech, *Fagus hayatae* Palib. ex Hayata (Fagaceae), is the only known host plant for *S. kuafui* even though *S. fujisans* could be reared with *Quercus* sp. (Fagaceae) in artificial condition in Japan (Fukuda et al., 1984). This tree was first collected by Konishi at Cha-Tien-Shan in 1906 (Hayata, 1908). No collections had been made for many years and few botanists had seen a living tree. In 1974, however, Severinghaus and DeVol accidentally discovered a relatively pure stand of Taiwan beech from La-La-Shan during their ornithological field trip. According to Yang and Lu (1991), Taiwan Beech dominates the forests within 100 meters of both sides of the main ridges from Ta-Man-Shan to La-La-Shan, northwestward to Pei-Chia-Shan, and then northeastward to Chu-Lu-Shan. It had since been collected in Ilan County on San-Hsing-Shan (Liu, 1960) and in Taichung County on An-Ma-Shan (Severinghaus and DeVol, 1974), but these populations were probably wiped out because of deforestation. Since it grows on rather inaccessible mountains, collections have seldom been made. That is the reason why this new *Fagus*-feeding Theclini butterfly was discovered so recently.

After examining the specimens of Taiwan Beech deposited in the Herbarium of Botany Department of National Taiwan University (TAI), the senior author found dried eggs of *S. kuafui* from *Li 3516*, *Li 3515*, *Suzuki ST17876*, *Severinghaus s.n.*, and *Yang 1328* (TAI). Among these plant specimens, *Suzuki ST17876* was made from San-Shin-Shan, I-Lan County, in 1939, *Yang 1328* and *Severinghaus s.n.* were both made from La-La-Shan, Taoyuan County, in 1974 and 1983, respectively. This discovery suggests *S. kuafui* was present at these localities

in the past.

This tree was formerly recognized as Taiwan endemic, recently has been reported from central China with a additional variety. (Shen 1993; Shen and Boufford 1988). This discovery suggests that the population of *S. kuafui* in Taiwan may be a relict and leads to Hsu and Lin (1994)'s prediction of finding this insect on mainland China (Hsu and Lin, 1994).

Conservation

Like other Taiwanese Theclini butterflies, loss and alternation of habitat by deforestation and injury of host trees by commercial collecting have immediately threatened the survival of *S. kuafui*. A male specimen costs about 10,000 Japanese Yen according to local resources. Additionally, an undescribed and high-priced *Neolucanus* sp. (Coleoptera) was recently collected from Pei-Cha-Tien-Shan Area (Tanikado, 1994), so it is predictable that commercial collecting will lead to interruption by human activities and injury of Taiwan Beech by wood-cutting in the near future.

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插天山綠小灰蝶（鱗翅目：小灰蝶科）之生活史

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摘 要

本文首次描述臺灣產插天山綠小灰蝶 *Sibatanozephyrus kuafui* Hsu & Lin, 1994 之幼生期形態及成蟲之野外生態觀察。卵及幼蟲皆採自殼斗科之臺灣山毛櫸 *Fagus hayata* Palib. ex Hayata。幼蟲期共有四齡，於實驗室中，自卵孵化至成蝶羽化約40天，並推測於野外之生活史約280-330天。插天山綠小灰蝶與其產於日本之最近緣種富士綠小灰蝶 *S. fujisanus* 之幼蟲及蛹在顏色和大小上具有細微之差異。而作者於國立臺灣大學植物學系植本館所藏，採自宜蘭縣三星山及桃園縣拉拉山之臺灣山毛櫸標本中發現插天山綠小灰蝶之卵殼，顯示本種蝶類至少曾分布於該區域。此外，本文並提供簡短之棲地觀察，寄主植物描述及本種於保育上之問題。

關鍵詞：插天山綠小灰蝶、富士綠小灰蝶、幼生期、臺灣山毛櫸、插天山自然保留區

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一般原則 稿件需一式參份(包括一份原稿及兩份影本)，以21×28公分白紙雙空格打字，左右兩邊各留3公分空間。學名下方需加橫線。除分類報告按分類格式撰寫外，其餘研究報告請依下列次序撰寫：(1)標題頁：包括題目(以簡明扼要為原則)、作者，服務機構及小標題(以10字為限)。標題頁右上角請註明負責連繫的作者姓名、地址、及電話。(2)中文摘要：以不超過全文3%的長度為原則，並應附為數不超過5個的關鍵詞；(3)本文(包括前言、材料與方法、結果、討論)；(4)誌謝；(5)參考文獻；(6)英文題目、作者、摘要及關鍵詞，文中之英文不得斷字；(7)註腳(footnote)頁：文稿中所有的註腳(例如作者地址變更)必須集中置於本頁。(8)表格：表格說明必須中英文對照，表的內容以英文表示，表格不得劃縱線，橫線亦應儘量少用；(9)圖說：圖的說明應中英文對照另頁繕打，不可附在繪圖及相片上面；(10)圖版或相片：圖不可超過14×20公分，分類用之圖版不在此限。作者投稿時必須將原圖一併寄達，不得使用影印圖片。如係電腦列印，其品質必需符合印刷標準，對於無法製版之圖及相片，本刊退還作者重製。本刊只接受黑白相片，如需印彩色照片時，作者自行負擔費用。來稿文字應力求清晰簡明，稿件請編頁碼。對於過長之稿件，本刊有權刪除或縮短。來稿一律採用公制單位，如m, cm, mm, ml, l, kg, g等。數值請以阿拉伯數字表示。

分類報告 除結果部分按下列格式撰寫外，其餘部分則參照“一般原則”撰寫。

1. 分類名稱標題(Taxonomic name heading)

屬以上全大寫、粗體：種之學名為斜體字，其屬名第一個字母大寫，其餘各字母為小寫(包括種之名及種小名)。新分類單元、新同物異名必須加註comb. n., comb. rev., nom. n., sp. n., stat. n., stat. rev., syn. n.等；或其他相同意義之縮寫。例如：

Family **BRACONIDAE**

Genus *Allobracon* Gahan, gen. n.

Allobracon pilosipes (Ashmead)

II. 異名表(Synonymous listing)

Musca Linnaeus, 1758: Syst. Nat. (ed. 10th) 1: 589

Type species: *Musca domestica* Linnaeus, 1758, Syst. Nat. 1: 589

Musca pattoni Austen, 1910: Ann. Mag. Nat. Hist. 5: 115;

Van Emden, 1939. Ruwenzori: 75

Musca yerburyi Patton, 1923: Philipp. J. Sci., 23: 329;

Patton et Serior-White, 1924. Rec. Ind. Mus., 26: 564;

Patton, 1937. Ann. Trop. Med. Paras., 30: 131-133.

III. 描述性徵(Description paragraph)

用電報體，盡量簡潔、明確，不要用冠詞；可由作者決定是否再分成不同段落。

IV. 標本檢查(Material examined)

1. 如果是新種請僅指定Holotype與Paratype(s)，不要指定Allotype。

2. 按地名，蟲數及性別，日期(日 月 年)，採集者，標本來源(ex寄主on植物)，標本存放處及編號等之次序撰寫。

(1)地名：

地點由最大的地點寫到最小(最精確)的地點；按英文字母次序排列；每一種之地名表中，同一地名僅可出現一次，相同地點按不同時間、採集者或標本來源時，以逗號(,)區隔。

國名與省(州)名用全大寫並加句點(.)，例如CHINA. TAIWAN.，但如果全文所用之標本全部採自同一個國家或省，則國名或省名可省，但需於前言中說明標本採集的地區。縣市用全大寫並加冒號(:)，縣市與縣市間用句點區隔。鄉鎮與其他地名，第一個字大寫，其餘小寫，海拔或距離用公制，例如3 km S of Taichung；鄉鎮與鄉鎮間用分號(;)區隔。

(2)月名用羅馬字(I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XII)；或英文前三字母，第一字母大寫，不加標點。

(3)不論蟲數多少，性別符號均只用一個♀或♂。如果用英文，則用male(s), female(s), nymph(s)或larva(e)等。

範例如下：

Material examined: Holotype♀, NANTOU: Tungpu 1,200 m, 23-VII-1984(或 23 Jun 1984), K. C. Chou. Paratypes: NANTOU: Wushe 1,150 m, 4♀7♂, 13-IV-1983, K. C. Chou. PINGTUNG: Shantimen, 3♀, 16-I-1984, K. C. Chou.

TAOYUAN: Fuhsing 500 m, 1♀1♂, 6-V-1983, K.C. Chou; Paling 800 m, 3♀6♂, 3-V-1983, K. C. Chou, ex *Spodoptera litura* on cabbage (TARI, 1000).

V. 鑑別性徵(Diagnosis or remarks paragraph)

如果是新分類單元，必須指出和相近分類單元最容易區別之性徵；用非電報體。

VI. 圖版(Figures)

插圖請用油性黑色墨水描繪並拼版，如果是照片，則照片之間隔力求一致；附比例尺並說明單位，但如果僅是說明結構性狀之照片，可由作者自行決定。

本文中引用文獻 引用文獻，作者用姓，年代用公元。例如一位作者：(Wu, 1993)；兩位作者：(Jander and Jander, 1970)或 Jander and Jander (1970)；三位作者以上：(Koeniger *et al.*, 1988)或 Koeniger *et al.*(1988)。引用文獻之排列順序，以年代先後為準。

參考文獻 一律以英文列出，依姓氏字母順序排列。同一作者之發表作品依年代順序排列。第一作者相同時，以作者人數排序。引用不常見之雜誌時，須寫出全名。引用中文文獻需在參考文獻中加註“(In Chinese)”等字樣。引用雜誌名稱之英文縮寫須按照“生物學摘要”(Biological Abstracts)所列者。其他請參考 CBE Style Manual。範例如下：

Bates, B. A., and M. T. Weiss. 1991. Seasonal abundance of *Limpothrips denticornis* (Thysanoptera: Thripidae) on spring barley. *Environ. Entomol.* 20: 419–426。

Hanski, I. 1989. Fungivory: fungi, insects and ecology. pp. 25–68. *in*: N. M. Collins, P. M. Hammond, and J. F. Webber, eds. *Insect–fungus Interactions*. Academic Press, London. (書籍中的一章)

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The Chinese Journal Of Entomology

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General: Three copies of each manuscript must be submitted (one original and two xerox copies). English scripts must be *typewritten* on one side of bond paper of 21×25 cm, *double-spaced* throughout, with ample margins of 3 cm. Underscore only where *italics* are intended in the body of the text.

Galley proof will be sent to the corresponding author. Authors of accepted paper will be asked to submit an electronic version of the manuscript. The Journal accepts 3.5" or 5.25" DOS-formatted diskettes. Major changes in proof will be charged to the author.

A manuscript other than scientific notes preferably contains: (1) Title page, including title, author(s) and affiliation, corresponding author, running title (no more than 10 words); (2) Abstract, about 3% of full manuscript in length is advisable, with, no more than 5 keywords; (3) Introduction; (4) Materials and Methods; (5) Results; (6) Discussion; (7) Acknowledgements; (8) References.

The metric system is to be used exclusively in manuscripts except where citing label data on type material, or in direct quotations when cited as such.

Contribution for Taxonomic Papers: Taxonomic papers submitted to Chinese Journal of Entomology should follow the style manual of this Journal stated as below:

1. Manuscripts must be in English.
2. Taxonomic name heading:

The name above generic level must be Boldface capital letters; generic name must be italic

small letter except first letter should be capital; specific and subspecific names are italic small letters. New taxonomic category and new Synonym should be stated as: comb. n., comb. rev., nom. n., sp. n., stat. n., stat. rev., syn. n. etc., all in boldface. for example:

Family **BRACONIDAE**

Genus *Allobracon* Gahan, gen. n.

Allobracon pilosipes (Ashmead)

3. Synonymous listing

Authors are asked to follow the example listed below:

Musca Linnaeus, 1758: Syst. Nat. (ed. 10th) 1: 589

Type species: *Musca domestica* Linnaeus, 1758, Syst. Nat. 1: 589

Musca pattoni Austen, 1910: Ann. Mag. Nat. Hist. 5: 115;

Van Emden, 1939. Ruwenzori: 75

Musca yerburyi Patton, 1923: Philipp. J. Sci., 23: 329;

Patton et Serior-White, 1924. Rec. Ind. Mus., 26: 564;

Patton, 1937. Ann. Trop. Med. Paras., 30: 131-133.

4. Description paragraph:

Description of a taxon must be short, clear and unambiguous sentence; article such as a, an or the are not necessary.

5. Materials examined:

- i) Holotype and Paratype(s) must be designated if a new taxon published. Allotype is not necessary.
- ii) Collecting site, number of specimens examined, sex, date, collector, host, specimens deposited and specimen number assigned should be stated in such order.

For example:

Materials examined: Holotype♀, NANTOU: Tungpu 1,200 m, 23-VII-1984, K. C. Chou.
Paratypes: NANTOU: Wushe 1,150 m, 4♀7♂, 13-IV-1983, K. C. Chou, PINGTUNG: Shantimen, 3♀, 16-I-1984, K. C. Chou. TAOYUAN: Fushing 500 m, 1♀1♂, 6-V-1983, K. C. Chou; Paling 800 m. 3♀6♂, 3-V-1983, K. C. Chou, ex *Spodoptera litura* on cabbage. (TARI no.1000).

If a new taxon described, it must have a relationship with other distinguished related taxon to be compared and or characters that easily to be recognized.

6. Figures:

Drawing or photographic figures must be clearly described, scale on each figure must be accompanied. Figure must be boldly drawn in black water-proof ink and in equal space in order to prepared a good figure.

References: All authors are expected to refer to the "Council of Biology Editors Style Manual" (American Institute of Biological Sciences, 3900 Wisconsin Ave., Wash., D.C. 20016) for preparation of manuscripts. For example:

Chu, Y. I. 1980. Chemical and cultural control of the rice seedling fly, *Atherigona exigua* Stein (Diptera: Muscidae), on corn in East Jawa, Indonesia. Plant Protec. Bull. (Taiwan, R.O.C.) 22: 327-335 (in Chinese).

Abbreviations for titles of journals should follow the list of *Biological Abstracts*. All citations in text must be listed in chronological order.

Figure Legends: Tables, figures and photographs must be on separate sheets. All legends and captions must also be numbered and typewritten on separate sheets. Illustrations should not exceed 14×20 cm. Only monochrome photographs are accepted. Colored illustrations are charged to the author. Improperly prepared illustrations will be returned to the author for correction prior to acceptance of the manuscript.

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