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REVISION OF THE GENUS *MACROILLEIS* MIYATAKE, 1965 (COLEOPTERA: COCCINELLIDAE: COCCINELLINI)

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Abstract.— The Oriental genus *Macroilleis* Miyatake is revised. Three species are recognized, including one new species *Macroilleis borneensis* **sp. nov.** (Borneo, Sabah). All species are redescribed and illustrated. A key to the species is given.

Key words.— Coccinellidae, *Macroilleis*, new species, revision, Coccinellini, Halyziini, *Illeis*, *Halyzia*, *Archilleis*.

INTRODUCTION

The Oriental genus *Macroilleis* Miyatake (1965) belongs to a relatively small group of true ladybird beetles (Coccinellini) that graze on conidia of mildew fungi. This mycophagous group has been traditionally recognized as a separate tribe named Psylloborini or Halyziini (Sasaji 1971) but more recently Iablokoff-Khnzorian (1979), Pope (1989) and Slipinski (2007) included it within the expanded Coccinellini. That placement was strongly supported by molecular data (Giorgi *et al.* 2009) which recovered three included genera of Halyziini nested within Coccinellini.

The type species of *Macroilleis* was first described from China as *Halyzia hauseri* by Mader (1930). Miyatake (1965) recorded it from Taiwan and noticed several differences between *H. hauseri* and other *Halyzia* species and created a new genus, *Macroilleis,* to accommodate it. Since its establishment, *Macroilleis* remained monotypic until *Thea chapuisi* Crotch was added to that genus by Kovář (2007). Strangely, Iablokoff-Khnzorian (1979), who recognized *Macroilleis* as a valid genus in his monograph of the oriental Coccinellini, did not notice obvious similarities between *M. hauseri* and *T. chapuisi*. He placed *T. chapuisi* in a new subgenus, *Anchilleis,* within the genus *Illeis*. Kovář (2007) discovered the true relationships of these taxa and synonymized *Archilleis* with *Macroilleis* in his catalogue of Palaearctic Coccinellidae.

Here we provide a redescription of the genus *Macroilleis* and the two known species, including the female of *Macroilleis chapuisi*, and describe a new species from Borneo that differs from both previously known species by its uniformly coloured elytra without any markings.

MATERIALS AND METHODS

Specimens examined were obtained from several institutions through the courtesy of the curators indicated in parentheses:

ANIC – Australian National Insect Collection, CSIRO Entomology, Canberra;
BMNH – The Natural History Museum, London (R. Booth);
BPBM – Bernice P. Bishop Museum, Honolulu, Hawaii (S. Myers);

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MNHN – Muséum National d'Histoire Naturelle, Paris (A. Mantilleri);
MZCU – Museum of Zoology, Cambridge University (W. Foster, R. Stebbings);
NHMB – Naturhistorishes Museum, Basel (M. Brancucci, D. Burckhardt);
NHMS – Naturhistorishes Museum, Stuttgart (W. Schawaller);
SYSM – The Museum of Biology, Sun Yat-sen University, Guangzhou.

Male and female genitalia were dissected, cleared in a 10% solution of KOH and examined and photographed in glycerol. The measurements were made using a micrometer attached to a dissecting microscope. The length of a beetle was measured from the apical margin of the clypeus to the apex of the elytra. The width was measured across both elytra at their widest part. The photographs of the habitus, genitalia and other structures were performed on a JVC digital camera in combination with Leica compound microscope. Composite images were generated using Auto-Montage software version 4.00 (Synoptics Ltd., http://www.syncroscopy.com).

Taxonomy

Macroilleis Miyatake

Macroilleis Miyatake, 1965: 71. Type species: *Halyzia hauseri* Mader, 1930, by original designation.
Anchilleis Iablokoff-Khnzorian 1979: 63. Type species: *Thea chapuisi* Crotch, 1874, by original designation. Synonymised by Kovář 2007: 72.

Diagnosis. *Macroilleis* is externally similar to *Illeis* and *Halyzia* but can be easily distinguished by a series of unique characters on the male and female genitalia. In *Macroilleis*, the penis (Figs 18, 20, 22) with capsule distinctly enlarged but with the inner branch indistinct; the parameres (Figs 26, 30, 34) bifid apically forming a subapical lobe, and both apices clothed with long hairs; the spermatheca (Figs 15–17) C-shaped with distinct ramus and nodulus; the sperm duct (Figs 15–17) with distinct infundibulum.

Description. Body 5–8 mm long, oblong-oval, moderately convex, widest at about the middle of elytra. Head (Fig. 1) with large eyes and comparatively narrow frons. Antenna 11-segmented (Fig. 8), much longer than the width of head capsule including eyes; scape rounded on outer side; pedicel stout, antennomere III relatively long, IV–VIII slim and elongate, almost identical; antennal club 3-segmented, loosely articulated. Clypeus (Fig. 1) truncate anteriorly. Labrum (Fig. 2) transverse with lateral margin almost rounded. Mandible (Fig. 3) apically bifid with two molar teeth at base; subapical tooth with a row of minute teeth along ventral edge (more than six). maxillary palpomere II (Fig. 7) about 2 times as long as III, the terminal segment (Fig. 7) strongly expanded with its lateral sides at base forming about 100° angle. Labial palps (Fig. 4) 3-segmented, terminal palpomere blunt. Pronotum weakly convex or flat, at base much narrower than elytra; anterior margin almost straight; anterior and lateral margins almost completely transparent. Pronotal hypomeron relatively broad without lateral foveae. Prosternum with distinct parallel carinae that are incomplete anteriorly; prosternal process not extending beyond procoxae. Scutellum small, less than $^1/_{12}$ times the width of elytral bases. Mesoventrite relatively narrow, with anterior margin (Fig. 5) almost straight, slightly emarginate medially; meso-metaventral process narrow, about 0.5 times width of mesocoxal cavity. Elytra oval, widest at middle and abruptly narrowing apically; disc finely punctured; epipleuron broad, complete apically, slightly concave but without distinct fovea. Legs slim and long with no tibial spurs; claws appendiculate with broad basal tooth. Abdomen with 6 ventrites well visible in both sexes; intercoxal process (Fig. 6) narrow, about 0.2 times width of abdomen; abdominal postcoxal line (Fig. 6) short, not reaching posterior margin of ventrite; posterior margin of ventrite V in male emarginate medially, in female strongly produced medially (Fig. 6); ventrite VI in male deeply emarginate medially, forming a W-shaped margin, in female broadly rounded.

Male genitalia: penis (Figs 19–22) moderate in size, consisting of two segments; capsule enlarged with inner branch indistinct; tube swollen near second section with a pair of small membranous tubercles dorsally. Tegmen (Figs 24–35) in lateral view with long phallobase; parameres short and very broad laterally, bifid at inner apical $^2/_3$, forming subapical projection, both apex and projection covered with dense and long hairs; penis guide tapered, strongly arched towards parameres; basal strut much longer than tegmen.

Female genitalia: spermatheca (Figs 15–17) slim and long, strongly curved, surface with light spirals; nodulus distinct; ramus comparatively long, as long or much longer than nodulus; sperm duct with very peculiar, incomplete infundibulum (only about a half of a diameter is scletorized); vagina short; coxities short and broad, surface densely punctured.

Immature stages. Unknown.

Biology. *Macroilleis* belongs to a mycophagous group of Coccinellini and probably feeds on powdery mildew fungi. Liu (1950) studied the life history of *M. hauseri* in China and found this species has an average life cycle length of 53 days while feeding on mildew fungus *Podopshaera leucotricha* (Ellis & Everhart) Salmon. In this light the report by Khan *et al.* (2006) recording *M. hauseri* as a predator on

the San José scale, (*Quadraspidiotus perniciosus* Comstock) is probably erroneous. It is quite possible that the ladybeetle was actually feeding on sooty mould fungi growing on the honeydew produced by the scale.

Included species. *M. hauseri* (Mader), *M. borneensis* sp. nov., *M. chapuisi* (Crotch).

Distribution. Central and southern part of China, India, Vietnam, northeastern Borneo and Java.

Key to the species of *Macroilleis*

1. Elytra uniformly creamy yellow, with no spots or lines ..... ***borneensis*** sp. nov.
–. Elytra with light or dark longitudinal lines **2**
2. Elytra yellow with three dark lines on each elytron ..... ***chapuisi***
–. Elytra yellow with four bright colour bands on each elytron ..... ***hauseri***

Macroilleis hauseri (Mader)
(Figs 1–10, 15, 18, 19, 24–27)

Halyzia hauseri Mader, 1930: 162; Liu, 1963: 52. Type locality: China: Mengzi district of Yunnan Province and Mts. Wushan of Hubei province.

Macroilleis hauseri: Miyatake 1965: 71–73; Iablokoff-Khnzorian 1982: 216–217; Pang & Mao 1980: 36; Hoang 1983: 39; Cao *et al*.1992: 24; Yu & Wang 1999: 164; Pang *et al*. 2004: 33; Kovář 2007: 598.

Diagnosis. *Macroilleis hauseri* is similar to *M. chapuisi* (Mader), but can be easily distinguished from that species by the presence of four bright bands on each elytron (*M. chapuisi* with three dark lines).

Description. Length: 5.5–7.8 mm; Width: 4.1–5.8 mm. Body (Figs 9, 10) elongate oval, head yellow; pronotum creamy with yellow spots in the middle forming "M" shaped area; elytra yellow with four longitudinal, creamy-white bands on each elytron, 1st band very close to elytral suture; 2nd band originates from the middle of the base and merges with 1st band at apex; 3rd band originates from just below the humerus and apically merges with 4th band, which is parallel to lateral margin. Venter completely yellow. Male genitalia (Figs 18, 19, 24–27): apical segment of penis with membranous window in the middle dorsally. Female genitalia (Fig. 15): spermatheca with long nodulus that is almost as long as ramus; membranous part of sperm duct very short.

Material examined. **China:** 2000–2250 m, Shanxi, Qinling mts, Xunyangba (12 km SW), 14–18.vi.1998, J. H. Marshal (1♂, NHMS); 1000–1200 m, Guizhou prov. Leigongshan, Xijiang, 29.v–2.vi.1997, Bolm (1♀, NHMS); Su-Tchuen, Mo-Sy-Mien, 1897 (2, MNHN); Thibet, Chasseurs de Tà-sien-Loù, 1895 (1, MNHN); Yunnan, Région de Lou-Nan, 1932 (1, MNHN); Kouy-Tchéou, Gan Chouen Fou, Kiang-long et Yun-lin-tcheou, 1912, P. Cavaierie (1 1♀, MNHN); 1400 m, Hainan, Jianfengling peak, 27.ii.1982, Riqiang Deng (1♂1♀, SYSM); 1258 m, Hainan, Jianfengling subpeak, 24.ii.1982, Riqiang Deng (2♂, SYSM); Hainan, Jianfengling subpeak, 24.ii.1982, Jiaoping Lu (1♂, SYSM); Hainan, Jianfengling subpeak, 25.vii.1983, Huanqiang Chen (1♀, SYSM); Guizhou, Fanjing Mt, Jinding, 1.vii.2001, Hong Pang (1♂, SYSM); Guizhou, Guiyang forest park, 19.viii.1987, Xiongfei Pang (1♀1♂, SYSM); Guizhou, Guiyang botanic park, 16.viii.1987, Lan Chen (1♀, SYSM); Guizhou, Daozhen Dasha river, 24.–28.viii. 2004, Pian Xu (1♂, SYSM).

India: Darjeeling Dist, Kalimpong, 17.iv,1984, C. Holzschun (1, NHMB); Darjeeling Dist, Kalimpong, 7–11.iv.1983. C. Holzschuh (1, NHMB). **Vietnam:** N. Vietnam (Tonkin), Tamdao, 12.–24.v.1989. Pacholatko (1, NHMB).

Distribution. **China**: Yunnan, Guizhou, Hubei, Shanxi, Hainan, Sichuan, Tibet, Taiwan. **Vietnam**, **India, Pakistan.**

Macroilleis borneensis sp. nov.
(Figs 11, 12, 16, 20, 21, 28–31)

Etymology. This species is named by its type locality, the island of Borneo.

Diagnosis. This species can be easily distinguished from the other two *Macroilleis* species by its uniformly creamy-yellow elytra.

Description. Length: 6.5–7.8 mm; Width: 5.2–6.3 mm. Head creamy-yellow; pronotum creamy-yellow with transparent area in middle of disc forming "M" shaped pattern. Elytra creamy-yellow, finely punctured, with base and sutural margin black, lateral margins transparent. Venter bright yellow except for legs, metaventrite and anterior portion of metepisternum light brown. Male genitalia (Figs 20, 21, 28–31): apical segment of penis slim and strongly curved apically; apex of penis guide blunt, weakly emarginate medially. Female genitalia (Fig. 16) very similar to *M. hauseri* with ramus usually much longer than nodulus, but sometimes ramus just slightly longer than nodulus.

Types. Holotype (♂): Borneo, Sabah, km 53 road KK- Tambunan E slope Gn. Emas, 700 m, 1.–5.iv.2000. Bolm (NHMB). Paratypes: same data as holotype (1♀, NHMB); Sabah, km 53 road KK- Tambunan E slope Gn. Emas, 1650 m, 22.iii–6.iv.2000. Bolm (1♀, NHMB); Borneo, Tenompok, 1460 m, Jesselton, 30 mi. E, 26.–31.i. 1959, T. C. Maa (1♂2♀, BPBM, BMNH). Sabah, kungtasans, 2.iv.2002. G. T. Lim (2♀, SYSM)

Distribution. Sabah, Borneo (Malaysia).

Macroilleis chapuisi (Crotch)
(Figs 13, 14, 17, 22, 23, 32–35)

Thea chapuisi Crotch, 1874: 134.
Illeis (*Anchilleis*) *chappuisi* [sic!]: Iablokoff-Khnzorian 1979: 63, 1982: 287.
Macroilleis chapuisi: Kovář 2007: 72, 598.

Diagnosis. This species is similar to *M. hauseri* in general outline of the body, but can be distinguished from the latter by the presence of three dark lines on each elytron (four bright bands in *M. hauseri*) and black metaventrite.

Description. Length: 6.5–7.0 mm; width: 5.4–5.8 mm. Outline and colour pattern as in Figs 13–14. Head entirely yellow, pronotum yellow with lateral and anterior margin transparent, elytra yellow with base and sutural margin black. Each elytron with three black narrow longitudinal lines, almost parallel to each other, the middle line the longest and the most lateral line the shortest. Venter almost completely yellow except for metaventrite and anterior part of metepisternum black. Male genitalia (Figs 22, 23, 32–35): apical section of penis slim and short; penis guide (Fig. 32, 35) tapering towards parameres but slightly expanded at $^1/_3$ part to the end. Female genitalia (Fig. 17): spermatheca slim, ramus relatively long, nodulus short and somewhat rounded; sperm duct long, about 1.6 times length of sperm duct in the other two species, the length of infundibulum almost identical with the other two species.

Types. 'Java, Chapuis. /Holotype/*Thea chapuisi* Crotch 1874/ *Illeis chappuisi* Cr. / Khnzorian det' (MZCU, Holotype male).

Other material examined. 6.48°S 106.57°E, W. JAVA: Gn. Gedepanggrango NP. East Ridge above Cibodas 14–1600 m Jun–Aug.1994 C. Reid coll. (1♀, BMNH).

Distribution. Java (Indonesia).

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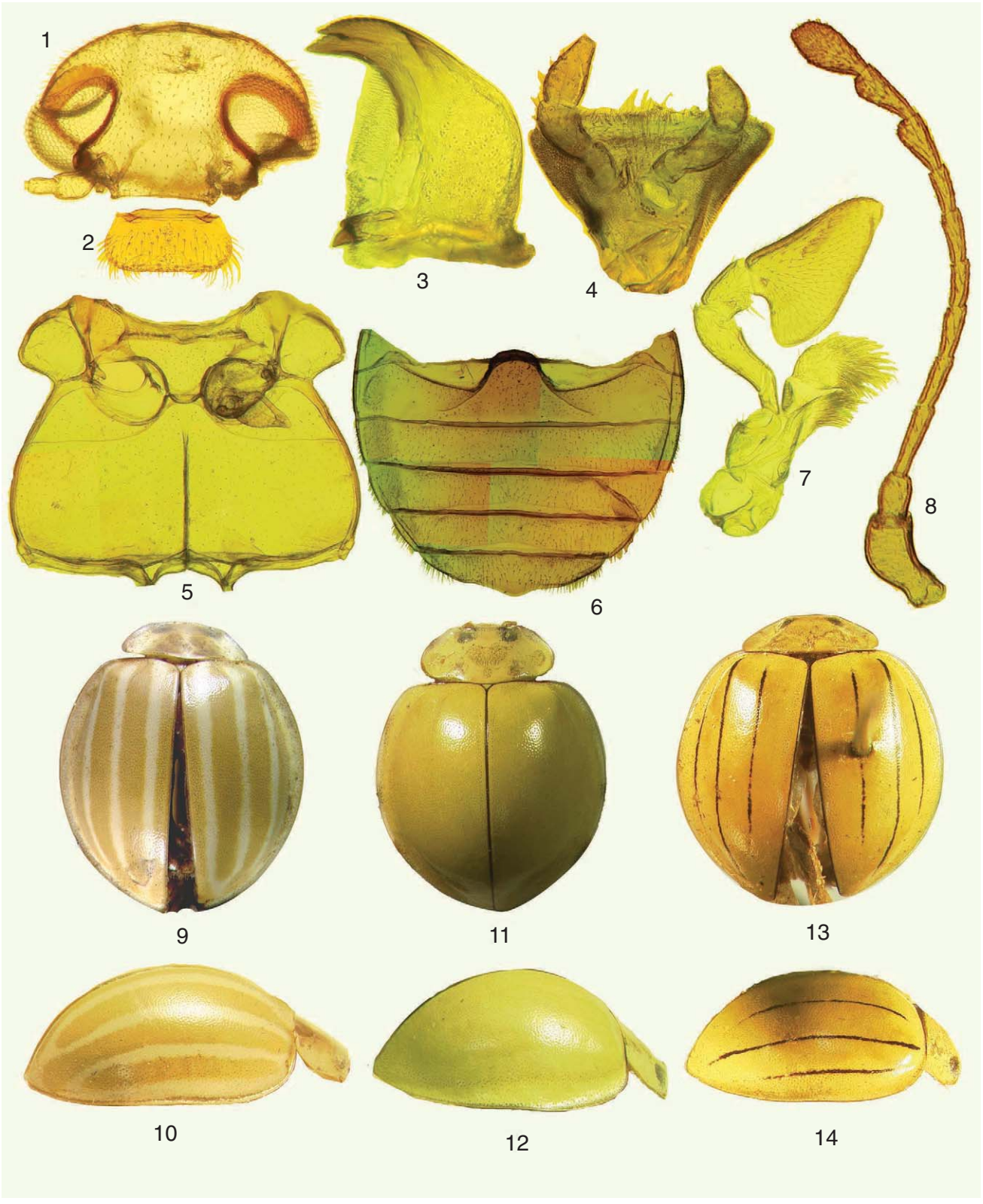
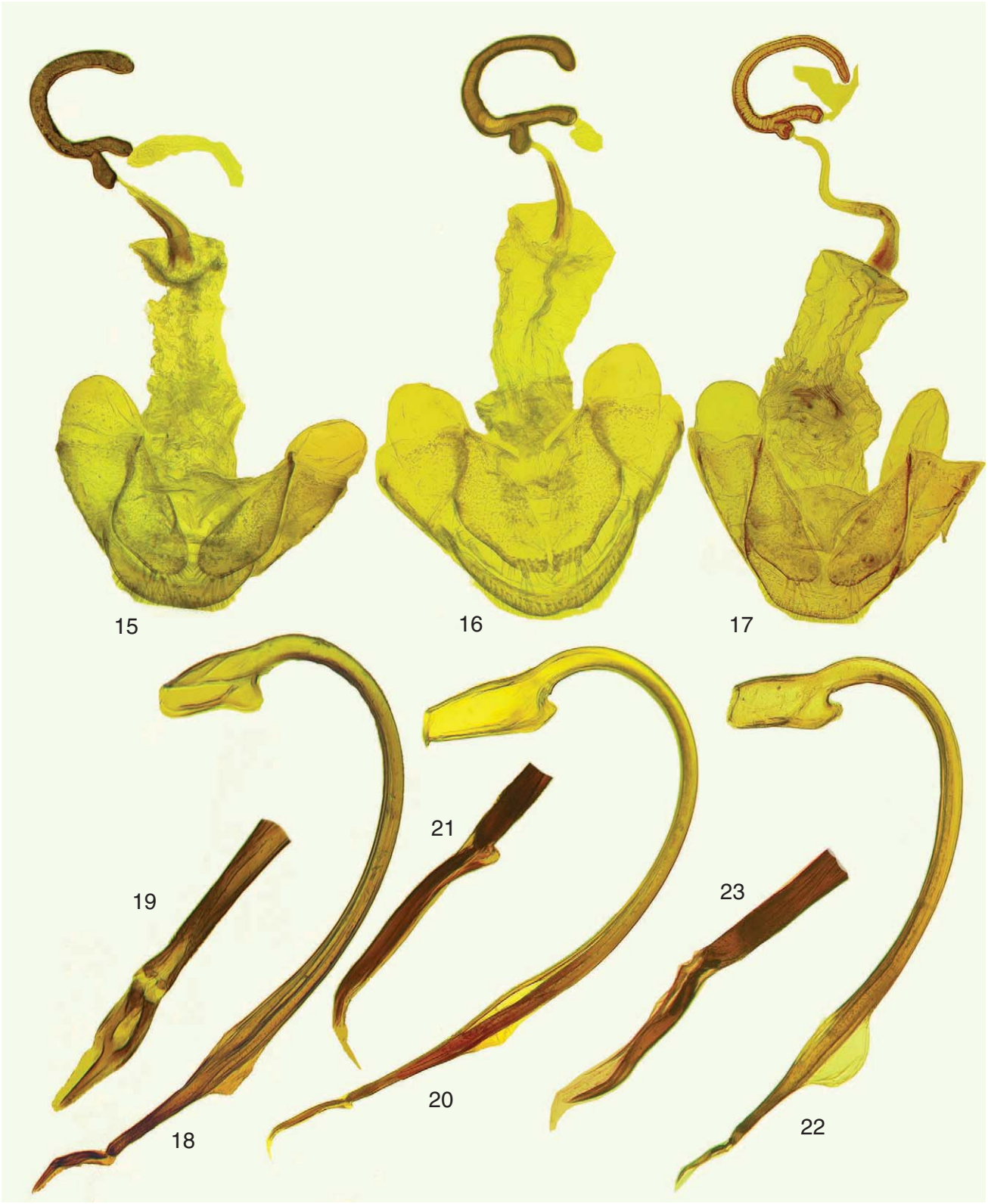
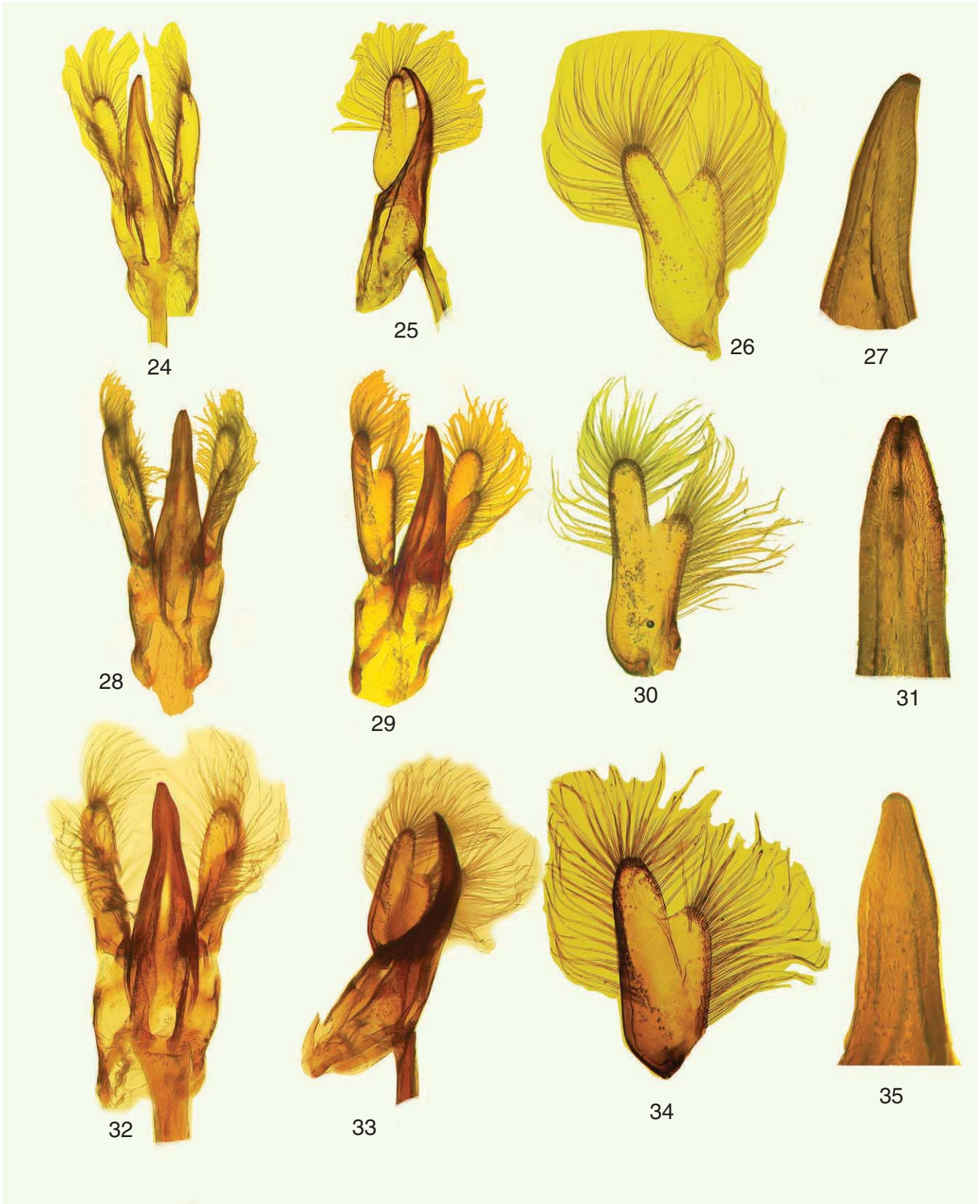


Figures 1–14. (1–10) *Macroilleis hauseri* (Mader); (11–12) *Macroilleis borneensis* sp. nov.; (13, 14) *Macroilleis chapuisi* (Crotch). (1) Head, frontal; (2) labrum; (3) mandible; (4) labium; (5) meso-metathorax; (6) abdomen of female; (7) maxilla; (8) antenna; (9, 11, 13) body dorsal view; (10, 12, 14) body lateral view.



Figures 15–23. *Macroilleis* species. Penis and female genitalia: (15, 18, 19) *M. hauseri* (Mader); (16, 20, 21) *M. borneensis* sp. nov.; (17, 22, 23) *M. chapuisi* (Crotch); (15–17) female genitalia; (18, 20, 22) penis; (19, 21, 23) apical sclerite of penis.



Figures 24–35. *Macroilleis* species. Tegmen: (24–27) *M. hauseri* (Mader); (28–31) *M. borneensis* sp. nov.; (32–35) *M. chapuisi* (Crotch); (24, 28, 32) ventral view of tegmen; (25, 29, 33) lateral view of tegmen; (26, 30, 34) lateral view of paramere; (27, 31, 35) apex of penis guide.