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Taxonomic Studies on the Genus *Apophylia* from Taiwan (Coleoptera: Chrysomelidae: Galerucinae)

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Abstract

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The Taiwanese species of *Apophylia* Thomson are reviewed. Four species are redescribed: *A. asahinai* Chûjô, 1962; *A. beeneni* Bezděk, 2003; *A. miyamotoi* Kimoto, 1969; and *A. velai* Bezděk, 2003. Two new synonyms are proposed: *A. taiwanica* Bezděk, 2003 as a junior synonym of *A. asahinai* Chûjô, 1962; and *A. kaoi* Bezděk and Lee, 2009 as a junior synonym of *A. velai* Bezděk, 2003. Diagnostic characters of both sexes are illustrated. Occurrence of sibling species of chrysomelids in Taiwan is briefly discussed.

Key words: Leaf beetles, Taxonomy, Endophallic sclerites.

INTRODUCTION

Chrysomelidae is one of the most diverse family belonging to Coleoptera. The genus *Apophylia* Thomson, 1858 is a large genus of the subfamily Galerucinae, which comparised 144 species distributed in Asia and Africa (Wilcox 1971; Beenen 2010; Bezděk unpublished data). The biology is little known, only adults were collected on Poaceae, Ehretiaceae, Lamiaceae, Convolulaceae, and Acanthaceae (Jolivet & Hawkeswood 1995). Recently Bezděk (2007) reported that two species of this genus were collected by sweeping of Cynoglossum sp. (Boraginaceae). No articles reported that adults of *Apophylia* caused damage to crops.

The taxonomic history of *Apophylia* in Taiwan is scattered and complex. *A. flavovirens* Fairmaire, 1878 and *A. nigriceps* Laboissière, 1927 were first recorded by Chûjô (1935). Later, Chûjô (1962) reported again on *A. nigriceps* and described the new species *A. asahinai*. *A. flavovirens* was recorded again from Taiwan by Kimoto (1965), and a new species, *A. miyamotoi* Kimoto, was described. However, after examining types Bezděk (2003a) found that *A. flavovirens* and *A. nigriceps* identified by Kimoto and Chûjô, respectively, were misidentified and described them as new species, *A. beeneni* and *A. velai*. Bezděk (2003b) also illustrated the male aedeagus of *A. asahinai* and described a new species, *A. taiwanica*. This species and *A. asahinai* are morphologically indistinguishable. Bezděk and Lee (2009) described the sixth new species although it and *A. velai* were also morphologically indistinguishable.

The Taiwan Chrysomelid Research Team (TCRT) was founded in 2005 and composed of 10 members. All of them are amateurs who are interested in inventorying all species of Chryso-

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melidae in Taiwan. Specimens of the genus have been extensively collected and studied, and plants that adults feed on recorded. The diagnostic characters were assessed and the status of all species was evaluated based on a large series of specimens, and the results are reported here. In addition, the possibility of sibling species of *Apophylia* in Taiwan is discussed based on their distributions and biology.

MATERIALS AND METHODS

Nearly 500 specimens have been examined. About half were collected by TCRT and deposited at the Taiwan Agricultural Research Institute (TARI). The others are conserved in the historical collection compartments at TARI. To prepare drawings of the adult reproductive systems, the abdomens of adults were separated and boiled in a 10% KOH solution, cleared in distilled water, and then covered by a cover glass on slide glass with glycerin for observation. Specimens were examined and drawings were made using a Leica M165 stereomicroscope. Microscopic slides were examined and illustrated using a Nikon ECLIPSE 50i microscope. Body parts were then stored in glycerin tubes with the dry mounted specimens.

Host plants are recorded by observing adult feeding behavior in the field. These plants were identified by Chih-Kai Yang.

The type specimens examined are deposited in the following collections: JBCB (Jan Bezděk collection, Brno, Czech Republic), KUEC (Kyushu University, Fukuoka, Japan), and TARI (Taiwan Agricultural Research Institute, Taichung, Taiwan).

Exact label data are cited for all type specimens; a double slash (//) divides the data on different labels and a single slash (/) divides the data in different rows. Other comments and remarks are indicated as follow: (p) - preceding data are printed, (h)- preceding data are handwritten, (w)- white label, (y)- yellow label, and (r)- red label.

RESULTS AND DISCUSSION

Genus *Apophylia* Thomson, 1858

Apophylia Thomson, 1858: 221. Type species: *Apophylia chloroptera* Thomson, 1858.

Bequaertinia Laboissière, 1922: 263. Type species: *Bequaertinia nodicornis* Laboissière, 1922.

Galerucesthis Weise, 1896: 296. Type species: *Auchenia thalassina* Faldermann, 1835.

Glyptolus Jacoby, 1884: 62. Type species: *Glyptolus viridis* Jacoby, 1884.

Malaxia Fairmaire, 1878: 139. Type species: *Malaxia flavovirens* Fairmaire, 1878.

Malaxoides Fairmaire, 1888: 155. Type species: *Malaxoides grandicornis* Fairmaire, 1888.

Daignosis. Body small to medium size, elongate. Color variable but elytra metallic green. Body covered with dense pubescence.

Head hypo-prognathous, oval, convex from lateral view. Frons without frontal ridge. Annal calli smooth or raised, separated from each other, not delineated from vertex. Interantennal space narrower than transverse diameter of eye. Clypeus short, labrum typical. Antenna 11-segmented, filiform.

Pronotum wide, widest near apex, with lateral impressions. All borders unmargined. Procoxal cavity open behind. Primary setigerous pore on anterior part of lateral margin of pronotum.

Elytra elongate, with lateral sides parallel. Humeral callus well developed, without shallow transverse impression posteriorly. Elytral punctures, small but distinct, extremely dense. Epipleuron wide, almost reaching elytral apex.

Apices of tibiae unspined. First segment of posterior tarsus as long as remainder combined. Tarsal claws simple, with angular bases.

***Apophylia asahinai* Chûjô, 1962**

Apophylia flavovirens: Chûjô, 1935: 174 (Taihorin and Taihorinsho = Talin, in Chiyi; Sokutsu, near Chiasien, in Kaohsiung;

Fuhosho, a unidentified locality of Chishan, in Kaohsiung; Shis = Shishitou, in Nantou); Chûjô, 1938: 135.

Apophylia asahinai Chûjô, 1962: 23 (Musya = Wushe, in Nantou); Chûjô, 1963: 387 (Takao = Kaohsiung city; Kosempo = Chiasien, in Kaohsiung); Kimoto, 1965: 489; Kimoto, 1966: 26 (Polisha = Puli, in Nantou; Zentai = Chietapu, in Tainan); Kimoto, 1969: 22 (Fenchihu, in Chiayi); Kimoto, 1986: 56 (Nanshanchi, in Nantou; Lushan, in Nantou); Kimoto, 1991: 9 (Hohuanshan-doubtful locality, in Nantou; Shaping, in Kaohsiung); Bezděk, 2003b: 481 (illustration of male aedeagus; Tungpu, in Nantou).

Apophylia taiwanica Bezděk, 2003b: 505 (Lienhuachih, in Nantou; Alishan, in Chiayi). **new synonymy**

Type Specimens Examined. *Apophylia asahinai*: Holotype (♂), labelled: "Musha (h) FORMOSA (p) 26.X.1928 (h) COL. M. CHUJO (w, p) //Holotype (r, h) //*Apophylia asahinai* CHÛJÔ (w, h)" (KUEC).

Apophylia taiwanica: 1 paratype (♂), labelled: "Taihorin/Formosa/H. Sauter, 1911 (w, p) //7.VII. (w, p) //Chujo det. (w, h) //PARATYPUS/*Apophylia*/taiwanica sp. nov./J. Bezděk det. 2002 (r, p)" (JBCB); 1 paratype (♂), with same labels but collected "7.XI." (JBCB); 1 paratype (♂), labelled: "Formosa/Taihorin. (p) VI. (h) 09/Sauter S G. (y, p) //PARATYPUS/*Apophylia*/taiwanica sp. nov./J. Bezděk det. 2002 (r, p)" (JBCB).

Specimens Examined (n = 137). **Hsinchu:** 1♂, Peitelaman, 26.VI.2008, leg. H. Lee; 1♂. Wufeng, 14–16.VII.1982, leg. K. C. Chou and C. C. Pan; **Ilan:** 1♀, Fushan botanical park, 8.V.2008, leg. S. F. Yu; **Keelung:** 1♀, Chingjenhu, 9.IV.2009, leg. S. Y. Wu; 1♂, same locality, 10–13.X.2012, leg. L. P. Hsu; **Kaohsiung:** 1♂, Chiasien, 10–13.V.1981, leg. C. C. Chen and C. C. Pan; 1♀, Chungchihkuan, 3.VII.2009, leg. M. H. Tsou; 1♂, 1♀, same locality, 10–13.X.2012, leg. L. P. Hsu; 5♂♂, 1♀, Tengchih, 4.VIII.2012, leg. J. C. Chen; **Nantou:** 1♀, Hoshe, 22.VII.1982, L. Y. Chou and T. Lin; 1♀, Lushan, 27–31. V.1980, leg. K. S. Lin and L. Y. Chou; 1♀, Meifeng, 19.VI.2010, leg. C. F. Lee; 1♀, Sunglintsun, 9.VII.2007, leg. M. H. Tsou; 4♂♂, Tungpu, 20–22.VI.1980, leg. C. C. Chen; 3♂♂, 2♀♀, same locality, 25–29.IX.1980, leg. L. Y. Chou and T. Lin; 2♀♀, 28.IV.–2.V.1981, leg. T. Lin and C. J. Lee; 2♂♂, 3♀♀, same locality, 19–23.VII.1982, leg. L. Y. Chou and T. Lin; 1♀, same locality, 22–25.XI.1982, leg. K. C. Chou and S. P. Huang; 2♂♂, same locality, 20–24.VI.1983, leg. K. C. Chou and C. Y. Wong; 3♂♂, 1♀, same locality, 23–27.VII.1984, leg. K. C. Chou and C. H. Yang; 2♂♂, 2♀♀, same locality, 5–8.X.1981, leg. T. Lin and W. S. Tang; 1♂, Wushe, 30.VIII.–2.IX.1982, leg. L. Y. Chou and K. C. Chou; 1♂, same locality, 7–8.X.1982, leg. K. C. Chou; 4♂♂, Wutakeng, 5.V.2013, leg. J. C. Chen; **Pingtung:** 1♀, Mutan, 5.V.2010, leg. J. C. Chen; 1♀, Nanjenshan, 7.XII.2009, leg. Y. T. Wang; 3♂♂, 4♀♀, Peihulushan, 4.XI.2009, leg. M. H. Tsou; 1♀, Peitawushan, 21.VII.2010, leg. J. C. Chen; 1♂, same locality, 25.VI.2012, leg. J. C. Chen; 1♂, Tahanshan, 1.VIII.2011, leg. J. C. Chen; 1♂, same locality, 12.IX.2011, leg. J. C. Chen; 2♂♂, 3♀♀, same locality, 6.VI.2012, leg. C. F. Lee; 4♂♂, same locality, 19.VII.2012, leg. C. F. Lee; 1♀, same locality, 20.VIII.2012, leg. J. C. Chen; 1♀, same locality, 14.IX.2012, leg. Y T. Chung; 2♂♂, same locality, 25.V.2013, leg. Y. T. Chung; 1♂, Wanan Trail, 31.VIII.2009, leg. J. C. Chen; **Tainan:** 1♂, Pichien trail, 31.III.2010, leg. U. Ong; **Taipei:** 1♀, Chutzuhu, 26.V.1983, leg. K.C. Chou; 4♂♂, 9♀♀, same locality, 9.VIII. 2008, leg. M. H. Tsou; 1♀, Fengkueitsui, 29.VI.2007, leg. S. F. Yu; 1♀, Fulung, 20.V.2008, leg. H. Lee; 1♂,

1♀, Hsiaoyukeng, 22.VI.2008, leg. S. F. Yu; 1♂, Tatunshan, 20.VI.2010, leg. M. H. Tsou; 4♂♂, Wulai, 22.X.2006, leg. S. F. Yu; 4♂♂, Yuanshan, 11.V.2012, leg. S. F. Yu; **Taitung:** 1♀, Chihpen, 17–18. II. 1983, leg. L.Y. Chou and K.C. Chou; 1♀, same locality, 15.XI.2007, leg. I. C. Yu; 1♀, Lichia trail, 6.IV.2010, leg. J. C. Chen; 1♀, Motien, 23.V.2011, leg. C. F. Lee; 1♀, Tajen, 25.II.2009, leg. C. F. Lee; 1♀, Wulu, 7.VII.2010, leg. J. C. Chen; **Taoyuan:** 1♂, 1♀, Fuhsing, 6.V.1983, leg. K. C. Chou and C. C. Pan; 4♂♂, 2♀♀, Lalashan, 15.VII.2009, leg. H. J. Chen; 1♀, Paling, 3–5.V.1983, leg. K.C. Chou and C.C. Pan; 1♂, 1♀, same locality, 23.V.2009, leg. M. H. Tsou; 1♂, same locality, 1.IX.2009, leg. H. Lee; 1♀, Tungyanshan, 26.IV.2007, leg. H. Lee; 12♂♂, same locality, 12.IV.2010, leg. H. Lee.

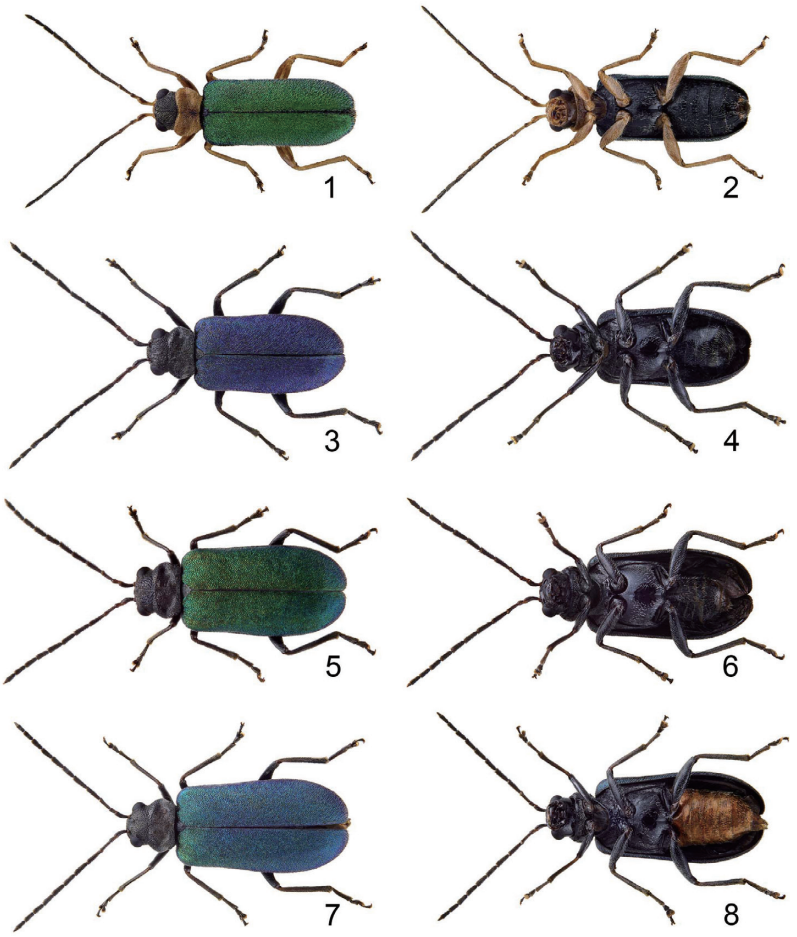
Remarks. *Apophylia asahinai* is similar to *A. beeneni* with yellow mouthparts and legs but may be distinguished from the latter by the yellow pronotum with black spots (in contrast with the blackish brown pronotum with yellow anterior and posterior margins in *A. beeneni*).

Male. Length 5.5–6.6 mm. General color (Figs. 1–2) black; head bicolorous, vertex, frontal tubercles and postgena black, anterior part of head, mouthparts and underside yellow; antenna yellowish brown but last three or five antennomeres darkened; prothorax yellow, pronotum with median black spot, sometimes with one pair of small black spots at sides, in some specimens black spots absent; elytra metallic green; legs yellow. Antennomeres (= antennal segments) VII-XI flattened and widened, ratio of length of antennomeres III to XI about 1.0 : 1.6 : 1.3 : 1.2 : 1.2 : 1.1 : 0.9 : 0.8 : 1.0; ratio of length to width of antennomeres III to XI about 3.2 : 5.2 : 4.2 : 4.0 : 3.6 : 3.1 : 2.4 : 2.4 : 3.0 (Fig. 9). Penis (Fig. 11a) slender, 5.8 times longer than wide; parallel-sided, apex narrowly rounded, or abruptly narrowed subapically in some specimens, moderately curved near base from lateral view (Fig. 12); opening apically tapering, basal margin indistinct; endophallic sclerites composed of three visible sclerites, stick-like (elongate, parallel-sided) sclerite longest, about 0.7 times as length of penis; a small, elongate, flattened sclerite located near apex of stick-like sclerite, outer margin of apex with small teeth; a small, flattened, curved, sclerite behind base of stick-like sclerite.

Female. Length 7.4–8.1 mm. Similar to male, but antennomeres VII to XI a little widened, ratio of length of antennomeres III to XI about 1.0 : 1.3 : 1.2 : 1.1 : 1.1 : 1.0 : 1.0 : 0.8 : 1.1; ratio of length to width of antennomeres III to XI about 3.4 : 4.5 : 3.9 : 3.6 : 3.1 : 3.0 : 3.0 : 2.5 : 3.5 (Fig. 10). Apex of last abdominal ventrite with a shallow median notch. Gonocoxae (Fig. 14) wide, apex of each gonocoxa with seven to nine setae, connection of gonocoxae extremely slender, base widened. Sternite VIII (Fig. 13) weakly sclerotized, apical margin convex at middle, surface with sparse short setae along apical margin, spiculum extremely long. Spermathecal receptaculum (Fig. 15) strongly swollen; pump longer, moderately curved; spermathecal duct short, stout, shallowly projecting into receptaculum.

Host Plants. Boraginaceae: *Ehretia resinosa* Hance; *E. dicksonii* Hance.; *E. acuminate* R. Brown; *E. longiflora* Champ. ex Benth.

Notes. *Apophylia taiwanica* was described based on the specimens with a narrow apex of penis (Fig. 11b) (Bezděk 2003b) in contrast to the wider apex of aedeagus in *A. asahinai*. After the description of *Apophylia taiwanica*, the second author (J. B.) had the opportunity to identify specimens with transitional forms of the aedeagus. Now, after the examination of more than 100 specimens, we can confirm that the apex of



Figs. 1–8. Color habitus of *Apophylia* species. 1. *A. asahinai*, male, dorsal view; 2. *A. asahinai*, male, ventral view; 3. *A. miyamotoi*, male, dorsal view; 4. *A. miyamotoi*, male, ventral view; 5. *A. miyamotoi*, female, dorsal view; 6. *A. miyamotoi*, female, ventral view; 7. *A. miyamotoi*, female, dorsal view, color variation; 8. *A. miyamotoi*, female, ventral view, color variation.

the aedeagus varies from narrow to wide (Figs. 11a, b). Thus, *A. taiwanica* is proposed to be a new synonym of *A. asahinai*.

Distribution. Taiwan. It is a common and widespread species in Taiwan (Fig. 16). Most populations inhabit lower elevation habitats (0–1,500 m).

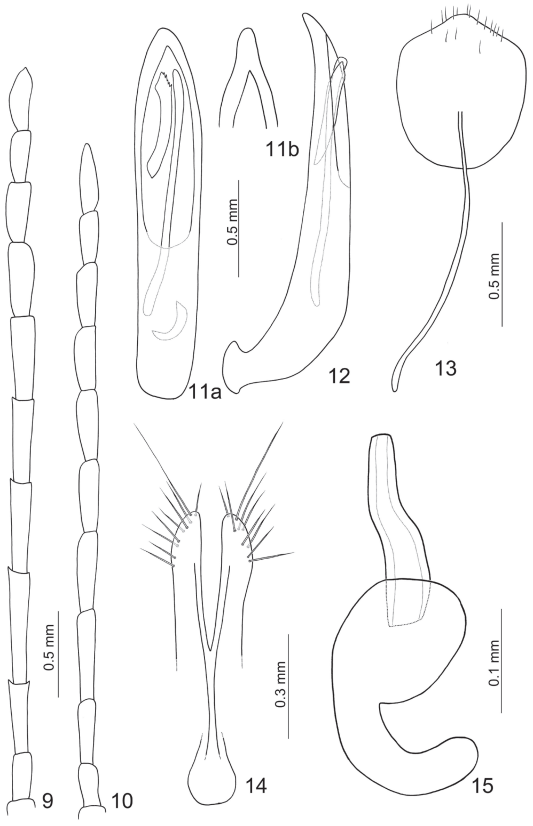
Apophylia beeneni Bezděk, 2003

Apophylia flavovirens: Kimoto, 1965: 489 (Yentempo = Yentenchi, in Kaohsiung); Kimoto, 1966: 27 (Zentai = Chietapu, in Tainan); Kimoto, 1969: 23; Kimoto, 1987: 188.

Apophylia beeneni Bezděk, 2003a: 207 (Sokutsu, near Chiasien, in Kaohsiung).

Type Specimens Examined. 2 paratypes (♀♀), labelled: "FORMOSA/KENTING/3-10.6.1995/DALIHOD leg. (w, p) // PARATYPUS/*Apophylia*/beeneni sp. nov./ J. Bezděk det. 2002 (r, p)" (JBCB).

Specimens Examined (n = 48). **Pingtung:** 1♂, 2♀♀, Checheng, 5.XII.2011, leg. J. C. Chen; 1♂, 1♀, Hengchun, 7.VII.2010, leg. J. C. Chen; 1♂, 1♀, Kenting, 2–6. III.1982, leg. K. C. Chou and C. N. Lin; 1♂, Mutan, 28.V.2010, leg. J. C. Chen;

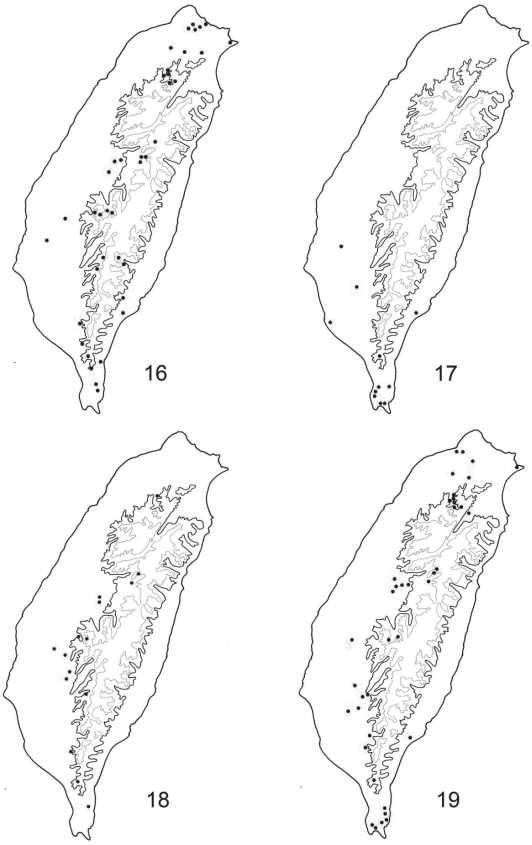


Figs. 9–15. *Apophylia asahinai*. 9. Antenna, male; 10. Antenna, female; 11a. Penis, dorsal view; b. Apex of penis, dorsal view, variation; 12. Penis, lateral view; 13. Sternite VIII; 14. Gonocoxae; 15. Spermatheca.

1♀, Sheting, 4.XI.2009, leg. M. H. Tsou; 9♂♂. 4♀♀, same locality, 7.VII.2010, leg. J. C. Chen; 6♂♂, Suchunghsi, 8.V.2013, leg. Y. T. Chung; 8♂♂, 1♀, Tahanshan, 24.VI.2007, leg. C. F. Lee; 2♂♂, 2♀♀, same locality, 17.VII.2007, leg. M. H. Tsou; 1♂, 1♀, same locality, 8.X.2012, leg. S. F. Yu; 1♂, 1♀, same locality, 3.VI.2013, leg. J. C. Chen; **Taitung:** 3♀♀, Chihpen, 15.XI.2007, leg. Y. C. Yu.

Remarks. This species is similar to *A. asahinai* with yellow mouthparts and legs. Besides differences mentioned in the diagnosis of *A. asahinai*, *A. beeneni* has a smaller body, darkened labrum, and modified metasternum in males.

Male. Length 5.1 mm. General color (Figs. 20–21) black; head bicolorous, vertex, frontal tubercles and postgena black, anterior part of head, mouthparts yellow except labrum blackish brown; antenna yellowish brown but last three or five antennomeres darkened; prothorax yellow, pronotum blackish brown but anterior and posterior margins yellow; elytra metallic green; legs yellow. Antennomeres VII-XI filiform, ratio of length of antennomeres III to XI about 1.0 : 1.3 : 1.3 : 1.2 : 1.1 : 0.9 : 0.9 : 0.9 : 1.1; ratio of length to width of antennomeres III to XI about 4.2 : 5.5 : 6.0 : 5.6 : 5.2 : 4.3 : 3.8 : 3.6 : 5.0 (Fig. 28). Penis (Fig. 30) slender, 5.3 times longer than wide; parallel-sided, apex narrowly rounded, strongly and subapically curved and basally widened in lateral view (Fig. 31); apical margin of



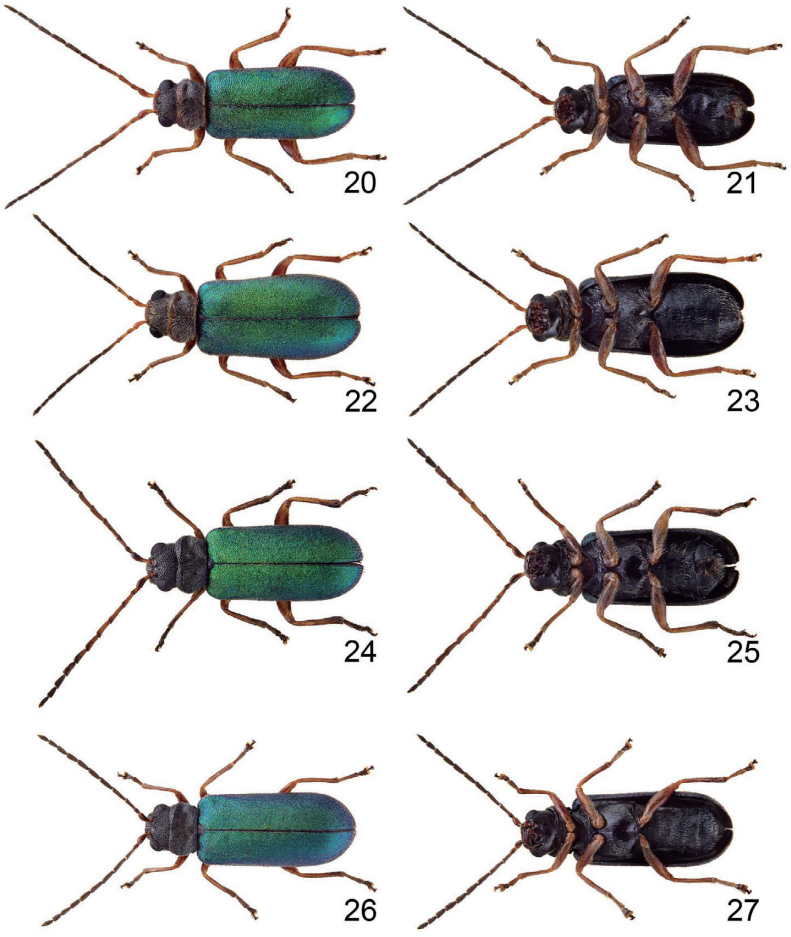
Figs. 16–19. Distribution map of *Apophylia* species, solid line: 1,000 m, broken line: 2,000 m. 16. *A. asahinai*; 17. *A. beeneni*; 18. *A. miyamotoi*; 19. *A. velai*.

opening indistinct; endophallic sclerites composed of two visible sclerites, stick-like sclerite short, about 0.3 times as length of penis; another sclerite as long as stick-like sclerite, but apically widened and flattened, outer margin of apex serrate.

Female. Length 5.8–6.5 mm. Similar to male (Figs. 22–23), but antennomeres VII to XI shorter and wider, ratio of length of antennomeres III to XI about 1.0 : 1.2 : 1.2 : 1.1 : 1.1 : 1.0 : 1.0 : 0.8 : 1.0; ratio of length to width of antennomeres III to XI about 3.2 : 4.3 : 4.3 : 3.9 : 3.7 : 3.6 : 3.8 : 3.5 : 4.3 (Fig. 29). Apex of last abdominal ventrite rounded. Gonocoxae (Fig. 33) wide, apex of each gonocoxa with eight setae, connection of gonocoxae slender, base slightly widened. Sternite VIII (Fig. 32) weakly sclerotized, apical margin convex at middle, surface with sparse short setae at sides and along apical margin, spiculum relatively shorter. Spermathecal receptaculum (Fig. 34) strongly swollen; pump longer, moderately curved; spermathecal duct short, stout, shallowly projecting into receptaculum.

Host Plants. Boraginaceae: *Trichodesma calycosum* Collett & Hemsl.; *Carmona retusa* (Vahl) Masam.; *Ehretia resinosa* Hance.

Distribution. Taiwan, Korea, Vietnam, Hongkong, China (Beijin, Fujian, Guangxi, Hainan, Heilongjiang, Sichuan, and Zhejiang). This species is restricted to southern Taiwan (Fig. 17).



Figs. 20–27. Color habitus of *Apophylia* species. 20. *A. beeneni*, male, dorsal view; 21. *A. beeneni*, male, ventral view; 22. *A. beeneni*, female, dorsal view; 23. *A. beeneni*, female, ventral view; 24. *A. velai*, male, dorsal view; 25. *A. velai*, male, ventral view; 26. *A. velai*, female, dorsal view; 27. *A. velai*, female, ventral view.

***Apophylia miyamotoi* Kimoto, 1969**

Apophylia miyamotoi Kimoto, 1969: 23 (Fenchihu, in Chiayi; Chiaoliping, in Chiayi); Kimoto, 1986: 56 (Jiuyuehtan, in Nantou); Kimoto, 1987: 188 (Sungkang, in Nantou); Kimoto, 1989: 248 (Chunyunshan, in Kaohsiung); Kimoto, 1991: 9 (Liukui, in Kaoshiung); Bezděk, 2003a: 202 (illustration of male aedeagus).

Type Specimens Examined. Holotype (♂), labelled: "(Taiwan) Fenchihu (p) 1,400 m (h) Chiayi Hsien (w, p) //10.IV. (h) 1965 S. Miyamoto (w, p) //Japan-U.S. Co-op. Sci. Programme (y, p) //HOLOTYPE (r, p) // *Apophylia miyamotoi* Kimoto, n.sp. (w, h)" (KUEC).

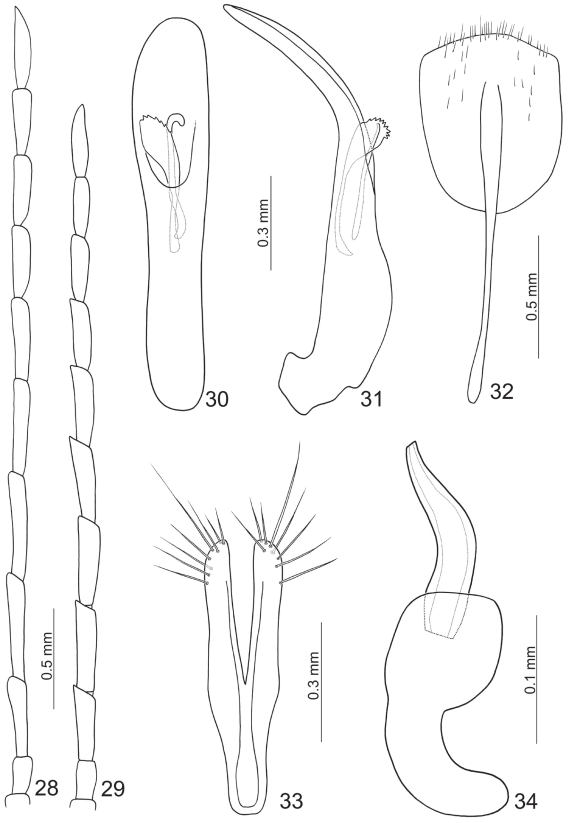
Specimens Examined (n = 36). **Kaohsiung:** 1♀, Tengchih, 18.IV.2013, leg. B. X. Guo; **Nantou:** 2♂♂, Lienhuachih, 27.III.2008, leg. C. F. Lee; 1♂, Wushe, 19–22.IV.1983, leg. K. C. Chou and P. Huang; **Pingtung:** 1♂, Mutan, 19.II.2007, leg. S. F. Yu; 4♀♀, Peitawushan, 10.V. 2010, leg. J. C. Chen; 2♂♂, 2♀♀, same locality, 12.IV.2013, leg. Y. T. Chung; 1♀, Tahanshan, 9.IV.2010, leg. J. C. Chen; 1♀, same locality, 10.IV.2010, U. Ong; 1♂, 1♀, same locality, 28.IV.2012, leg.

M. H. Tsou; **Tainan:** 1♂, 1♀, Meiling, 24.IV.2013, leg. B. X. Guo; 8♂♂, 2♀♀, Pichien trail, 31.III.2010, leg. U. Ong; 2♂♂, same locality, 22.III.2011, leg. U. Ong; **Taoyuan:** 4♂♂, 1♀, Tungyanshan, 12.IV.2010, leg. H. Lee.

Remarks. *Apophylia miyamotoi* is characterized by its black body.

Male. Length 4.7–5.9 mm. General color (Figs. 3–4) black but tibia paler; elytra metallic green or blue. Antennomeres VII–XI flattened and widened, ratio of length of antennomeres III to XI about 1.0 : 1.3 : 1.3 : 1.2 : 1.2 : 1.1 : 1.1 : 0.9 : 1.1; ratio of length to width of antennomeres III to XI about 3.2 : 4.0 : 4.0 : 3.8 : 3.8 : 3.7 : 3.7 : 3.2 : 3.9 (Fig. 35). Penis (Fig. 37) extremely elongate, 7.3 times longer than wide; sides asymmetric, right lateral margin widened at apical 2/5; apex narrowly rounded and posteriorly curved, moderately curved near base from lateral view (Fig. 38); opening apically tapering, basal margin indistinct; endophallic sclerites composed of two visible sclerites, stick-like sclerite longest, about 0.5 times as length of penis; another with apex strongly widened and flattened, margin with large teeth, smaller, about 0.8 times length of stick-like sclerite.

Female. Length 7.4–8.1 mm. Similar to male (Figs. 5–8), but abdomen brown or yellowish brown; antenna filiform, ratio of length of antennomeres III to XI about 1.0 : 1.4 : 1.4 : 1.2 : 1.2 : 1.2 : 1.0 : 1.0 : 1.1; ratio of length to width of antennomeres



Figs. 28–34. *Apophylia beeneni*. 28. Antenna, male; 29. Antenna, female; 30. Penis, dorsal view; 31. Penis, lateral view; 32. Sternite VIII; 33. Gonocoxae; 34. Spermatheca.

III to XI about 3.2 : 4.5 : 4.5 : 4.0 : 3.5 : 3.5 : 2.9 : 3.2 : 3.1 (Fig. 36). Apex of last abdominal ventrite rounded. Gonocoxae (Fig. 40) wide, apex of each gonocoxa with seven to eight setae, connection of gonocoxae extremely slender, base widened. Sternite VIII (Fig. 39) weakly sclerotized, surface with dense long setae at sides and along apical margin, spiculum extremely long. Spermathecal receptaculum (Fig. 41) strongly swollen; pump longer, moderately curved; spermathecal duct long, stout, shallowly projecting into receptaculum.

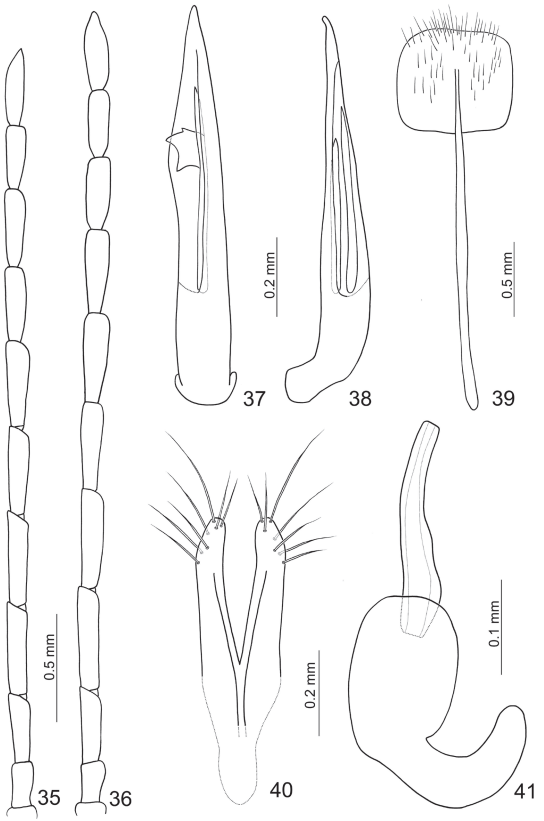
Host Plants. Boraginaceae: *Ehretia longiflora* Champ. ex Benth.; *E. acuminate* R. Brown.

Distribution. Taiwan. Specimens are uncommon but the species is widespread in Taiwan (Fig. 18). Most populations inhabit low elevation habitats (0–1,500 m).

***Apophylia velai* Bezděk, 2003**

Apophylia nigripes (sic!): Chûjô, 1935: 174 [Pingtung: Henchun (= Kankau); Manchoutsun (= Teraso)]; Chûjô, 1938: 135.

Apophylia nigriceps: Chûjô, 1962: 21 (Taihoku = Taipei city); Chûjô, 1963: 388 (Kosempo = Chiasien, in Kaohsiung); Kimoto, 1965: 489; Kimoto, 1966: 27; Kimoto, 1969: 23 (Nanshanchi, in Nantou; Meichi, in Nantou; Kenting, in Pingtung); Kimoto, 1986: 56 (Jiuyehtan, in Nantou); Kimoto, 1987: 188 (Sungkang, in Nantou); Kimoto, 1989: 248 (Chunyunshan, in Kaohsiung); Kimoto, 1991: 8 (Shaping and Shinanshan, in Kaohsiung).



Figs. 35–41. *Apophylia miyamotoi*. 35. Antenna, male; 36. Antenna, female; 37. Penis, dorsal view; 38. Penis, lateral view; 39. Sternite VIII; 40. Gonocoxae; 41. Spermatheca.

Apophylia velai Bezděk, 2003a: 222 (Taihorin = Talin, in Chiayi; Chilan, in Ilan; Huisun, in Nantou; Guanyinshan, in Taipei).

Apophylia kaoi Bezděk and Lee, 2009: 430 (Chuwei, in Taipei). **new synonymy**

Type Specimens Examined. *Apophylia velai*: 1 paratype (♂), labelled: "Kankau (Koshun) /Formosa/H. Sauter V. 1912 (w, p) //7.IV. (w, p) //Chujo det. (w, h) // PARATYPUS/*Apophylia*/velai sp. nov./J. Bezděk det. 2002 (r, p)" (JBCB); 1 paratype (♂), labelled: "Teraso II. 09 (w, h) // Chujo det. (w, h) //PARATYPUS/*Apophylia*/velai sp. nov./J. Bezděk det. 2002 (r, p)" (JBCB).

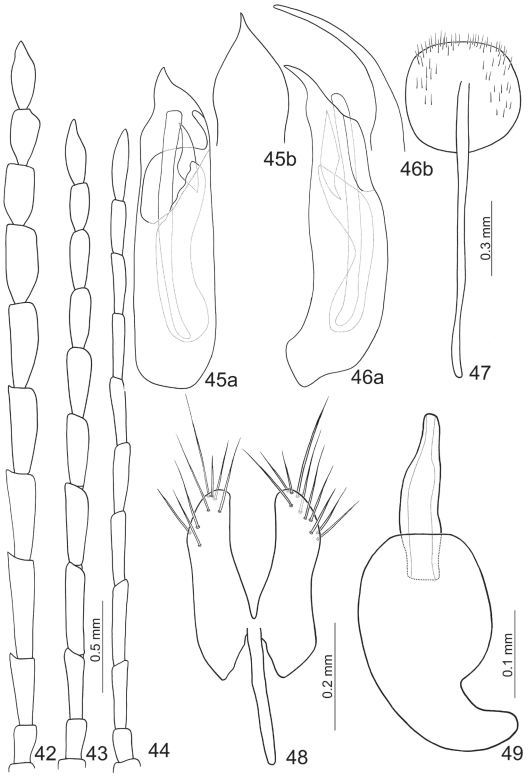
Apophylia kaoi: Holotype (♂), labelled: "Taiwan: Taipei (1181) /Fushan/05.IV.2007, leg. M.-H. Tsao (w, p) //HOLOTYPUS, /*Apophylia*/ kaoi sp. nov., /Bezděk & Lee det. 2009 (r, p)" (TARI); 1 paratype (♂), labelled: "Taiwan: Taipei (1182) /Fushan/05.IV.2007, leg. M.-H. Tsao (w, p) //PARATYPUS, /*Apophylia*/kaoi sp. nov., /Bezděk & Lee det. 2009 (r, p)" (JBCB).

Specimens Examined (n = 270). **Hsinchu:** 1♀, Peitelaman, 26.VI.2008, leg. S. F. Yu; **Kaohsiung:** 4♂♂, 3♀♀, Meinung, 25.IV.2012, leg. leg. J. C. Chen; **Nantou:** 1♀, Meifeng, 7–9.V.1981, leg. K. S. Lin and S. C. Lin; 1♂, same locality, 20.IV.2011, leg. C. F. Lee; 1♂, Tatachia, 27.IV.2010, leg. C. F. Lee; 4♀♀, Tungpu, 20–22.VI.1980, leg. C. C. Chen; 3♂♂, same locality, 28.IV.–2.V.1981, leg. T. Lin and C. J. Lee; 1♀, same locality, 5–8. X.1981, leg. T. Lin and W. S. Tang; 4♂♂, 14♀♀, same locality, 19–23.VII.1982, leg. L. Y. Chou and T. Lin; 4♂♂, 13♀♀, same locality, 20–24.VI.1983, leg. K. C. Chou and C. Y. Wang; 24♂♂, 3♀♀, same locality, 16–20.IV.1984, leg. K. C. Chou and C. H. Yang; 29♀♀, same locality, 23–27. VII.1984, leg. K. C. Chou & C. H. Yang; 1♂, Wanta Reservoir, 24.IV.2008, leg. W. T. Liu; 5♂♂, 2♀♀, Wushe, 6–11.V.1981, K. S. Lin and S. C. Lin; 1♀, same locality, 23–28.VI.1981, leg. K. S. Lin and W. S. Tang; 2♂♂, same locality, 19–22.IV.1983, leg. K. C. Chou and P. Huang; 3♀♀, same locality, 7.V.1984, leg. K. C. Chou and C. C. Pan; 1♂, 1♀, Wutakeng, 5.V.2013, leg. J. C. Chen; 1♀, Yushih, 4.VIII.1981, leg. T. Lin and W. S. Tang; **Pingtung:** 2♀♀, Chiupeng, 6–27.II.2010, leg. M. L. Jeng; 4♀♀, Kenting, 422.III.1980, leg. K. S. Lin; 1♂, same locality, 18–23.III.1981, leg. K. S. Lin and T. Lin; 8♂♂, 16♀♀, same locality, 24–28.VI.1981, leg. T. Lin and C. C. Pan; 13♂♂, 14♀♀, same locality, 22–26.III.1982, leg. T. Lin and S. C. Lin; 1♂, 1♀, same locality, 15.III.1984, leg. K. C. Chou and C. C. Pan; 5♂♂, Nanjenhu, 15.III.2010, leg. M. H. Tshou; 1♀, Neiwen, 12.IV.2013, leg. B. X. Guo; 1♀, Peitawushan, 10.V.2010, leg. J. C. Chen; 1♀, Shantimen, 24.III.1982, leg. K. C. Chou and C. C. Pan; 1♀, Shouka, 16.IV.2013, leg. Y. T. Chung; 1♀, Tahanshan, 20.VII.2007, leg. M. H. Tsou; 1♂, same locality, 14.VIII.2011, leg. Y. T. Wang; 1♂, 1♂, same locality, 6.VI.2012, leg. C. F. Lee; 1♂, same locality, 18.VI.2012, leg. Y. T. Chung; **Taipei:** 3♀♀, Chuwei, V.2006, leg. H. T. Cheng; 1♀, same locality, IV.2007, leg. H. T. Cheng; 3♀♀, Fulung, 20.V.2008, leg. H. Lee; 1♂, Fushan, 10.IV.2010, leg. H. J. Chen; 1♀, Sushoushan, 2.V.2008, leg. H. J. Chen; 1♀, Wulai, 20.IV.2007, leg. H. J. Chen; 2♀♀, Yuanshan, 11.V.2012, leg. S. F. Yu; **Taitung:** 2♂♂, 5♀♀, Chihpen, 24.V.2013, leg. J. C. Chen; **Taoyuan:** 2♂♂, 1♀, Fuhsing, 6.V.1983, leg. K. C. Chou and C. C. Pan; 11♂♂, 9♀♀, Lalashan, 2.V.2009, leg. M. H. Tsou; 1♀, Lofu, 11.IV.2010, leg. M. H. Tsou; 1♀, same locality, 19.VI.2010, leg. H. J. Chen; 4♀♀, Paling, 3–5.V.1983, leg. K. C. Chou and C. C. Pan; 2♂♂, Tungyanshan, 12.IV.2010, leg. H. Lee.

Remarks. *Apophylia velai* is similar to *A. miyamotoi* with black head and pronotum, but differs in possessing yellow legs.

Male. Length 4.9–5.9 mm. General color (Figs. 24–25) black; antenna yellowish brown but last three or five antennomeres darkened; elytra metallic green; legs yellow but base of femur, apex of tibia, and tarsi darkened. Antennomeres III–XI flattened and widened, ratio of length of antennomeres III to XI about 1.0 : 1.5 : 1.3 : 1.3 : 1.3 : 1.2 : 0.9 : 0.9 : 1.1; ratio of length to width of antennomeres III to XI about 2.7 : 4.1 : 3.4 : 3.0 : 3.0 : 2.5 : 2.0 : 2.0 : 2.7 (Fig. 42). Penis (Fig. 45) relatively wider, 4.0 times longer than wide; subapex asymmetric, with a prominent notch at apical 1/7 of left margin and at apical 1/20 of right margin, apex pointed, moderately curved near apex and base from lateral view (Fig. 46); opening asymmetric, slender and close to right margin at apical 1/7, then abruptly widened, basal margin indistinct; endophallic sclerites composed of three visible sclerite, stick-like sclerite longest, about 0.7 times as length of penis; a small, triangular sclerite located near apex of stick-like sclerite; a wide, flattened sclerite located from base to apical 1/3 of stick-like sclerite, basal margin oblique and irregular.

Female. Length 5.5–6.3 mm. Similar to male (Figs. 26–27); antenna black but first three antennomeres paled, antenna a little shorter and narrower, ratio of length of antennomeres III to XI about 1.0 : 1.4 : 1.1 : 1.1 : 1.1 : 0.9 : 0.9 : 0.8 : 1.0; ratio of length to width of antennomeres III to XI about 3.0 : 4.0 : 3.0 : 3.0 : 3.0 : 3.0 : 3.0 : 2.6 : 3.0 (Fig. 43); some with filiform antenna, ratio of length of antennomeres III to XI



Figs. 42–49. *Apophylia velai*. 42. Antenna, male; 43. Antenna, female; 44. Antenna, female, variation; 45a. Penis, dorsal view; b: apex of penis, dorsal view, 'kaoi' type; 46a. Penis, lateral view; b: apex of penis, lateral view, 'kaoi' type; 47. Sternite VIII; 48. Gonocoxae; 49. Spermatheca.

about 1.0 : 1.3 : 1.1 : 1.1 : 1.0 : 1.0 : 0.9 : 0.8 : 1.1; ratio of length to width of antennomeres III to XI about 4.1 : 5.3 : 4.6 : 4.5 : 4.5 : 4.5 : 4.5 : 4.2 : 4.7 (Fig. 44). Gonocoxae (Fig. 48) wide, apex of each gonocoxa with seven to ten setae, base extremely slender. Sternite VIII (Fig. 47) well sclerotized, with dense short setae at sides, denser along apical margin, spiculum extremely long. Spermathecal receptaculum (Fig. 49) strongly swollen; pump short, moderately curved; spermathecal duct short, stout, shallowly projecting into receptaculum.

Host Plants. Boraginaceae: *Ehretia longiflora* Champ. ex Benth.; *E. dicksonii* Hance; *E. acuminate* R. Brown.; *E. resinosa* Hance.

Notes. The shape of the aedeagus apex is variable. The specimens with the short, sharp apex were described as *A. velai*, while specimens with longer, flattened apex were described as *A. kaoi* (compare Bezděk 2003a and Bezděk et Lee 2009). Because of the similarity in shapes of the opening and endophallic sclerites, we have concluded that *A. velai* and *A. kaoi* belong to the same species. Thus, *A. kaoi* is proposed to be a new synonym of *A. velai*.

Distribution. Taiwan. Specimens are common and widespread, making it the most common species in Taiwan. Most populations inhabit low elevation habitats (0–1,500 m).

Key to *Apophylia* species in Taiwan

1. Head black but mouthparts yellow; pronotum yellow with three black spots or dark brown with yellow margins ····· 2
- Head and pronotum completely black ····· 3
2. Pronotum dark brown with yellow anterior and posterior margins; labrum blackish brown; male metasternum modified, bearing large symmetrical protuberance ····· ····· *A. beeneni*
- Pronotum yellow with three black spots (median and two lateral); labrum yellow as same color as other parts of mouth; male metasternum not modified ····· *A. asahinai*
3. Legs black but tibiae paler ····· *A. miyamotoi*
-Legs yellow but apices of tibiae darker ····· ····· *A. velai*

CONCLUSIONS

Most of *Apophylia* species in Taiwan are widespread and common in lowland habitats (Figs. 16, 18–19). They are associated with certain species of Boraginaceae, including *Ehretia longiflora* (Figs. 50–51), *E. acuminate* (Fig. 52), and *E. dicksonii* (Fig. 53). The exception is *A. beeneni*, found only in south Taiwan (Fig. 17), possibly because of its association with tropical host plants, including *Carmona retusa* (Fig. 54), *E. resinosa* (Figs. 55–56), and *Trichodesma calycosum* (Fig. 57). Obviously *Apophylia* species in Taiwan are sympatric since they share the same hosts and distributions. Even *A. beeneni* shares the same host, *E. resinosa* with *A. asahinai*, they tend to "look different" from each other. *A. beeneni* have yellow mouthparts, pronotum, and legs, characters shared with *A. asahinai*. But Taiwanese populations of *A. beeneni* have darker pronota that are different from the yellow pronota of *A. asahinai*. The absence of apparently identical allopatric species suggests that sibling species are not present in Taiwanese *Apophylia*. A possible model of sibling species in chrysomelids in Taiwan occurs in the genus *Agetocera*. Sibling species of the *A. taiwana* species group may result from allopatric speciation (Lee *et al*. 2010). To confirm the occurrence of sibling species of chrysomelids in Taiwan researchers should work on their taxonomic problems based on sufficient material and fully explore their biology.

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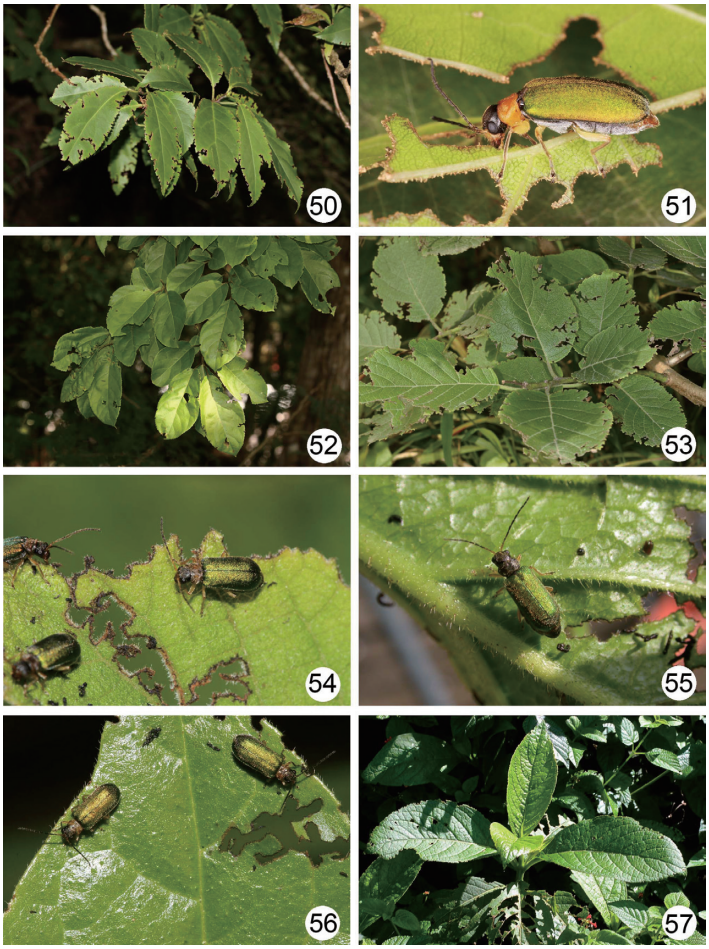

Figs. 50–57. Field observations. 50. Leaves of *Ehretia longiflora* with feeding marks; 51. One adult of *Apophylia asahinai* feeding on leaves of *E. longiflora*; 52. Leaves of *E. acuminata* with feeding damage; 53. Leaves of *E. dicksonii* with feeding damage; 54. Adults of *A. beeneni* feeding on leaves of *Carmona retusa*; 55. One adult of *A. beeneni* feeding on leaves of *E. resinosa*; 56. Adults of *A. beeneni* feeding on leaves of *E. resinosa*; 57. Leaves of *Trichodesma calycosum* with feeding marks.

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REFERENCES

Beenen, R. 2010. Galerucinae. p.443–491. *in*: Catalogue of Palaearctic Coleoptera, Volume 6. Chrysomeloidea (Löbl, I. and A. Smetana, eds.) Apollo Books. Vester Skerninge, Denmark. 924 pp.

Bezděk, J. 2003a. Studies on asiatic *Apophylia*. Part 3: Revisional study of type materials and descriptions of eight species new to science (Coleoptera: Chrysomelidae: Galerucinae). Genus 14:191–230.

Bezděk, J. 2003b. Studies on asiatic *Apophylia*. Part 5: Revisional study of type materials and descriptions of five species new to science (Chrysomelidae: Galerucinae). Genus 14:479–510.

Bezděk, J. 2007. Two new *Apophylia* species from Maharashtra state, India (Coleoptera: Chrysomelidae: Galerucinae). Genus 18: 271–277.

Bezděk, J. and C. F. Lee. 2009. *Apophylia kaoi* sp. nov. from Taiwan (Coleoptera: Chrysomelidae: Galerucinae). Genus 20:429–434.

Chûjô, M. 1935. H. Sauter's Formosa-Ausbeute: Subfamily Galerucinae (Coleoptera: Chrysomelidae). Arb. Morph. Taxon. Entomol. 2:160–174.

Chûjô, M. 1938. H. Sauter's Formosa-Collection: Subfamily Galerucinae (Coleoptera: Chrysomelidae). Arb. Morph. Taxon. Entomol. 5:135–152.

Chûjô, M. 1962. A taxonomic study on the Chrysomelidae (Insecta: Coleoptera) from Formosa Part XI. Subfamily Galerucinae. Philipp. J. Sci. 91:1–239.

Chûjô, M. 1963. Chrysomelid-beetles from Formosa, preserved in the Hungarian Natural History Museum, Budapest. Ann. Mus. Nat. Hung. 55:379–402.

Fairmaire, L. 1878. In: Deyrolle H. & Fairmaire L.: Descriptions de coléoptères recueillis par M. abbé David dans la Chine central. Ann. Soc. Entomol. France 8:87–140.

Fairmaire, L. 1888. Notes sur les coléoptères des environs de Pekin (2e partie). Rev. Entomol. 7:111–160.

Jacoby, M. 1884. Descriptions of new genera and species of phytophagous Coleoptera from Sumatra. Notes Leyden Mus. 6:9–70.

Jolivet, P. and T. J. Hawkeswood. 1995. Host-plants of Chrysomelidae of the World. Backhuys Publishers. Leiden, Netherlands. 281 pp.

Kimoto, S. 1965. A list of specimens of Chrysomelidae from Taiwan preserved in the Naturhistorisches Museum/Wien (Insecta: Coleoptera). Ann. Naturhist. Mus. Wien 68:485–490.

Kimoto, S. 1966. A list of Chrysomelid specimens of Taiwan preserved in the Zoological Museum, Berlin. Esakia 5:21–38.

Kimoto, S. 1969. Notes on the Chrysomelidae from Taiwan II. Esakia 7:1–68.

Kimoto, S. 1986. The Chrysomelidae (Insecta: Coleoptera) collected by the Nagoya University Scientific Expedition to Taiwan in 1984. Kurume Univ. J. 35:53–60.

Kimoto, S. 1987. The Chrysomelidae (Insecta: Coleoptera) collected by the Nagoya University Scientific Expedition to Taiwan in 1986. Kurume Univ. J. 36:183–194.

Kimoto, S. 1989. The Taiwanese Chrysomelidae (Insecta: Coleoptera) collected by Dr. Kintaro Baba, on the occasion of his entomological survey in 1983 and 1986. Kurume Univ. J. 38:237–272.

Kimoto, S. 1991. The Taiwanese Chrysomelidae (Insecta: Coleoptera) collected by Dr. Kintaro Baba, on the occasion of his entomological survey in 1987, 1988 and 1989. Kurume Univ. J. 40:1–27.

Laboissière, V. 1922. Étude des Galerucini de la collection du Musée du Congo Belge. Première partie (suite). Rev. Zool. Afr. 10:219–271.

Laboissière, V. 1927. Contribution a l'étude des Galerucini de l'indochine et du Yunnan avec descriptions de nouveaux genres et espèces (Col. Chrysomelidae). Ann. Soc. Entomol. France 96:37–62.

Lee, C. F., J. Bezděk, and C. L. Staines. 2010. A review of the genus *Agetocera* (Coleoptera: Chrysomelidae: Galerucinae) in Taiwan—are there only two species? Zootaxa 2441:1–19.

Thomson, J. 1858. Deuxième Partie. Insects. I. Arch. Entomol. 2:30–343.

Weise, J. 1896. Synonymische Bemerkunge über europäische Chrysomelinen. Dtsch. Entomol. Z. 1896:293–296.

Wilcox, J. A. 1971. Chrysomelidae: Galerucinae (Oidini, Galerucini, Metacyclini, Sermylini). *in*: Coleopterorum Catalogus Supplementa. Pars 78(1), 2nd ed. (Wilcox, J. A., ed.) W. Junk. S-Gravenhage, Kluwer Academic Pub. Dordrecht, Netherlands. 220 pp.

台灣產翠螢金花蟲屬的分類回顧 (鞘翅目：金花蟲科：螢金花蟲亞科)

李奇峰 [1,*] Jan Bezděk[2]

摘要

李奇峰、J. Bezděk。2014。台灣產翠螢金花蟲屬的分類回顧 (鞘翅目：金花蟲科：螢金花蟲亞科)。台灣農業研究 63(1):1–16。

本文針對台灣產翠螢金花蟲屬 *Apophylia* 的種類做分類回顧，四個種類被視為有效種：斑胸翠螢金花蟲 *Apophylia asahinai* Chûjô, 1962、黃緣翠螢金花蟲 *Apophylia beeneni* Bezděk, 2003、黑翠螢金花蟲 *Apophylia miyamotoi* Kimoto, 1969 及黃腳翠螢金花蟲 *Apophylia velai* Bezděk, 2003；此外，兩個新的同物異名被提出：*Apophylia taiwanica* Bezděk, 2003 為 *A. asahinai* Chûjô, 1962 的新同物異名，*Apophylia kaoi* Bezděk and Lee, 2009 為 *A. velai* Bezděk, 2003 的新同物異名。不同性別的診斷特徵以線圖描繪；在台灣，金花蟲同胞種 (sibling species) 的發生是否可能發生的議題也在此討論。

關鍵詞：金花蟲、分類學、內囊骨片。

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