

A Revision of the *Heliophorus kohimensis* Group (Lepidoptera: Lycaenidae)*

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Abstract. A lycaenine species, *Heliophorus kohimensis* (Tytler) hitherto known from India to Vietnam is revised based mainly on the morphology of male and female genitalia and wing markings. The species is classified into two subspecies, *H. k. kohimensis* from Naga Hills, India and *H. k. elioti* subsp. nov. newly discovered in Laos, Myanmar, Vietnam and adjacent areas of Yunnan. Both inhabit rather high altitudes. *Heliophorus delacouri* Eliot stat. nov. originally described as a subspecies of *H. kohimensis* is known from lowlands in Vietnam and Guangdong, China. *Heliophorus delacouri* is separated from *H. kohimensis* based on extensive differences in genital morphology and wing markings and in altitudes of habitats besides their approximated distributions. Hitherto unknown larval hostplant of *H. delacouri* is recorded as *Persicaria chinensis* (Polygonaceae).

Key words: biogeography, *Heliophorus delacouri*, Lycaeninae, morphology, new subspecies, taxonomy.

Introduction

Heliophorus kohimensis (Tytler, 1912) belonging to the subfamily Lycaeninae was described from Naga Hills, India (Tytler, 1912). In the revision of the genus *Heliophorus* Geyer, 1832, Riley (1929) did not recognize subspecies in this species. Eliot (1963, 1965) included it in the *Heliophorus epicles* complex, together with *H. epicles* (Godart, 1824), *H. ila* (de Nicéville, 1896), *H. indicus* (Fruhstorfer, 1908) and *H. cantliei* Eliot, 1965. He divided *H. kohimensis* into two subspecies, namely the nominotypical one from Naga Hills, and a new subspecies *H. k. delacouri* Eliot, 1963 from Bac-Kan, Tonkin [= Vietnam]. Zhdanko (1995) divided *Heliophorus* into the subgenus *Heliophorus* and a new subgenus *Kulua*, and included *H. kohimensis* in the former. In addition, he separated a new genus *Nesa* from *Heliophorus*. Yago *et al.* (2000) followed his treatment and assigned *H. kohimensis* to the subgenus *Heliophorus*.

Heliophorus kohimensis is recorded from the north-east of India, Myanmar, Laos, Vietnam and the south-west of China. In this paper we examined specimens of this species from these areas, and those newly recorded from southern China. As a result of this morphological study, we detected that specimens from the southwest of China, Laos, the northwest of Vietnam and the northeast of Myanmar represent a new subspecies distinguished from the known subspecies on the basis of male genitalia. On the other hand, *H. k. delacouri* greatly differs from the nominotypical subspecies and from the new subspecies not only in wing markings but also in male and female genitalia. In this study *H. k. delacouri* was found to occur in some localities of Vietnam that are very close to the range of the new subspecies. The morphological difference and the geographical evidence enabled us to treat *H. k. delacouri* as a species distinct from *H. kohimensis*. We also give some biological information on *H. delacouri*.

Materials and Methods

The materials used in this work are dried specimens, and their detailed data are mentioned under the de-

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scriptions of each taxon. They were from Sibatani's collection of the Museum of Nature and Human Activities, Hyogo (MNHAH) and the collections of the Kunming Institute of Zoology, China (KIZC), the Laboratory of Insect Ecology, South China Agricultural University (SCAU), Dr. A. L. Monastyrskii (ALM), Mr. S. Osada (SO) and the Biosystematics Laboratory, Kyushu University (BLKU). In particular, recent materials were collected under the permissions of the Forest Protection Department of Ministry of Agriculture and Rural Development of Vietnam, the Department of Hotel & Tourism of Myanmar and the National Democratic Association of Kachin, and in cooperation with the Vietnam Russian Tropical Center, the BirdLife International Vietnam Programme, the Forest Inventory and Planning Institute in Vietnam and the Hanoi Agricultural University. The specimens in the BLKU were donated by many Japanese entomologists, mentioned in the acknowledgments of this paper.

Materials were treated in a similar manner to Yago *et al.* (2000) for observation of their genital structures. Terminology of the male genitalia follows Shirôzu (1960), except for the substitution of falx for brachium, and that of the female genitalia by Shirôzu & Yamamoto (1956) excluding the corpus bursae. In wing markings, we adopt the system proposed by Schwanwitsch (1949), but E^3 of the underside includes not only the outer black lines but also the inner white and black lines. The white spots appearing in the postdiscal area on the underside of the hindwing are interpreted as M^1 . The cells $1'$ and 1 in Schwanwitsch's system are treated as cells 1a and 1b+c, respectively.

Descriptions

We do not describe the female of the nominotypical subspecies of *H. kohimensis*, as we could not distinguish it from those of sympatrically occurring allied species. Identification of female specimens of the *H. epicles* species complex from one and the same locality is often very difficult (Eliot, 1963).

Key to *H. delacouri* and subspecies of *H. kohimensis*

1. Red submarginal markings on underside of hindwing broad, slightly wider than width of cell 2 at outer margin; M^1 arranged in straight line from cells 4 to 1b+c on underside of forewing; M^2 on underside of hindwing widely separated from E^3 ; white marginal line on upperside of hindwing very faint. Valva of male genitalia with its dorsal margin not strongly emarginate, bearing more or less lamellate subbasal process on costa, and slender, acutely pointed subapical process. Lamella antevaginalis of female genitalia bearing long lamellate process widened and slightly bifurcate apically. *H. kohimensis*, 2
- Red submarginal markings on underside of hindwing very broad, more than $1.5\times$ width of cell 2 at outer margin; M^1 distinctly shifted outwardly in cells 2 and 1b+c on underside of forewing; M^2 on underside of hindwing connected with E^3 ; white marginal line on upperside of hindwing distinctly appearing in cells 1a to 3. Valva of male genitalia with its dorsal margin strongly emarginate, bearing style-like, long subbasal process on costa, and weak subapical protuberance. Lamella antevaginalis of female genitalia bearing eaves-like, short lamellate process *H. delacouri* stat. nov.
2. In male, orange submarginal marking on upperside of hindwing clearly appearing in cells 1b+c and 2; valva of male genitalia narrow, with dorso-proximal portion extending to less than dorsal 1/3 of ring, with slender subbasal process and short, stout subapical process; ventral inner margin of valva roughly serrate from middle to subapical portion. *H. kohimensis kohimensis*
- In male, orange submarginal marking on upperside of hindwing faint in cells 1b+c and 2, often almost absent; valva of male genitalia swollen and wide, with dorso-proximal portion extending to more than dorsal 1/3 of ring, with short, wide subbasal process and long, slender subapical process; ventral inner margin of valva minutely serrate from middle to subapical portion. *H. kohimensis elioti* subsp. nov.

Heliophorus kohimensis kohimensis (Tytler)

(Figs. 1A, B, 2)

Ilerda kohimensis Tytler, 1912: 598-599 (type locality: Naga Hills).

Heliophorus kohimensis [!]: Fruhstorfer, 1918: 53.

Ilerda kohimensis [!]: Seitz, 1927: 1018.

Male. Wings (Figs. 1A, B): Forewing triangular; costal margin straight, but weakly curved near apex and more or less arched near base; apex weakly angulated, slightly less than 90° ; outer margin weakly arched anteriorly and straight posteriorly; inner margin almost straight. Hindwing with long tail at tip

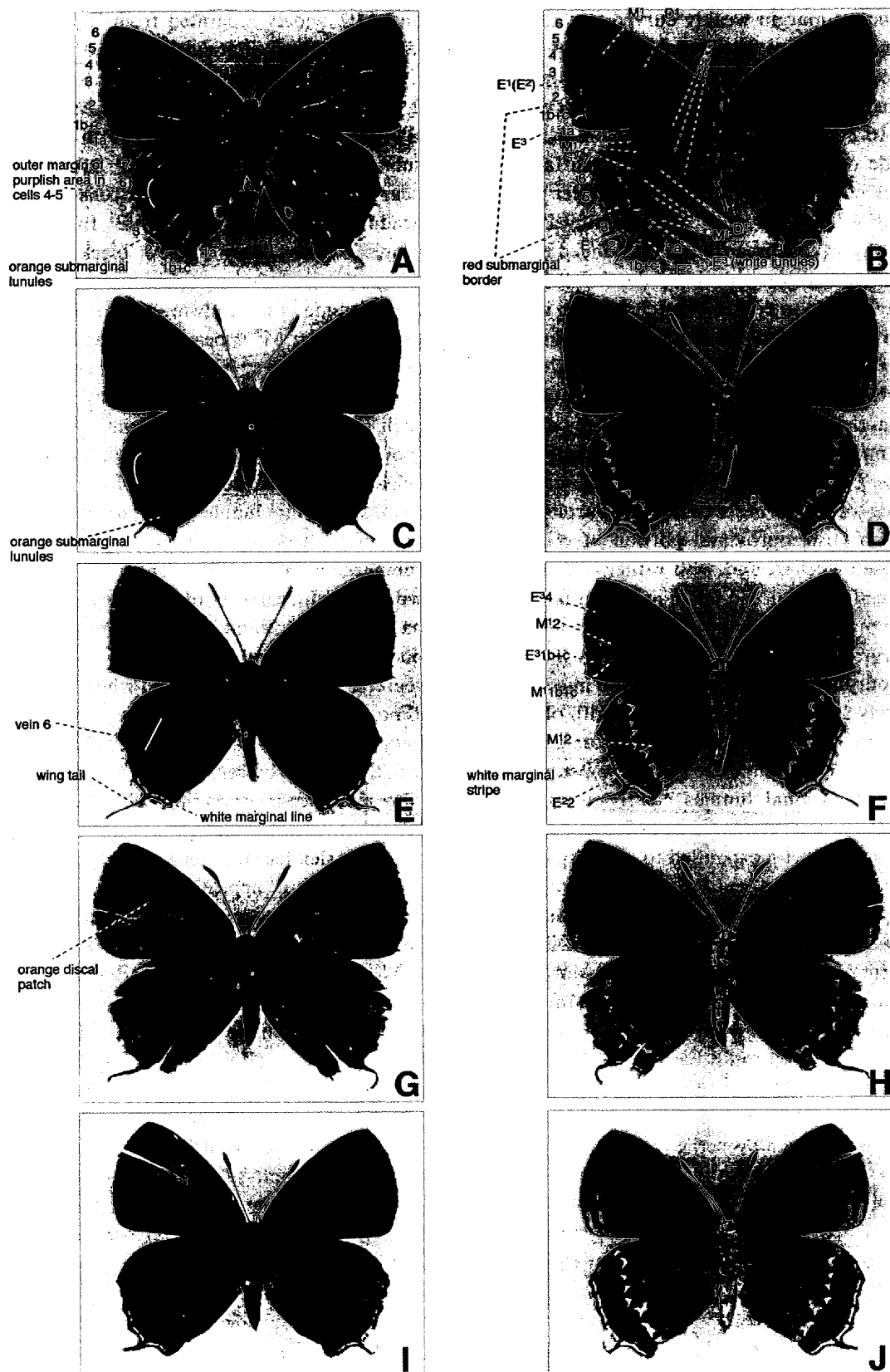


Fig. 1. *Heliophorus kohimensis* and *Heliophorus delacouri*. A, B, *Heliophorus kohimensis kohimensis* ♂, upper- (A) and underside (B); C, D, *H. kohimensis elioti* subsp. nov. ♂ [holotype], upper- (C) and underside (D); E, F, *H. delacouri* ♂, upper- (E) and underside (F); G, H, *H. kohimensis elioti* subsp. nov. ♀ [paratype], upper- (G) and underside (H); I, J, *H. delacouri* ♀, upper- (I) and underside (J).

of vein 2; costal margin weakly curved and almost as long as inner margin; outer margin faintly arched, slightly produced at tip of each vein but strongly so at tips of veins 3 and 6; anal angle developed. Length of forewing: 16.2–16.5 mm.

Upperside of forewing deep purple with faint dim lustre; black costal border very narrow; outer marginal black border broader, gradually expanded toward apex, so that purplish area roundly produced apically; width of outer marginal black border 2.0–2.2 mm in cell 1a, 1.3–1.4 mm in cell 1b+c, 1.7–1.8 mm in cell 2, 2.0–2.3 mm in cell 3, 3.0–3.1 mm in cell 4, 3.3–3.6 mm in cell 5, 4.4–4.5 mm in cell 6, and 4.5–4.7 mm on apical portion of wing; fringe consisting of short, blackish basal scales and long, whitish apical scales; the latter much darker at tips of veins and toward tornus.

Upperside of hindwing extensively purplish from cell 1b+c to posteroproximal portion of cell 6 and extreme base of cell 7, and with rather broad costal, narrow outer marginal and inner marginal black borders; outer marginal border nearly as wide as that of forewing, gradually widened toward costa; outer margin of purplish area slightly undulate in cells 1b+c to 3, weakly arched in cells 4 and 5; width of border 1.3–1.4 mm in cell 1b+c, 1.8–1.9 mm in cell 2, 1.2–1.3 mm in cell 3, 1.5–1.8 mm in cell 4, 2.0–2.3 mm in cell 5; orange submarginal lunules clearly appearing in cells 1b+c to 3, but small and occasionally absent in cell 3; that in cell 1b+c expanded to anal angle; width of lunule in cell 1b+c about 0.6 mm; obscure narrow white marginal line appearing along outer margin in cells 1a to 3, and widely divided in each cell; fringe almost as in forewing but longer, and whitish long scales becoming darkened apically in cells 1a to 2.

Underside of forewing ochreous with yellow tinge in ground color; cell 1a and basal 1/3 of cell 1b+c tinged with whitish-gray; D¹ (discocellular bar) recognizable as a very obscure dark line; M¹ (postdiscal markings) represented by series of blackish bars in cells 1b+c to 6, but often absent in some cells, arranged in straight line in cells 1b+c to 4; M¹1b+c

and M¹2 widely separated from E³; E³ appearing as large, elongate, elliptical bar broadly white-bordered inwardly in cell 1b+c, similar but narrower bar in cell 2, and very obscure in cell 3; distance between M¹ and E³ in cell 1b+c more than width of E³1b+c; red submarginal border between E¹ and E³ narrow, appearing in anterior portion of cells 1b+c to 6, and gradually narrowed apically; E¹ fused with E² and represented by very narrow blackish line close to fringe; fringe as in upperside.

Underside of hindwing yellowish ochreous in ground color; M² appearing as small to minute black dots in cells 1b+c, 7 and discoidal cell; D¹ discernible as very obscure dark bar; M¹ appearing as black dot in each of cells 1a, 7 and barely in cell 6, and as white spot in each of cells 1b, 2, 4 and 5, but disappearing in cells 1c and 3; white spot of M¹1b connected and often fused with white lunule consisting of part of E³; white spot of M¹2 separated from white lunule of E³2; red submarginal border wide (Table 1), partially suffused with whitish scales, bordered inwardly with series of narrow white lunules representing part of E³, and bordered outwardly with series of blackish E²; E³ represented by black-bordered white lunules, arranged almost parallel to outer margin of wing, but shifted inwardly in cells 4 and 6; width of lunule in cell 1b+c 0.2–0.3 mm; E² represented by triangular blackish spot in each cell, largest in cell 2 and connate outwardly with white marginal stripes; white marginal stripes obscure, slender and separated by each vein along outer margin; E¹ appearing as narrow black line along outsides of white marginal stripes; fringe as in upperside.

Male genitalia (Fig. 2): Slender as in other species of subgenus *Heliophorus*. Ring strongly inclined posteriorly, very oblique to body axis. Tegumen gradually widened dorsally. Vinculum narrowed. Saccus straight, extremely long and almost as long as height of ring. Socius long, half as long as height of ring, clothed with longish hairs above, in lateral view directed posteroventrally, evenly slender, arched in subbasal portion, then almost straight to tip, in dorsal view

Table 1. Width of red submarginal border (measured from E¹ to inner margin of submarginal border) on underside of hindwing in *Heliophorus kohimensis* and *H. delacouri*.

Species or subspecies	cell 1a	cell 1b+c	cell 2	cell 3	cell 4	cell 5	cell 6	cell 7	Degree of width
<i>H. kohimensis kohimensis</i> ♂	1.2–1.5	1.8–2.0	2.4–2.5	1.7–2.0	2.4–2.5	2.2–2.4	2.3–2.5	0.5–0.6	wide
<i>H. kohimensis elioti</i> ♂	1.2–1.4	1.4–2.2	1.6–2.5	1.5–1.7	1.7–2.1	1.6–2.1	1.5–2.2	0.4–0.6	wide
<i>H. kohimensis elioti</i> ♀	0.8	1.7–2.2	2.2–2.6	1.6–2.2	2.5–2.6	2.4–2.5	2.5–2.6	0.4–0.6	wide
<i>H. delacouri</i> ♂	1.6–2.0	2.2–3.0	2.9–3.9	2.0–2.6	2.3–2.9	2.3–3.1	2.5–3.2	0.4–0.7	very wide
<i>H. delacouri</i> ♀	1.5–1.7	2.6–2.7	2.2–2.7	2.2–2.7	2.4–2.7	2.2–3.0	2.1–2.8	0.6–0.7	very wide

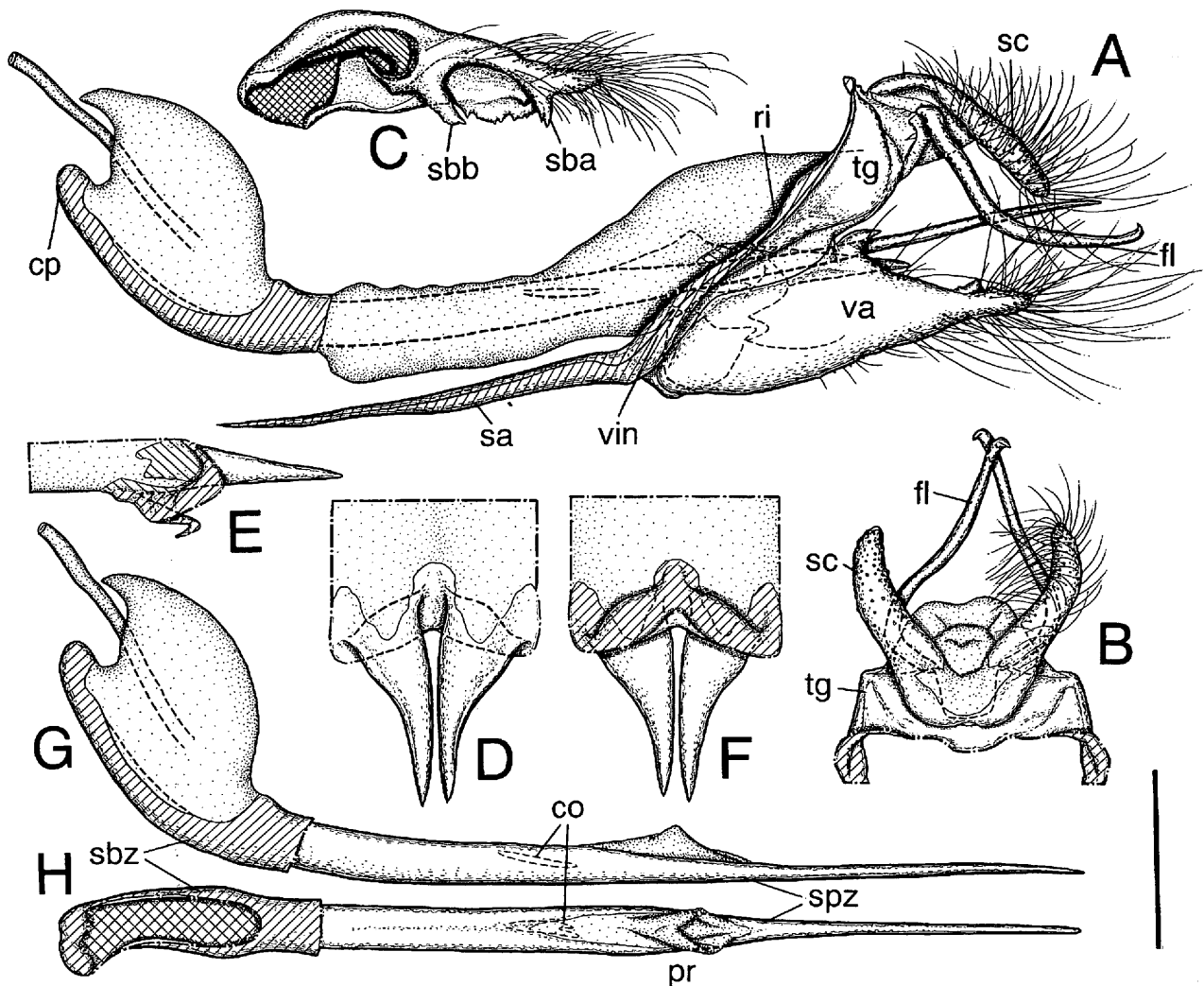


Fig. 2. Male genitalia of *Heliophorus kohimensis kohimensis*. A, genitalia as a whole, lateral view; B, dorsum, dorsal view; C, right valva, dorsal view; D-F, juxta, dorsal (D), lateral (E) and ventral (F) views; G, H, phallus, lateral (G) and dorsal (H) views. Scale bar=0.5 mm. Abbreviations: cp: coecum penis; co: cornutus; fl: falx; pr: perivesical area; ri: ring; sa: saccus; sc: socius; sba: subapical process; sbb: subbasal process; sbz: subzonal portion; spz: suprazonal portion; tg: tegumen; va: valva; vin: vinculum.

socius slender but slightly broader basally, divergent from opposite socius to apical $4/5$, then slightly curved posteriorly in apical $1/3$, tapered apically and weakly pointed at apex. Falx evenly long, slender, weakly curved dorsally in apical $1/2$, extending posteriorly well beyond tip of socius, pointed and hooked at apex. Valva moderately large and moderately broad basally, with dorsoproximal portion extending to less than dorsal $1/3$ of ring, and apex extending posteriorly slightly beyond tip of socius; in lateral view valva evenly tapered to slender apical portion, and with subbasal process of costa and subapical process projecting beyond the dorsal margin; in dorsal view valva weakly arched on outer wall, widely concave on inner wall, tapered to slender apical portion; dorsal inner margin of valva produced inwardly into sub-

basal and subapical processes; subbasal process moderately long and more or less style-like, but tending to be slightly lamellate, with serrate apical portion; subapical process short, basally thick and sharply pointed apically; ventral inner margin of valva distinctly arched from subbasal portion to middle and then roughly serrate to subapical portion. Phallus long, extremely slender, nearly $3\times$ as long as height of ring, with elongate cornutus; suprazonal portion nearly $3\times$ as long as subzonal portion, straight, gradually tapered toward tip on apical $1/2$ and ending in long apical projection which is almost as long as main part of suprazonal portion; dorsal surface of suprazonal portion occupied by perivesical area on middle $1/3$; subzonal portion slightly curved dorsally toward proximal end; coecum penis short. Juxta well developed,

nearly 2/3 as long as height of ring, in dorsal view moderately broadly flattened basally, slightly concave on dorsocentral region and produced into pair of long, slender, sharply pointed processes extended posteriorly close to and parallel with each other; lateral portion of juxta shortly produced posteriorly into pair of flexed projections which are tightly associated with basal extensions of costae of valvae; ventromedian projection of juxta short. Length of male genitalia: 2.4–2.5 mm (N=3).

Specimens examined. India: 1♂, 1920, Naga Hills [MNHAH]; 2♂, iv.1954, same locality [MNHAH].

Geographical distribution. This subspecies is known only from Naga Hills, India.

Remarks. In appearance, *H. kohimensis* (both subspecies) is similar to *H. ila ila* endemic to Sumatra, but it distinctly differs from the latter species in having a well-developed subbasal process on the costa of the male genital valva and no orange flushed patch on the lower half of the underside of the forewing. The male of *H. kohimensis* never has a small orange patch on the upperside of the forewing, which appears in some species of the *H. epicles* complex.

According to Tytler (1912), this subspecies was captured between 5,000–7,000 ft. (about 1,500–2,500 m) in the Naga Hills from September to December, and it was not nearly so common as *H. epicles* and lived at a much higher altitude.

***Heliophorus kohimensis elioti* subsp. nov.**

(Figs. 1C, D, G, H, 3, 4)

Heliophorus kohimensis delacouri (nec. *delacouri* Eliot, 1963): Osada, 1999: 216.

Male. Distinguished from the nominotypical subspecies as follows. Wings (Figs. 1C, D): Wing shape as in nominotypical subspecies. Length of forewing: 15.0–16.5 mm.

On upperside of forewing, width of black outer marginal border 1.9–2.2 mm in cell 1a, 1.0–1.2 mm in cell 1b+c, 1.4–1.5 mm in cell 2, 2.1–2.3 mm in cell 3, 2.6–3.0 mm in cell 4, 3.3–3.8 mm in cell 5, 4.6–4.7 mm in cell 6, and 5.5–5.6 mm on apical portion of wing. On upperside of hindwing, width of black border 1.2–1.5 mm in cell 1b+c, 1.0–1.2 mm in cell 2, 0.9–1.0 mm in cell 3, 0.9–1.5 mm in cell 4, 1.5–2.0 mm in cell 5; orange submarginal lunules appearing in cells 1b+c and 2, but narrower, very obscure and often disappearing; width of lunule in cell 1b+c 0.0–0.3 mm.

On underside of forewing, E³ present as larger elliptical bar in cell 1b+c. Underside of hindwing

with red submarginal border less suffused with whitish scales (width of red submarginal border shown in Table 1); width of E³ variable, almost overlapping ranges of *H. k. kohimensis* and *H. delacouri*; width of white lunule in cell 1b+c 0.2–0.4 mm.

Male genitalia (Fig. 3): Tegumen slightly thicker. Falx weakly curved throughout length. Valva large and very broad basally, with dorsoproximal portion extended to more than dorsal 1/3 of ring, and apex extended posteriorly beyond tip of socius; in lateral view valva evenly tapered from subbasal portion to pointed apex, and with subbasal process of costa and subapical process distinctly projected beyond dorsal margin; in dorsal view valva prominently arched on outer wall, narrowly concave on inner wall, and tapered to slightly thicker apical portion; dorsal inner margin of valva with subbasal process shorter, rather broad and with subapical process long, slender and pointed apically; dorsal portion of valva often with small, transversely extended bump near base of subbasal process; ventral inner margin of valva distinctly arched from subbasal portion to middle and then minutely serrate to subapical portion. Phallus stouter and thicker; apical projection of suprazonal portion half as long as main part; subzonal portion slightly longer and thicker. In dorsal view juxta produced into pair of thicker, more weakly pointed processes close to and parallel with each other. Length of male genitalia: 2.1–2.2 mm.

Female. Wings (Figs. 1G, H): Wing shape broader than in male. Forewing costal margin evenly and weakly arched, and outer margin strongly rounded; relative length of costal margin to inner margin slightly shorter than in male, so that apex more weakly produced. Length of forewing: 15.2–15.5 mm.

Upperside of forewing blackish brown, with rather small, elliptical, orange discal patch expanding from base of vein 10 to anterior 1/2 of cell 2 or vein 2, and extending to apical portion of discoidal cell, becoming obscure in cell 2, 2.7–3.0 mm in transverse length, 5.5–6.5 mm in longitudinal length; fringe consisting of short black scales and long whitish scales, the latter often darkened at tips of veins.

Upperside of hindwing blackish brown, with series of rather slender, orange submarginal lunules from cells 1a to 5; width of lunule in cell 1b+c 0.6–0.8 mm; narrow white marginal line faint as in male; fringe almost as in forewing but longer, and long whitish scales becoming darker toward anal angle.

Underside of fore- and hindwings almost as in male (width of red submarginal border on hindwing shown in Table 1); fringe as in upperside.

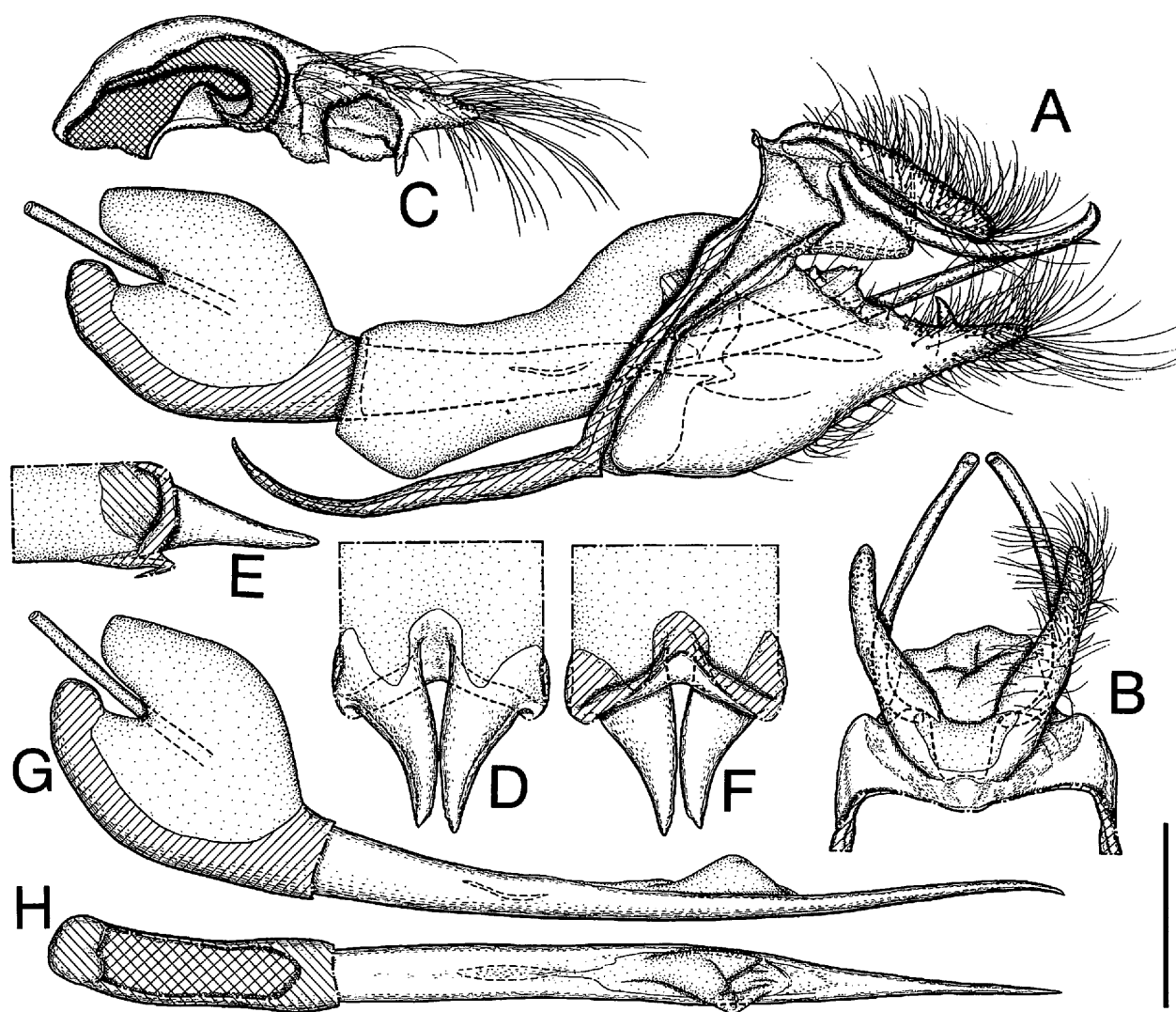


Fig. 3. Male genitalia of *Heliophorus kohimensis elioti* subsp. nov. A, genitalia as a whole, lateral view; B, dorsum, dorsal view; C, right valva, dorsal view; D-F, juxta, dorsal (D), lateral (E) and ventral (F) views; G, H, phallus, lateral (G) and dorsal (H) views. Scale bar=0.5 mm.

Female genitalia (Fig. 4): Eighth abdominal tergum trapezoidal, narrower posteriorly. Genital plate shorter than 8th abdominal tergum, consisting of well-developed lamella antevaginalis and wide lamella postvaginalis, united by deep transverse furrow, rather strongly sclerotized and expanded anteriorly; in ventral view, genital plate rather widely and deeply invaginated transversely just posterior to ostium bursae. Lamella antevaginalis with two pairs of transversely arranged small bumps on anterior portion, produced on middle portion into strongly sclerotized, large lamella process; lamella process slightly longer than wide or 8th sternum, only slightly widened apically, widely and weakly emarginate on posterior margin, in dorsal view deeply and longitudinally concave, forming furrow. Ostium bursae opened beyond anterior 1/3 of genital plate. Lamella postvaginalis transversely

extended, 1/3 as long as wide, rounded, strongly sclerotized but weak posteriorly, with weak ventromedian membranous incision continuing to irregular small ventromedian desclerotizations and bearing many shallow transverse wrinkles. Bursa copulatrix consisting of extremely long, very slender and sclerotized ductus bursae and elongate, membranous corpus bursae. Ductus bursae almost straight, nearly as long as 8th tergum, nearly 1/2 as thick as wide, slightly tapered distally, thin and transparent in endocuticular layer of coelomic side, more or less sclerotized, slightly pigmented in exocuticular layer of luminal side, and connected with base of coecum bursae at end; dorsal surface of ductus bursae deeply and longitudinally concave or furrow-like; ventral surface of ductus bursae hemicylindrical and without a short longitudinal furrow. Ductus seminalis arising from base of

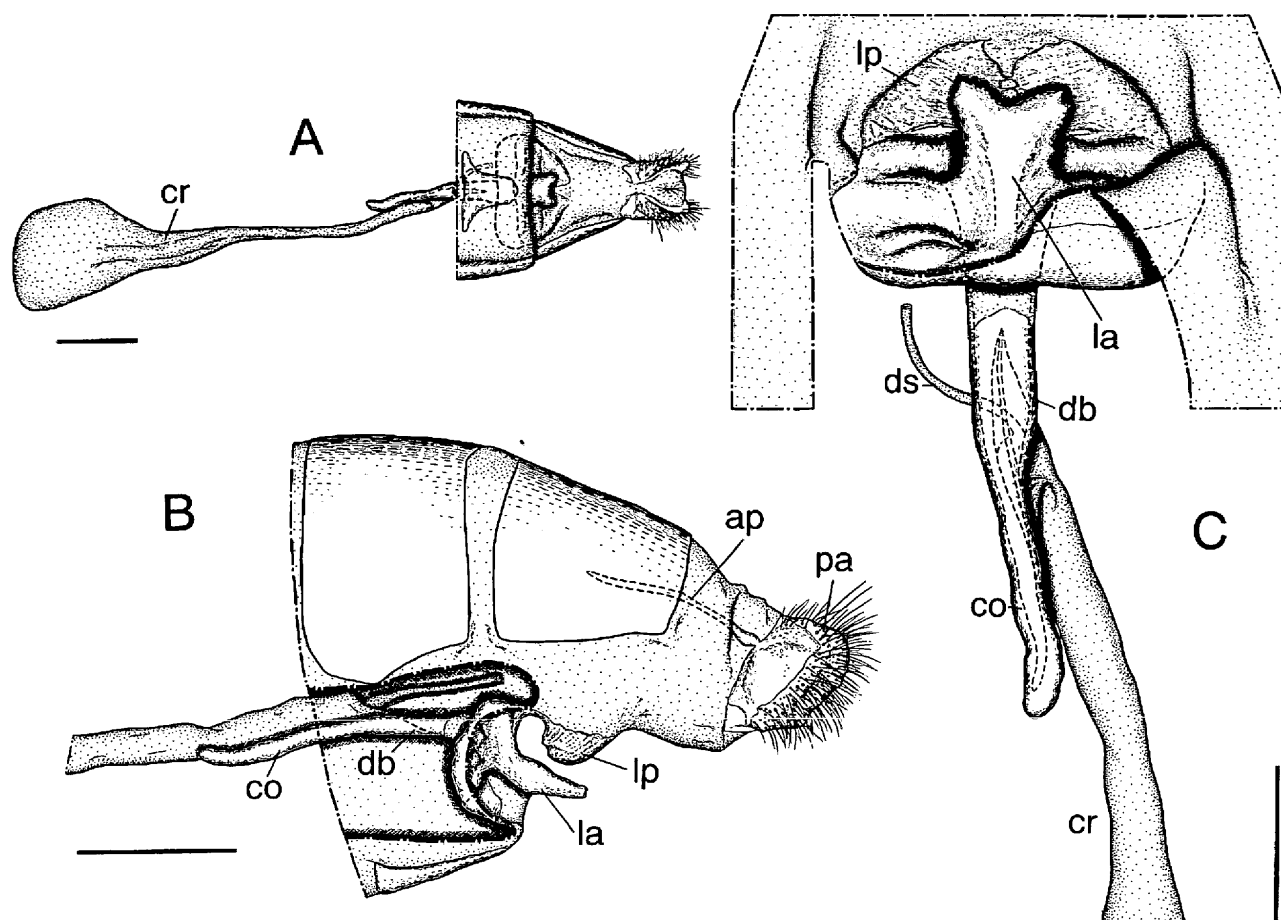


Fig. 4. Female genitalia of *Heliophorus kohimensis elioti* subsp. nov. A, genitalia as a whole, ventral view; B, genitalia except for corpus bursae, lateral view; C, genital plate, ventral view. Scale bars=1.0 mm (A); 0.5 mm (B); 0.5 mm (C). Abbreviations. ap: apophysis posterioris; co: coecum bursae; cr: corpus bursae; db: ductus bursae; la: lamella antevaginalis; lp: lamella postvaginalis; pa: papilla analis; ds: ductus seminalis.

corpus bursae rather posterior to base of coecum bursae close to ductus bursae. Coecum bursae slender, cylindrical, almost straight but slightly curved toward apex, nearly as long as ductus and more or less sclerotized on luminal side. Corpus bursae very long, directed anteriorly, nearly $4.8 \times$ as long as 8th tergum, arising from dorsal surface of anterior extremity of ductus bursae, evenly slender on proximal 1/2, then gradually swollen on distal 1/2, conglomerately thickened on the anterior 1/3, which is as long as 8th tergum in diameter; signum absent. Papilla analis oval in lateral view, with dorsal margin 2/3 as long as proximal margin or ventral (posterior) margin, rounded apically, more strongly sclerotized on basal half, bearing many setae of various lengths on apical half; apophysis posterioris longer than $2 \times$ length of dorsal margin of papilla. Length of female genitalia: Bursa copulatrix (from ostium to distal portion of corpus) 4.2–4.3 mm; ductus bursae+coecum bursae 1.2–1.3 mm; lamella antevaginalis 0.5–0.6 mm; free process of lamella antevaginalis 0.2–0.3 mm.

Holotype. 1♂, 23.v.1996, about 1,500 m alt. of Pingbian, Yunnan, China (T. Saigusa leg.) [KIZC].

Paratypes. Laos: 4♂, 20.iii.1995, Phong Saly (S. Osada leg.) [SO & BLKU]; 1♂1♀, 30.viii.1997, same locality (H. Wakahara leg.) [SO & BLKU]. Myanmar: 1♂, 20.vii.2001, 1,840 m alt. of Lop-pi, Kachin (Y. Watanabe leg.) [BLKU]. Vietnam: 1♀, 2.x.1998, 1,500m alt. of Hoang Lien Son Natural Reserve, Lao Cai Province (A. L. Monastyrskii leg.) [ALM]; 1♂, 3.viii.2000, Sa Pa, Lao Cai Province (K. Shibahara leg.) [BLKU].

Geographical distribution. At present, this subspecies is known from the southwest of China, the northwest of Vietnam, northern Laos and the northeast of Myanmar.

Remarks. Osada (1999) presented photographs of this new subspecies identified as *H. kohimensis delacouri*. Through the courtesy of Mr. S. Osada, we have examined his specimens and confirm this synonymy.

The male of this new subspecies is very similar to

the nominotypical subspecies, but distinctly differs from the latter as follows: 1) orange submarginal lunules more slender and often disappearing on upper-side of hindwing, 2) male genital saccus and phallus slightly thicker, 3) male valva more swollen and thickened as a whole, 4) subapical process of valva long and sharp, 5) subbasal process of costa of valva greatly widened, and 6) ventral inner margin of valva minutely serrate from middle to subapical portion. However, a specimen from the northeastern area of Myanmar has more or less narrow and rather weakly swollen valvae. According to Tytler (1912), the female of *H. k. kohimensis* differs from *H. epicles* in having a larger red discal patch on the upperside of the forewing. In contrast, that of *H. k. elioti* seems to be slightly smaller than in other species of the *H. epicles* complex including *H. k. kohimensis*. Moreover the female of *H. k. elioti* has narrower orange submarginal lunules on the upperside of the hindwing. The female genitalia of *H. kohimensis* had been undescribed. A brief comment by Yago *et al.* (2000) concerning the female genitalia of this species was that of the following species, *H. delacouri*.

In Yunnan, this subspecies was observed and collected along a trail bordering a mountain stream (1–2 m wide) at about 1,500 m alt. in an evergreen broad-leaved forest, which mainly consisted of *Castanopsis* (Fagaceae).

Etymology. The subspecific name, *elioti*, is dedicated to Mr. J. N. Eliot, who contributed to the study of the family Lycaenidae as well as that of the genus *Heliophorus*.

***Heliophorus delacouri* Eliot stat. nov.**

(Figs. 1E, F, I, J, 5, 6)

Heliophorus kohimensis delacouri Eliot, 1963: 180 (type locality: Bac-Kan, Tonkin [=Vietnam]).

Male. Distinguished from *H. kohimensis* as follows. Wings (Figs. 1E, F): Forewing apex more strongly angulated. Hindwing with longer tail; outer margin more obviously produced at vein 6. Length of forewing: 15.5–17.5 mm.

On upperside of forewing, purplish area more weakly produced apically; width of black outer marginal border 1.6–2.2 mm in cell 1a, 1.1–1.6 mm in cell 1b+c, 1.2–1.7 mm in cell 2, 1.5–2.2 mm in cell 3, 2.1–3.2 mm in cell 4, 2.8–4.3 mm in cell 5, 3.8–5.4 mm in cell 6, and 4.2–5.8 mm on apical portion of wing; fringe similar to *H. kohimensis*, but apical scales more whitish.

On upperside of hindwing, outer margin of purplish

area more reduced in cell 4 and conspicuously so in cell 5, so that outer margin of purplish area almost straight in both cells; width of black border 1.4–1.6 mm in cell 1b+c, 1.4–2.0 mm in cell 2, 1.2–1.5 mm in cell 3, 2.3–2.5 mm in cell 4, 2.9–3.5 mm in cell 5; orange submarginal lunules distinct and wide in cells 1b+c and 2, slightly in cell 3, but almost absent in all cells of some specimens; that in cell 1b+c usually expanded to anal angle; width of lunule in cell 1b+c 0.7–1.2 mm (if present); narrow white marginal line clearly appearing along outer margin in cells 1a to 3 and obscurely in cells 4 and 5 and divided by veins; fringe similar to *H. kohimensis*, but darker scales at tips of veins more sharply contrasted with white scales between each vein.

Underside of forewing ochreous with faint orange tinge in ground color; cell 1a and basal portion of cell 1b+c strongly tinged with whitish-gray; black bars of M^1 strongly shifted outwardly in cells 1b+c and 2, so that M^1 more strongly divergent from outer margin toward apex; E^3 appearing as larger elliptical bar in cell 1b+c, narrowed in cells 2 and 3, often faintly present in cell 4; distance between M^1 and E^3 in cell 1b+c almost as long as or less than width of E^3 1b+c; whitish line present in cells 1b+c to 3 or 4; red submarginal border between E^1 and E^3 deeper in color and distinctly wider; fringe as in upperside.

Underside of hindwing ochreous with slight orange tint as in forewing; white M^1 close to E^3 by reason of expansion of red submarginal border; M^1 2 almost connected with white lunule of E^3 ; red submarginal border deeper in color, very wide (Table 1), more densely suffused with white scales in cells 3, 4 and 5, and bordered inwardly with series of distinct white lunules representing part of E^3 , and bordered outwardly with series of triangular black E^2 , of which E^2 2 is more strongly extended inwardly; width of white lunule in cell 1b+c 0.4–0.6 mm; white marginal stripes striking and narrowly divided by each vein along outer margin; fringe as in upperside.

Male genitalia (Fig. 5): Similar to those of *H. k. kohimensis*, but differing as follows. In dorsal view, socius slightly wider basally. Falx weakly curved to basal 2/3, then strongly curved for apical 1/3. Valva small and narrow basally, with dorsoproximal portion extending to 1/2 of ring, and apex ending before or slightly beyond tip of socius. In lateral view, valva strongly tapered from base to middle by distinct emargination of dorsal margin, then keeping the same width from middle to subapical portion, ending in pointed tip, and with subbasal and subapical processes distinctly projected dorsally. In dorsal view, valva

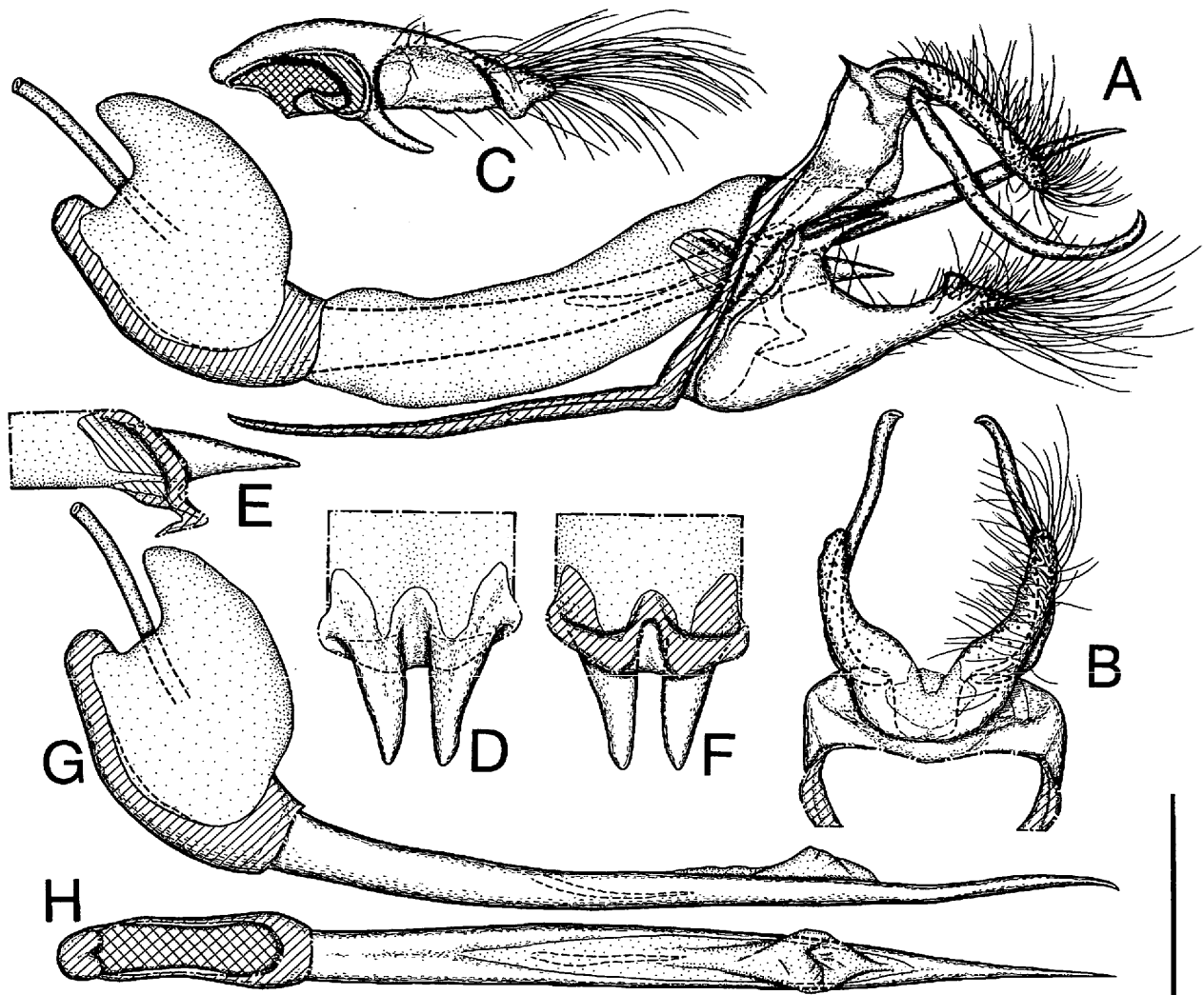


Fig. 5. Male genitalia of *Heliophorus delacouri*. A, genitalia as a whole, lateral view; B, dorsum, dorsal view; C, right valva, dorsal view; D-F, juxta, dorsal (D), lateral (E) and ventral (F) views; G, H, phallus, lateral (G) and dorsal (H) views. Scale bar=0.5 mm.

slightly arched on outer wall, broadly concave on inner wall, and gradually tapered to roundly produced apex; subbasal process style-like, very long, slender, weakly curved and pointed apically; subapical process represented by weak protuberance; ventral inner margin of valva almost straight with minute serration beyond middle. Phallus with more slender and longer cornutus; dorsal surface of suprazonal portion occupied by long perivesical area on middle 1/2; apical portion of suprazonal portion 1/3× as long as main part. Juxta shorter, about half as long as height of ring, in dorsal view produced into pair of slightly short, gently tapered processes more widely separated and parallel with each other; ventromedian projection of juxta more strongly produced. Length of male genitalia: 2.3–2.5 mm.

Female. Wings (Figs. 1I, J): On forewing, costal margin evenly arched; outer margin strongly rounded;

relative length of costa to inner margin shorter than in male, so that apex more weakly produced and rounded. Length of forewing: 16.0–17.2 mm.

Upperside of forewing blackish brown, with large, elliptical, orange discal patch expanding from base of vein 10 or 11 to cell 2, often slightly extended to cell 1b+c and apical portion of discoidal cell, not becoming obscure in cell 2, 3.8–4.0 mm in transverse length and 8.0–9.5 mm in longitudinal length; orange scales scattered in distal portion of discoidal cell and basal portions of cells 1b+c and 2; fringe as in male.

Upperside of hindwing blackish brown, with series of wide, almost band-like, orange submarginal lunules from cells 1a to 6; lunules connected with each other and becoming smaller and more obscure in cells 1a and 6; width of lunule in cell 1b+c 1.0–1.7 mm; some orange scales rarely scattered inwardly in cells 3, 4 and 5; narrow white marginal line and fringe as in male.

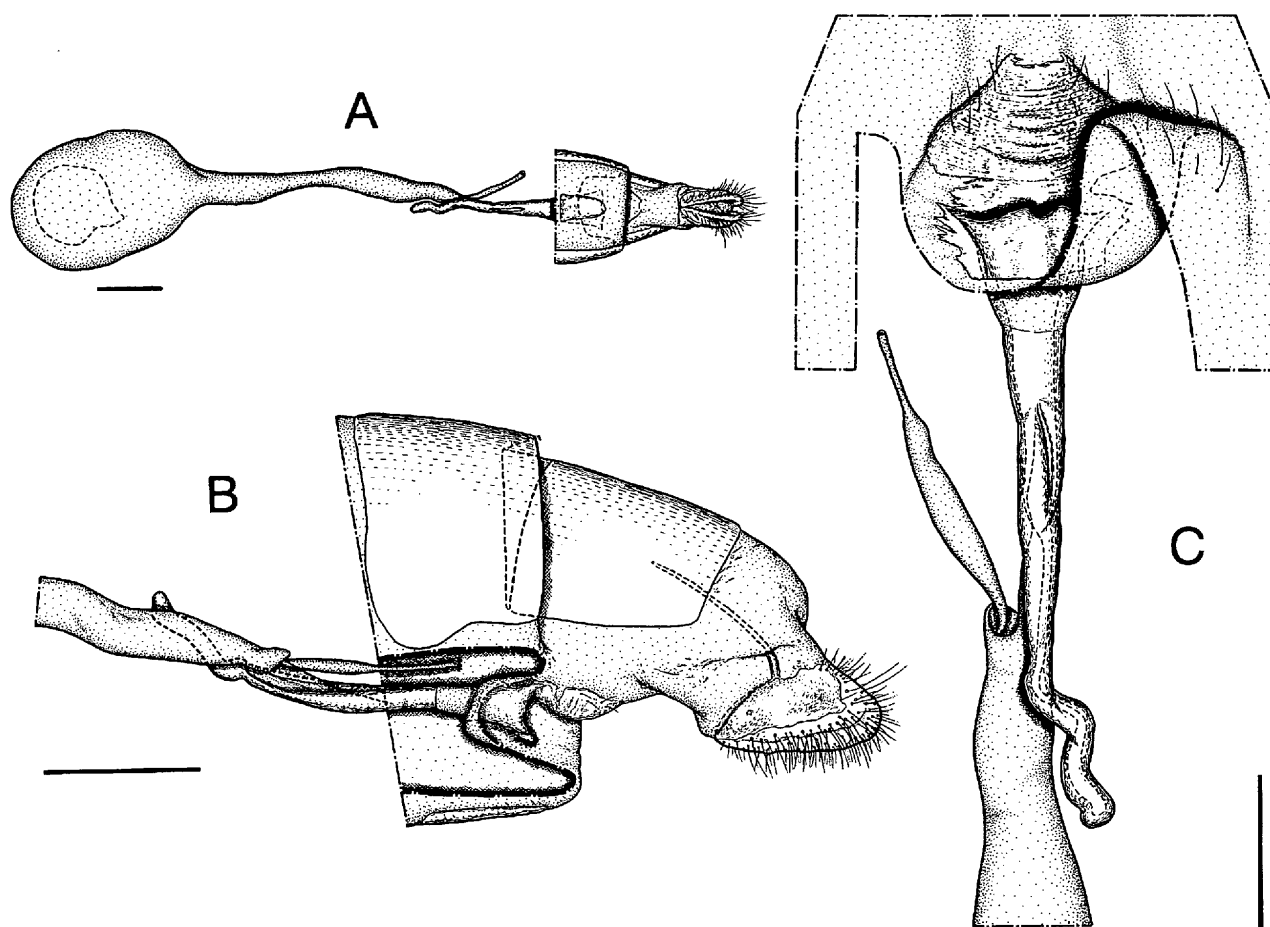


Fig. 6. Female genitalia of *Heliophorus delacouri*. A, genitalia as a whole, ventral view; B, genitalia except for corpus bursae, lateral view; C, genital plate, ventral view. Scale bars=1.0 mm (A); 0.5 mm (B); 0.5 mm (C).

Underside of fore- and hindwings similar to male (width of red submarginal border on hindwing shown in Table 1); fringes of undersides of both wings as in upperside.

Female genitalia (Fig. 6): Differing from those of *H. k. elioti* as follows. Genital plate consisting of rather small lamella antevaginalis and developed lamella postvaginalis, connected with each other by weak ventromedian sclerotization. Lamella antevaginalis strongly sclerotized, widely swollen hemicylindrically, more or less widened posteriorly, with posterior margin forming short eaves which cover ostium bursae and slightly incised medially. Ostium bursae opened at anterior 1/3 of genital plate. Lamella postvaginalis transversely extended, nearly 2/3 as long as wide, gradually narrowed posteriorly and ending in truncate, weakly sclerotized posterior margin; ventromedian portion of lamella postvaginalis slightly swollen, bearing many deeper transverse wrinkles. Ductus bursae more slender and longer; ventral surface of ductus bursae with short longitudinal furrow at middle. Coecum bursae more slender, irreg-

ularly curved toward apex and 1/2 as long as ductus bursae. Corpus bursae 6× as long as 8th tergum, evenly slender on proximal 3/5, then conglomerately swollen on distal 2/5, which is nearly as long as 8th tergum in diameter. Papilla analis oval but more narrowed in lateral view, with dorsal margin 2/3 as long as proximal margin or half of ventral (posterior) margin, roundly pointed apically; apophysis posterioris less than 2× as long as dorsal margin of papilla. Length of female genitalia: Bursa copulatrix (from ostium to distal portion of corpus) 5.6–6.0 mm; ductus bursae+coecum bursae 1.6–1.8 mm; lamella antevaginalis about 0.2–0.3 mm.

Specimens examined. Vietnam: 2♂, 5.vi.1997, 200–300 m alt. of Cuc Phuong, Ninh Binh Prov. (R. Matsumoto leg.) [BLKU]; 19♂2♀, 23–29.iv.1998, same locality (R. Matsumoto leg.) [BLKU]; 3♂1♀, 3–8.v.1998, 900–1,200 m alt. of Tam Dao, Vinh Phu Prov. (R. Matsumoto leg.) [BLKU]; 1♂, 10.xi.1998, Ben En Natural Reserve, Thanh Hoa Prov. (A. L. Monastyrskii leg.) [ALM]; 1♂, 16.xi.1998, same locality (A. L. Monastyrskii leg.) [ALM]. China:

2♂, 23.vi.1999, about 1,000 m alt. of Shimentai Prov. Natural Reserve, Yingde city, Guangdong (M. Wang leg.) [SCAU]; 1♂, 23.i.1983, Zhaoqing, Guangdong (T. Fujioka leg.) [SCAU].

Geographical distribution. This species is known only from the northeast of Vietnam and southern China.

Remarks. The male of this species is similar to that of *H. kohimensis* in external appearance. The differences between them are summarized as follows: 1) purplish area on upperside of hindwing more reduced in cells 4 and 5; 2) white marginal line on upper- and underside of hindwing distinctly developed; 3) red submarginal border on underside distinctly wider and deeper in color; 4) white M¹2 on underside of hindwing connected with white lunule of E³2; 5) tip of vein 6 on upperside of hindwing rather strongly produced; 6) hindwing tail longer; 7) valva of male genitalia narrower, strongly emarginate on dorsal margin and bearing an extremely long, slender subbasal process and a weak subapical protuberance.

The female of this species is very similar to those of other species of the *H. epicles* complex in wing markings and wing shape, but it may be recognized in having the larger elliptical orange patch on the upperside of the forewing, and conspicuously widened, band-like, orange submarginal lunules on the upper-

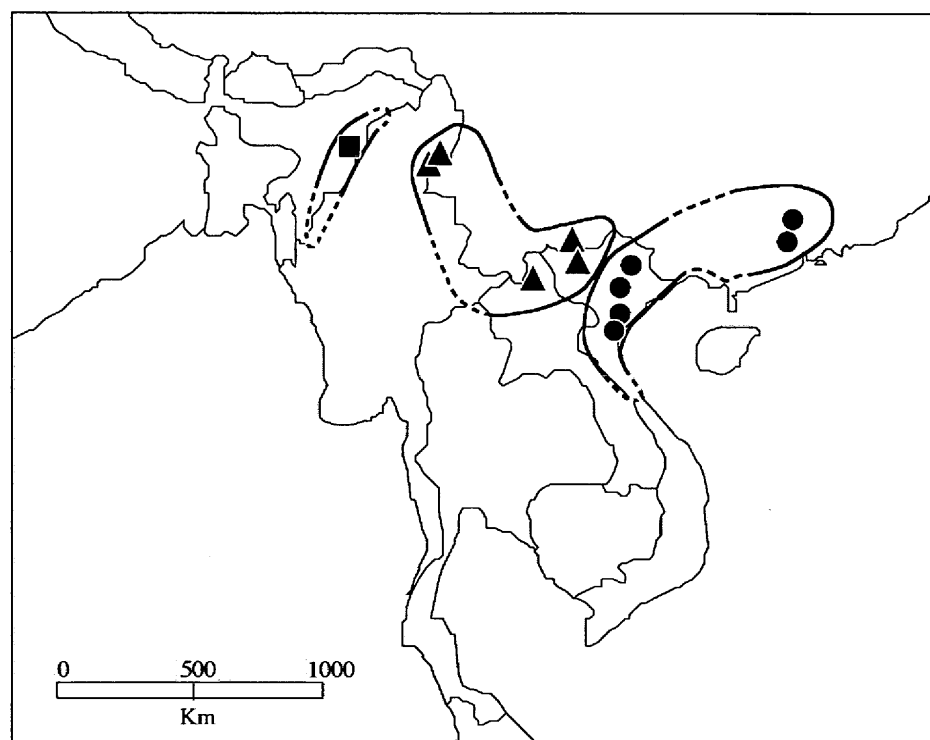
side of the hindwing. Moreover, it is characterized by the underside wing markings as mentioned above for the male.

According to Mr. B. Tanaka's and Mr. R. Matsumoto's observations (pers. comm.) in Cuc Phuong and Tam Dao, Vietnam, this species occurred in grassy fields at forest fringes, forest clearances and parks in densely forested areas. Females oviposited on *Persicaria chinensis* (L.) Nakai of Polygonaceae, which grew at the forest edge.

Relation between *H. kohimensis* and *H. delacouri*

Heliophorus delacouri was first described as a subspecies of *H. kohimensis*, but in this paper we treat *H. delacouri* as a species distinct from *H. kohimensis*. The reasons for this treatment are as follows.

Firstly, there are distinctive morphological differences between the two species. Although the male genitalia of some other species belonging to the *H. epicles* complex show considerable geographical variation within each species, the differences between *H. delacouri* and *H. kohimensis* are detected in many functionally important structures. The valvae of *H. delacouri* are much shorter than those of *H. kohimensis*, and nearly lacking a subapical process, and instead



■ *H. kohimensis kohimensis* ▲ *H. kohimensis elioti* subsp. nov. ● *H. delacouri* stat. nov.

Fig. 7. Geographical distribution of *Heliophorus kohimensis* and *H. delacouri*.

bear a long, style-like subbasal process, which is lamellate in *H. kohimensis*. The free process of the female lamella antevaginalis also differs between the two species. It is very short and eaves-like in *H. delacouri*, while in *H. kohimensis* it is very long, large, and slightly more widened apically. These structural differences in genitalia suggest that the two species would be incapable of copulation. In addition, there are definite morphological differences based on the analysis of wing markings, especially important are the connection between the M¹₂ and E³₂ markings in *H. delacouri* and an extremely expanded red submarginal border on the underside of the hindwing.

Secondly, the distributions of the two species are very close to each other in Vietnam (Fig. 7). The distance between Vinh Phu, Vietnam where *H. delacouri* occurs, and Lao Cai, Vietnam or Pingbian, Yunnan where *H. kohimensis elioti* is present, is only about 200 km. However, *H. delacouri* is morphologically quite different from *H. kohimensis elioti* as mentioned above. While, *H. kohimensis elioti* is morphologically very similar to the nominotypical subspecies from Naga Hills rather than to *H. delacouri*.

According to Eliot (1963), the two subspecies of *H. ila* belonging to the *H. epicles* complex, *H. i. pseudonexus* Eliot, 1963 and *H. i. nolus* Eliot, 1963, which greatly differ from each other in the male genitalia, are almost sympatric in the northeast of Myanmar, and no specimens showing intermediate characters are found there. This fact may actually indicate that the two forms are incapable of interbreeding. However, he treated them as subspecies of *H. ila*, because "a step-by-step transition from the *pseudonexus* genitalia pattern to that of *nolus* can be traced through subsp. *chinensis* and *urius*, and it seems probable that there is a continuously interbreeding population extending in an arc from Sikkim, through N. Burma [=Myanmar], West and Central China, South China, Tonkin [=Vietnam] and Siam [=Thailand] to Central and South Burma [=Myanmar]" (Eliot, 1963). This suggests that *H. ila* may be what is known as a ring species, in which a chain of intergrading subspecies encircles and the terminal forms coexist without interbreeding (e.g., Mayr, 1942). In addition, as far as we examined, the distribution of *H. epicles* also appears to display an arc-like pattern similar to that of *H. ila* (unpublished). Based on the material on hand, *H. kohimensis* does not have an arc- or circle-form distribution as in *H. ila*, and hence it seems best to treat *H. k. delacouri* as a distinct species.

As Tytler (1912) and Eliot (1963) pointed out, *H. kohimensis* occurs in rather high altitudes, whereas *H.*

delacouri appears to be adapted to more lowland tropical environments. Although *H. k. elioti* is known to have a disjunct subspecific distribution at present, in the future, it may be discovered from mountain ranges in the eastern part of Myanmar, the northern part of Thailand and the western part of Yunnan. On the other hand, *H. delacouri* probably occurs in low altitudes of Laos or southern China including Kwangsi, Hunan and Kiangsi.

Hostplants for *Heliophorus*

It is known that the larvae of the Lycaeninae mainly feed on the family Polygonaceae, and rarely Rosaceae, Ericaceae, Rubiaceae, Rhamnaceae and Fabaceae (e.g., Scott, 1986; Morishita, 1986; Tolman & Lewington, 1997; Zhdanko, 1997). In the genus *Heliophorus*, *Persicaria chinensis* [= *Polygonum chinense*] has been recorded as a hostplant of *H. epicles* (Johnston & Johnston, 1980; Morishita, 1986; Aoyama, 1998; Bascombe *et al.*, 1999), *H. ila* (Hamano, 1986; Igarashi & Fukuda 1997; Shu, 1999) and *H. kiana* (Igarashi & Fukuda, 1997), and *Rumex* sp. for that of *H. ila* (Muroya *et al.*, 1967a, 1967b). Both *Persicaria chinensis* and *Rumex* sp. belong to the Polygonaceae. Although Muroya *et al.* (1967a, 1967b) and Igarashi & Fukuda (1997) recorded hostplants of *H. epicles* from Taiwan, they should be treated as those of *H. ila*, as this is the only known species of *Heliophorus* distributed in Taiwan. Until now, the hostplant of *H. delacouri* had been unknown. In this paper *Persicaria chinensis* was first recorded as a hostplant of this species. Hereby it is clarified that four of 21 *Heliophorus* species feed on *Persicaria*.

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