19. SPERCHEIDAE ERICHSON, 1837

Martin Fikáček

Fig. 19.1. *Spercheus platycephalus* MacLeay

Common name. Filterfeeding water scavenger beetles.

Introduction. The family Spercheidae contains a single genus *Spercheus* Kugelann with 18 described species and two subspecies. It is distributed world-wide except the Nearctic, but most species occur in the Afrotropical and Oriental Regions. Only two species are distributed in South America and Australia, and the Palearctic Region only hosts one widespread species (Hebauer 1997, 1999; Hansen 1999; Archangelsky 2001).

Spercheidae are morphologically very distinctive and without any doubt form a monophyletic group, characterised by many unique adult and larval characters. Most of them seem to be related to the filter-feeding habits and are found on the head and alimentary canal (Beutel 1994, 1999; Beutel *et al*. 2001). The larval head, in particular, resembles in many aspects that of basal staphylinoid families. This is also the reason why two alternative hypotheses were proposed for the phylogenetic position of the Spercheidae. The first hypothesis considers spercheids as a derived clade within the Hydrophiloidea s.str., considering the morphology of larval head as secondarily derived from the predaceous hydrophiloid ancestor. Spercheidae is then placed as a sister-group of Hydrophilidae (Hansen 1991; Archangelsky 1998; Beutel & Komarek 2004; Lawrence *et al.* 2011) or Hydrochidae (Beutel & Leschen 2005). The second hypothesis considers Spercheidae as a sister-group to all other Hydrophiloidea s.str. (Beutel 1994) or the whole Hydrophiloidea + Histeroidea (Beutel 1999), and the spercheid-like head morphology is then considered as ancestral for the whole group. Molecular analyses confirm both above hypotheses when using different markers. The sister relationship to Hydrophilidae was revealed by Korte *et al*. (2004) (two nuclear rDNA), Bernhard *et al.* (2009) (mitochondrial protein-coding genes and rDNA combined with morphology) and McKenna *et al*. (2015a) (six nuclear protein coding genes and two rDNA). Spercheids as sister to all Hydrophiloidea s.str. were revealed by Bernhard *et al*. (2006) (mitochondrial protein-coding and rDNA) and McKenna *et al*. (2015b) (one nuclear protein-coding gene and one rDNA).

Hebauer (1997) revised the Spercheidae and provided the key to species, and two additional species were described subsequently by Hebauer (1999) and Archangelsky (2001). The revision is however rather superficial and based on small subset of characters, and additional studies are clearly necessary.

Immature stages (Fig. 19.2) are described for three non-Australian species: European *Spercheus emarginatus* (Schaller) (e.g. Archangelsky 1997), the Neotropical *S. halophilus* Archangelsky (Archangelsky 2001) and partly for the African-Near East *S. cerisyi* Guérin-Méneville (not illustrated, diagnosed in Archangelsky 2001). The pupa was never properly described and was only incompletely illustrated for *S. emarginatus* by Cussac (1852).

The fossil record of Spercheidae goes back to the Late Jurassic – the assignment of the well preserved fossil of *Prospercheus cristatus* Prokin from the Shar-Teg deposit in Mongolia to Spercheidae may be confirmed by the morphology of mouthparts of the fossil species (Prokin 2009; Fikáček *et al*., unpublished data). The other Mesozoic fossils assigned to or close to Spercheidae either belong to non-hydrophiloid beetles (*Wollastonia* Heer to Archostemata; *Paraspercheus* Ponomarenko to Coleoptera *incertae sedis*, possibly to Scarabaeoidea) or seem to not belong to Coleoptera at all (*Orphnospercheus* Hong likely belonging to Heteroptera) (Heer 1852; Ponomarenko 1977; Hong 1992; Fikáček, unpublished data). Undescribed fossils (isolated elytra assigned to *Spercheus*) are know from the Eocene-Oligocene deposits of Bembridge Marl Beds, Isle of Wight, UK (A. Ponomarenko, personal communication).

Biology. Both adults and larvae are aquatic, inhabiting densely vegetated standing waters. Biology was discussed for the European species *Spercheus emarginatus* (Cussac 1852; Fowler 1882; Schlick 1887; Bukh 1910; Böving and Henriksen 1938), notes on biology of the South American *S. halophilus* were provided by Archangelsky (2001). Adults live in a cryptic way among submerged vegetation, and are able to walk on the underside of water surface and filter plant remnants and decaying organic material from it (Rothmeier and Jäch 1986). As in Hydrophilidae, they breathe atmospheric oxygen which is held in an air bubble on the ventral side of the head, thorax and first abdominal ventrite; antennae are used to establish a connection between atmosphere and the air bubble on the venter once the beetle needs to renew the air supply (Hrbáček 1950). Eggs are laid in a bag-shaped egg case which is attached to metatibiae and carried by female on the ventral side of the abdomen (Fig. 19.3L). Embryonic development takes ca. 4–5 days in *S. halophilus*. Larvae are slowly moving, stay close to water surface and can also walk on the underside of it. They feed on drifting detritus, algae and detritus grazed from the substrate

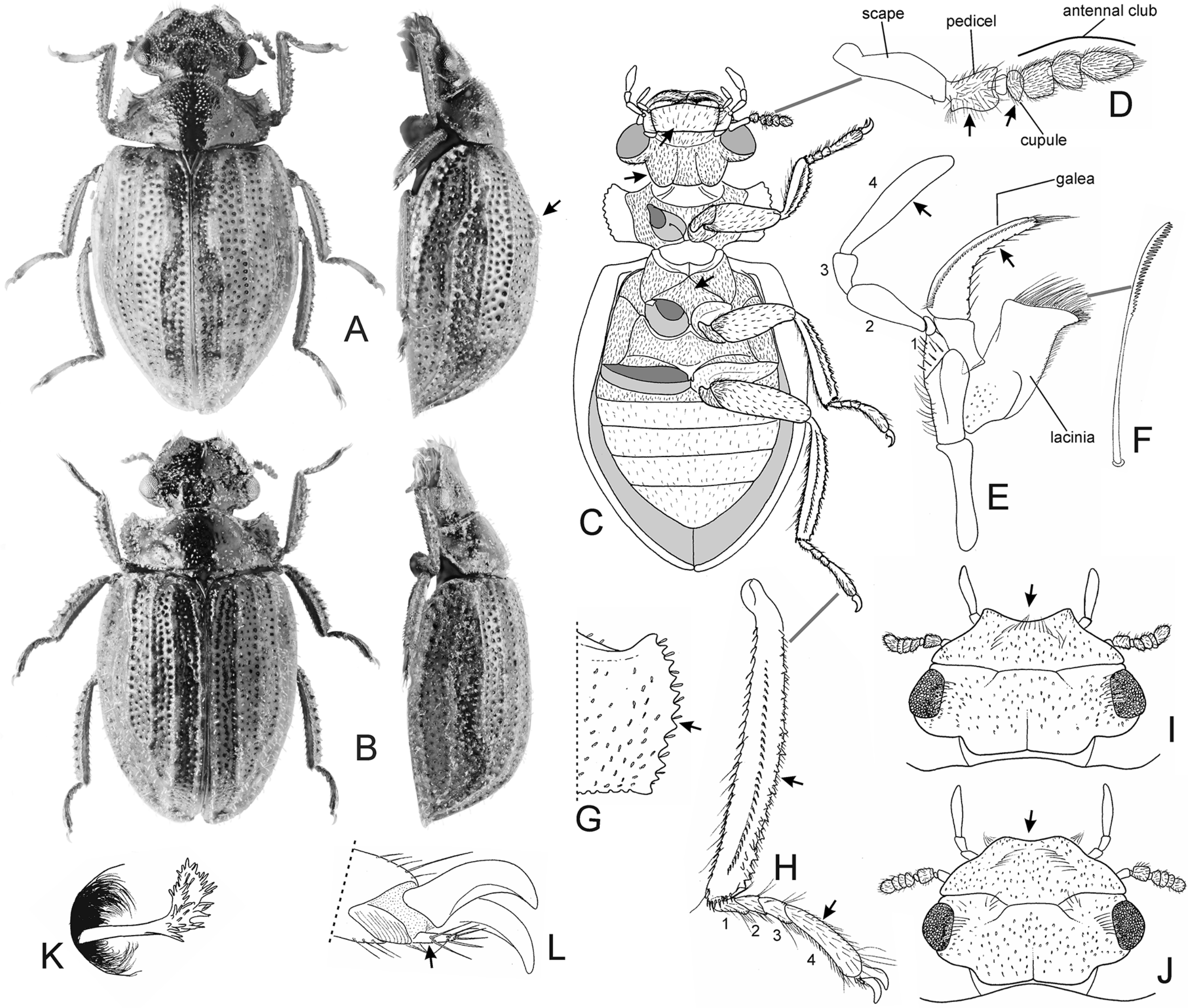


Fig. 19.2. Australian Spercheidae, genus *Spercheus*. A–B, general habitus in dorsal and lateral views: A, *Spercheus platycephalus* MacLeay; B, *S. wattsi* Hebauer, 1999. C–J, general morphology: C, ventral morphology; D, antenna; E, maxilla in ventral view; F, detail of lacinial comb-like seta; G, lateral margin of pronotum of *S. platycephalus*; H, metatibia and metatarsus; I-H, head of *S. platycephalus* in dorsal view (I, male; J, female); K, detail of the club-like seta of dorsal surface; L, pretarsus with claws and empodium. Drawings D–F, H, K–L based on non-Australian *S. senegalensis* Castelnau.

and on dead invertebrate prey. Some studies (Fowler 1882; Böving & Henriksen 1938) indicate that *S. emarginatus* larvae are also predaceous, feeding on small invertebrates and being cannibalistic, which was not observed in *S. halophilus*. All examined *Spercheus* larvae have a large muscular denticulate proventriculus (Beutel 1999) which probably helps in processing the detritus-based food. Additional studies on food preferences are necessary, but from available data it seems that larvae may be opportunistic and combine small invertebrates and detritus particles as food sources. Larval development includes three larval instars and takes ca. 30–35 days in *S. emarginatus* (Bukh 1910). Archangelsky (2001) mentions that the first instar takes 4–6 days and the second one 6–7 days in *S. halophilus*. Pupation takes place outside of water, in a pupal chamber built up of the soil and plant particles attached to surfaces (plants?) few centimetres above the water surface or situated among plant debris at the water edge; pupal stage is short, taking ca. 5–7 days (Bukh 1910; Cussac 1852; M. Soviš, personal observation).

Morphology. Adults (Figs 19.1, 19.2). Length ~1.9–7.0 mm (Australian species 3.2–4.2 mm). Body ~1.8–2.1 times as long as wide, with sides more or less evenly rounded, well sclerotized and moderately to strongly convex; yellowish to dark brown, elytra often with a pattern of dark and pale spots; dorsal surfaces smooth and glabrous, with stout erect club-like setae (Fig. 19.2K); elytra costate, costae in some species with elevated tubercles; ventral surfaces completely covered with

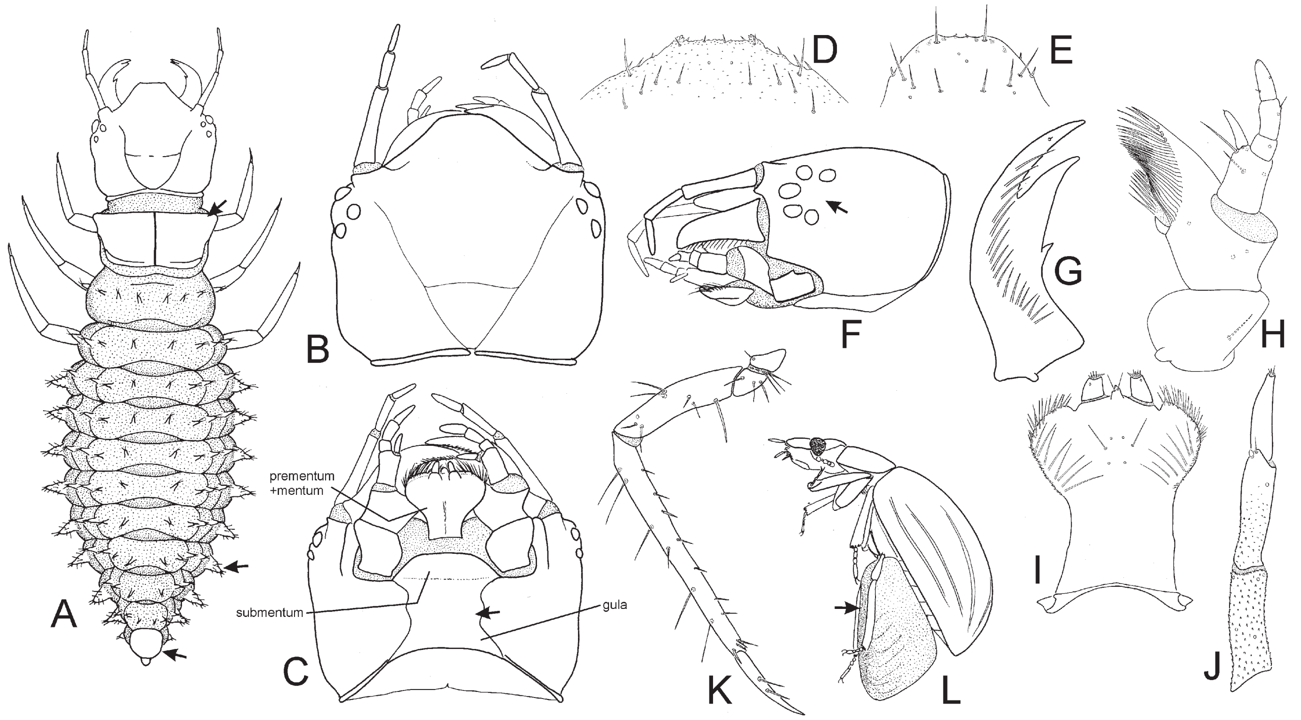


Fig. 19.3. Immature stages of Spercheidae, genus *Spercheus*. A–J, larva: A, general habitus; B, head, dorsally; C, head, ventrally; D-E, anterior margin of head (D, *S. emarginatus* (Schaller); E, *S. halophilus* Archangelsky); F, head, laterally; G, mandible; H, maxilla; I, labium; H, antenna; K, leg; L, female of *S. emarginatus* carrying egg case. A–D, F–J based on non-Australian *S. emarginatus*; E on *S. halophilus*; K on *S. belli* Champion. A, D, H from Archangelsky (1997); E from Archangelsky (2001); K redrawn and adapted from Darilmaz & Kiyak (2011).

hydrofuge pubescence (plastron) in *S. emarginatus*, without dense pubescence on abdominal ventrites 2–5 and on epipleura in other *Spercheus* species.

Head more or less prognathous, deeply inserted into prothorax, strongly constricted behind eyes. Eyes well developed, slightly protuberant, circular and entire, finely facetted, without interfacetal setae. Antennal insertions concealed from above; subantennal groove present. Frontoclypeal suture obsolete or partly distinct, nearly straight, mid-cranial suture distinct only posteriorly in some species; clypeus large, sexually dimorphic, deeply emarginate and with angulate lobes in males (Fig. 19.2I), weakly emarginate and with rounded lobes in females (Fig. 19.2J); sexual dimorphism very weak in *S. fimbriicollis* Bruch and *S. halophilus*. Labrum strongly transverse, well sclerotized, truncate or sinuate on anterior margin, not narrowed at base, retracted under clypeus and not visible from above. Antennae (Fig. 19.2D) short, 7-segmented, with pubescent widely conical pedicel, cupule and 3-segmented antennal club, pedicel and cupule separated by a small glabrous antennomere. Mandibles moderately large, concealed beneath clypeus; apex bidentate; mola well developed, slightly asymmetrical; prostheca well developed, membranous, without articulated or sclerotised processes. Maxilla (Fig. 19.2E) with setose galea and lacinia, galea long, slender and finger-like, with two series of setae; lacinia with a small uncus hidden among long setae, setae simple or comb-like (Fig. 19.2F); maxillary palps with 4 palpomeres, slender, ca. as long as antennae; apical maxillary palpomere long and asymmetrical. Mentum very large, transverse, subrectangular; prementum bilobed, pubescent, each lobe with a transversely oval sclerite; labial palps with three palpomeres, moderately long, situated on anterolateral corners of mentum. Corpotentorium narrow; laminatentoria well developed, sometimes meeting at midline. Cervical sclerites well developed.

Pronotum ~0.4–0.5 times as long as wide, widest at middle (incl. Australian species) or in anterior third, about as wide as combined elytral bases (narrower than elytral bases in some non-Australian species); sides strongly curved, explanate. Surface flat with club-like setae, or with median and submedian impressions (in *S. spangleri* Hebauer, *S. fimbriicollis* and *S. halophilus*). Anterior edge strongly bisinuate with median portion slightly produced forward. Lateral pronotal carinae complete, denticulate (Fig. 19.2G) or with finger-like lobes (in non-Australian species); anterior angles strongly produced and acute; posterior angles right to rounded; posterior edge slightly sinuate to straight, with underlying ventral ridge which interlocks with elytra and scutellar shield. Prosternum flat or weakly elevated medially, in front of coxae shorter than shortest diameter of procoxal cavity. Prosternal process complete and slightly expanded apically in most *Spercheus*, incomplete in *S. emarginatus*. Notosternal sutures complete.

35. BUPRESTIDAE LEACH, 1815

John F. Lawrence & Cate Lemann

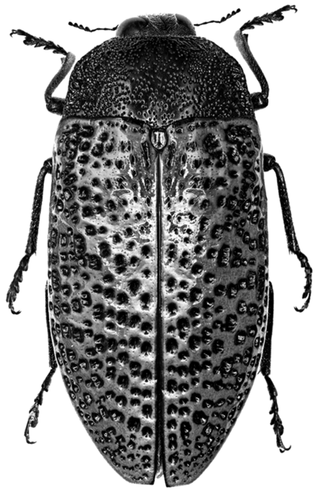


Fig. 35.1. *Stigmodera maculata* (Donovan), habitus.

Common names. Metallic wood-boring beetles, jewel beetles, flat-headed wood-borers.

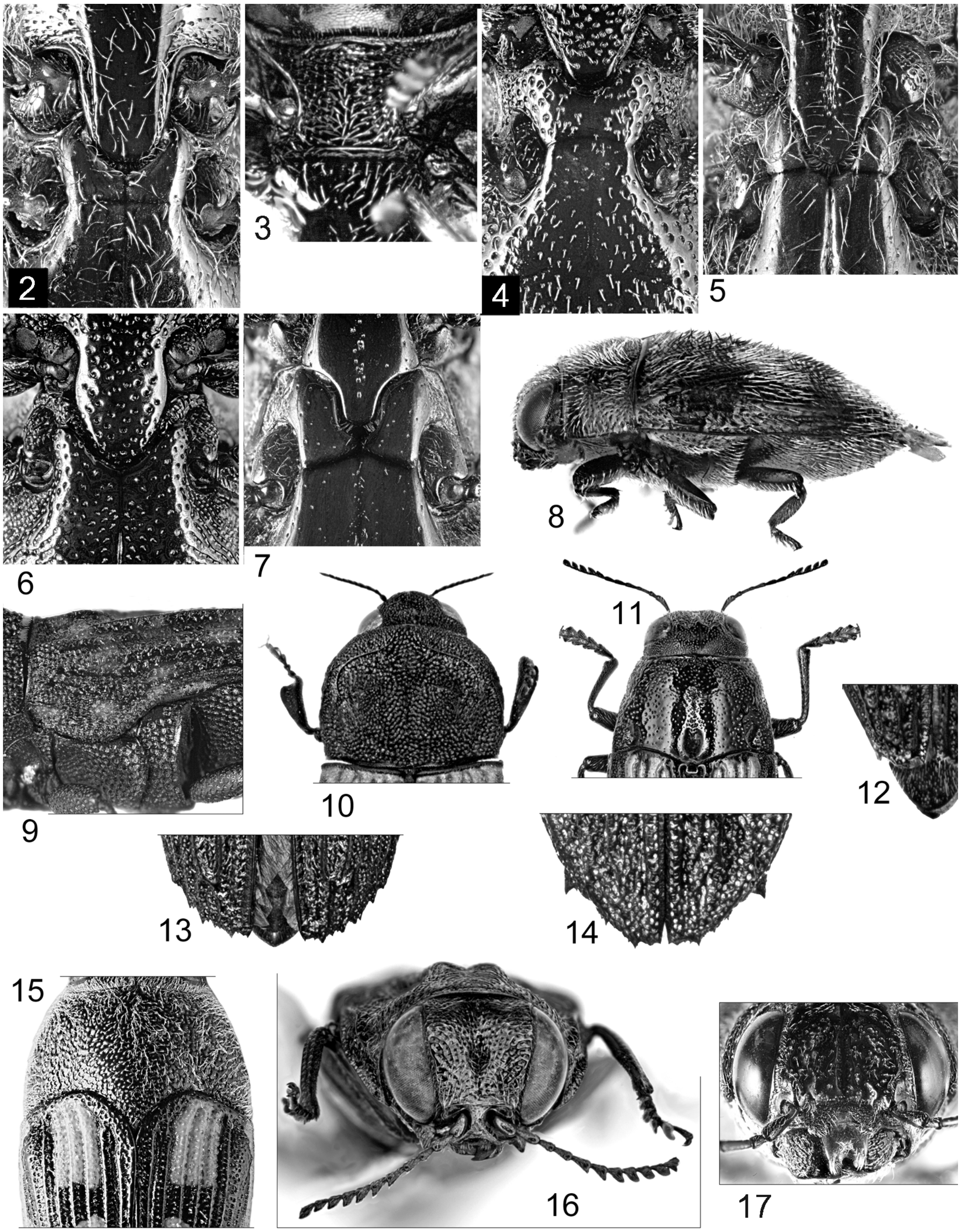
Introduction. The Buprestidae is a cosmopolitan family with ~520 genera and 15 000 species currently placed in six subfamilies and 87 tribes and subtribes (Bellamy 2008a–d, 2009). The present treatment includes four subfamilies, 30 tribes and subtribes and 74 genera, with two groups of genera not placed in subtribes. There is little doubt that the family Buprestidae is sister to the Schizopodidae, as first noted by Forbes (1926, 1942) and argued by Nelson & Bellamy (1991, 2002), Bellamy & Nelson (2002) and Bellamy (2003). The latter has been considered a subfamily of Buprestidae by Lawrence & Newton (1995), Lawrence *et al*. (2011) and Lawrence & Ślipiński (2013), but the two positions do not really differ phylogenetically and Schizopodidae is used in the current world catalogue (Bellamy 2008a). Both Schizopodidae and Buprestidae are known from middle Jurassic fossils of Kazakhstan and China and the latter group is relatively common throughout the late Mesozoic and Cenozoic (Ponomarenko 1971; Alexeev 1993, 1995, 2009; Hörnschemeyer & Wedmann 1994; Wedmann & Hörnschemeyer 1994; Yu *et al*. 2013; Cai *et al*. 2015). Records of Triassic Buprestidae based on single elytra from Australia (Dunstan 1923) and larval tunnels from Arizona (Walker 1938) need confirmation.

Crowson (1982) considered the buprestoids to be most closely related to the Dryopidae and related families, and in the morphological analysis of Lawrence *et al*. (2011), they form a clade with Dryopidae, Limnichidae, Lutrochidae Elmidae and Heteroceridae and sister to Byrrhidae, but excluding the psephenoid families, as defined by Lawrence (1988). An analysis based on DNA sequences from eight nuclear genes and utilising the same taxa as in the above study (McKenna *et al*. 2015), Buprestoidea was sister to Byrrhoidea in the broad sense (including the psephenoid families), a result diffrering only slightly from those of Hunt *et al*. (2007) and Bocak *et al*. (2014).

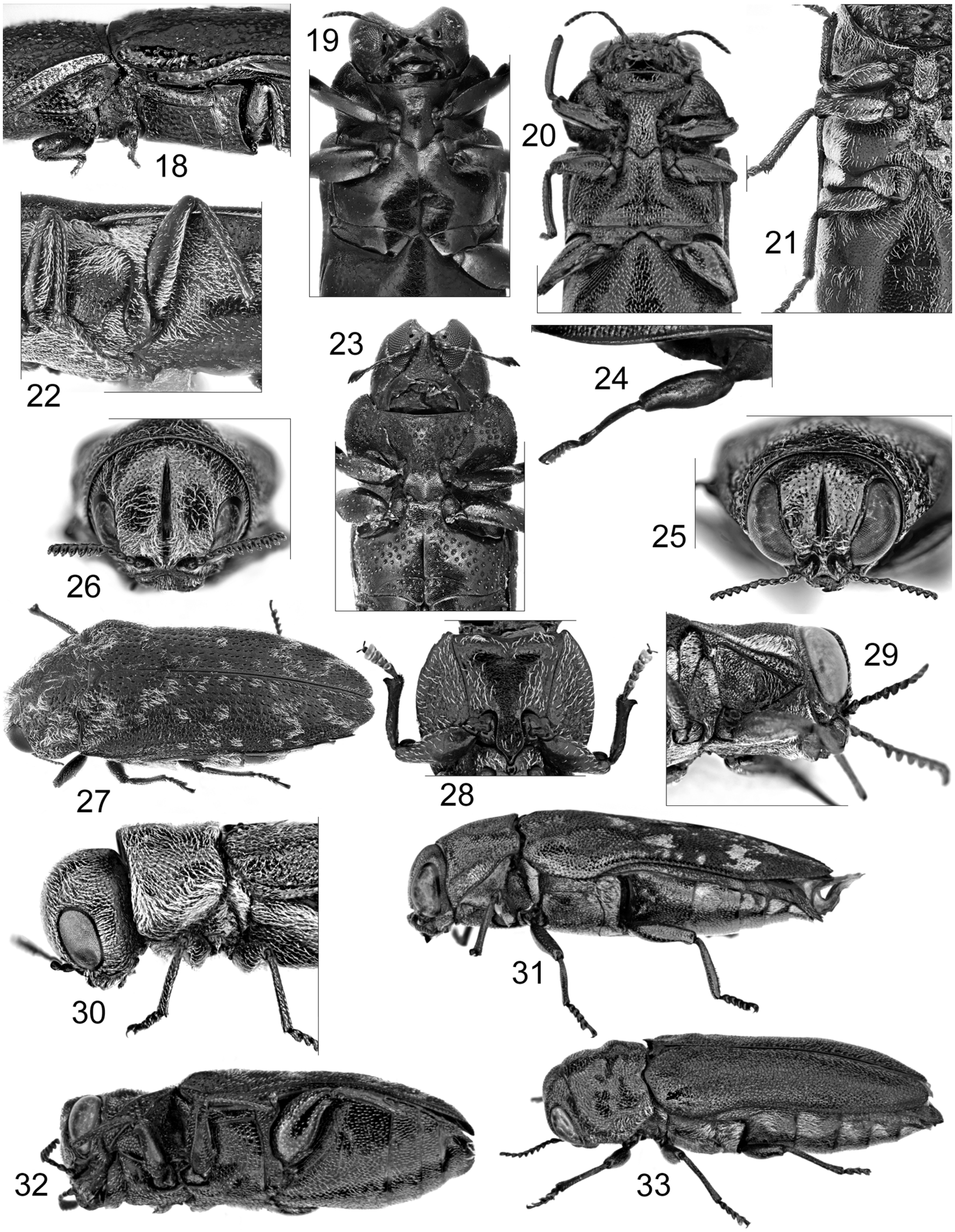
The subfamily, tribal and subtribal classification of the family Buprestidae is still in a state of flux and various classifications have been proposed by Kerremans (1893, 1906–1913), Obenberger (1923, 1928), Théry in Carter (1929), Cobos (1957, 1978, 1979, 1980, 1986), Nelson (1981), Toyama (1987), Bellamy (1988, 2003), Hołyński (1988, 1993), Nelson & Bellamy (1991, 2002), Bílý (2000), Kolibáč (2000), Kubáň *et al*. (2001), Volkovitsh (2001), Volkovitsh & Bílý (2015) and Bellamy & Volkovitsh (2016). In the recent molecular study by Evans *et al*. (2015), Polycestinae, as recognised here, was found to be monophyletic, with the exception of the tribe Haplostethini, which formed a clade with the exotic Julodinae, and Agrilinae formed a strongly supported clade; both Buprestinae and Chrysochroinae, however, were polyphyletic, with chrysochroine genera falling into different clades with buprestine genera. Within the Agrilinae, neither Agrilini nor Trachyini were monophyletic and the several genera of leaf-mining agrilines did not form a monophyletic group.

The first key to Australian subfamilies, tribes and genera was that of Théry in Carter (1929), while Matthews (1985) provided an illustrated key to genera occurring in South Australia and Bellamy (1986) published a revised subfamily and tribal key and a list of included Australian genera. Numerous modifications have been made in the last 30 years based on adults, larvae and more recently DNA sequence data. The Australian fauna was catalogued by Bellamy (2002) and the world fauna by Bellamy (2008a–d, 2009).

Characteristics. Adults. 1.5–65 mm long and usually elongate with sides subparallel or converging posteriorly, slightly flattened to strongly convex (short, broad and flattened in leaf-miners); colour reddish-orange to black, but often bicolored, forming light and dark pattern, or with metallic coloration. Upper surfaces usually subglabrous but sometimes clothed with short, decumbent to erect, fine hairs, rarely with thickened or scale-like setae forming patches on elytra. Head somewhat flattened, deeply inserted into prothorax, strongly declined, so that mouthparts are ventrally oriented, almost always with distinct median endocarina. Eyes large, entire, vertically oval, not protuberant, finely facetted, without interfacetal setae; ommatidium of the eucone type. Antennal insertions exposed, usually widely separated, but sometimes enclosed within antennal fossae, which may be narrowly separated in Agrilinae. Frontoclypeal suture absent; clypeus short and usually anteriorly emarginate, sometimes with membranous anteclypeus visible within emargination. Antennae 11-segmented and usually serrate from antennomere 4 (very rarely pectinate). Labrum visible, free, small, transverse. Mandible small, short and broad; unidentate or bidentate, without mola or prostheca. Maxilla almost always with distinct, setose galea and lacinia, rarely with single lobe; lacinia without uncus; apical palpomere cylindrical or fusiform. Gular sutures usually widely separated, sometimes narrowly separated or absent. Corpotentorium slender and arched; anterior tentorial arms not expanded



Figs 35.2–35.17. 2, *Prospheres aurantiopictus* (Laporte & Gory), prosternal process, meso- and metaventrite, ventral; 3, *Paratrachys australis* Bellamy & Williams, prosternal process, meso- and metaventrite, ventral; 4, *Polycesta mastersi* Macleay, prosternal process, meso- and metaventrite, ventral; 5, *Buprestis aurulenta* Linneaus, prosternal process, meso- and metaventrite, ventral; 6, *Diphucrania leucosticta* (Kirby), prosternal process, meso- and metaventrite, ventral; 7, *Iridotaenia bellicosa* (Blackburn), prosternal process, meso- and metaventrite, ventral; 8, *Paratrachys australis* Bellamy & Williams, habitus, lateral; 9, *Xyroscelis bumanna* Williams & Watkins, elytral base, metathorax, metacoxa, lateral; 10, *Xyroscelis crocata* (Gory & Laporte), head and prothorax, dorsal; 11, *Prospheres aurantiopictus* (Laporte & Gory), head and prothorax, dorsal; 12, *Prospheres aurantiopictus* (Laporte & Gory), elytral apices and pygidium, dorsal; 13, *Strigoptera bimaculata* (Linnaeus), elytral apices, dorsal; 14, *Polycesta mastersi* Macleay, elytral apices, dorsal; 15, *Astraeus flavopictus* Laporte & Gory, pronotum and elytral bases, dorsal; 16, *Aaaba nodosus* (Deyrolle); head, frontal; 17, *Austrochalcophora subfasciata* (Carter), head, frontal.



Figs 35.18–35.33. 18, *Helferella frenchi* (Théry), pronotum and pterotorax, lateral; 19, *Endelus* sp., head, thorax, base of abdomen, ventral; 20, *Sambus australis* Bellamy & Peterson, head, thorax, base of abdomen, ventral; 21, *Meliboeithon intermedium* (Kerremans), thorax, base of abdomen, ventral; 22, *Agrilus hypoleucus* Gory & Laporte; mesothorax, metathorax, base of abdomen, ventrolateral; 23, *Aphanisticus endeloides* Carter, head and thorax, ventral; 24, *Anthaxomorphus bougainvillensis* Williams & Weir, hind leg, lateral; 25, *Ethonion fissiceps* (Kirby); head and pronotum, anterior; 26, *Meliboeithon intermedium* (Kerremans), head and pronotum, anterior; 27, *Ethonion* sp., habitus, dorsolateral; 28, *Synechocera tasmanica* Théry, prothorax, ventral; 29, *Agrilus hypoleucus* Gory & Laporte, head and prothorax, lateral 30, *Paracephala pistacina* (Hope), head, thorax, elytral base, lateral; 31, *Neospades rugiceps* (Thomson), habitus, lateral; 32, *Sambus australis* Bellamy & Peterson, habitus, ventrolateral; 33, *Dinocephalia cyanipennis* (Blackburn), habitus, lateral.

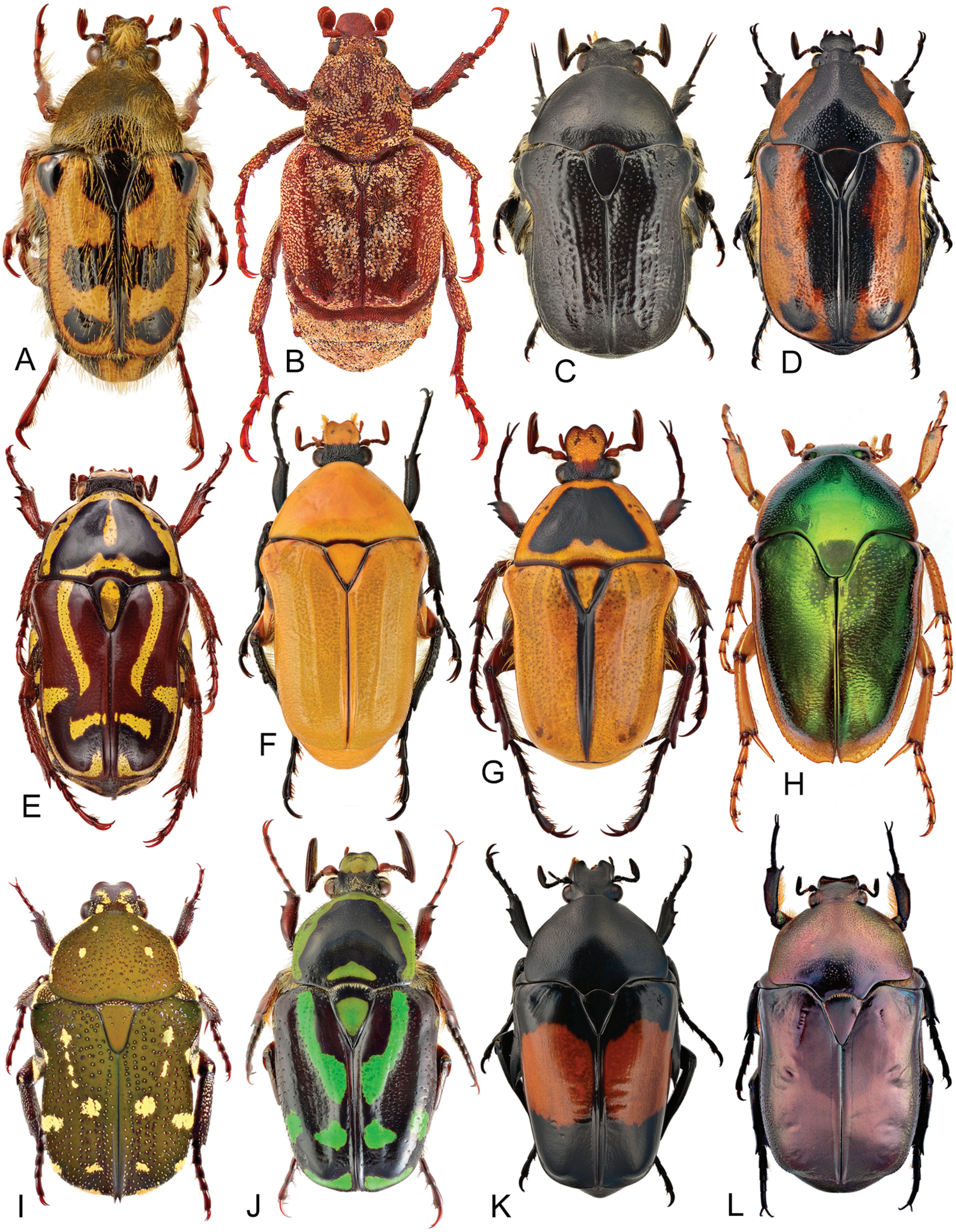


Plate 73. Scarabaeidae: Cetoniinae. A, *Clithria eucnemis* (Burmeister); B, *Charitovalgus quinquedentatus* (Lea); C, *Bisallardiana philippei* (Allard); D, *Chondropyga dorsalis* (Donovan); E, *Eupoecila australasiae* (Donovan); F, *Aphanesthes succinea* (Hope); G, *Diaphonia antoinei* Allard; H, *Mycterophallus duboulayi* (Thomson); I, *Glycyphana stolata* (Fabricius); J, *Chlorobapta frontalis* (Donovan); K, *Dilochrosis balteata* (Vollenhoven); L, *Chalcopharis lansbergei* (Gestro).

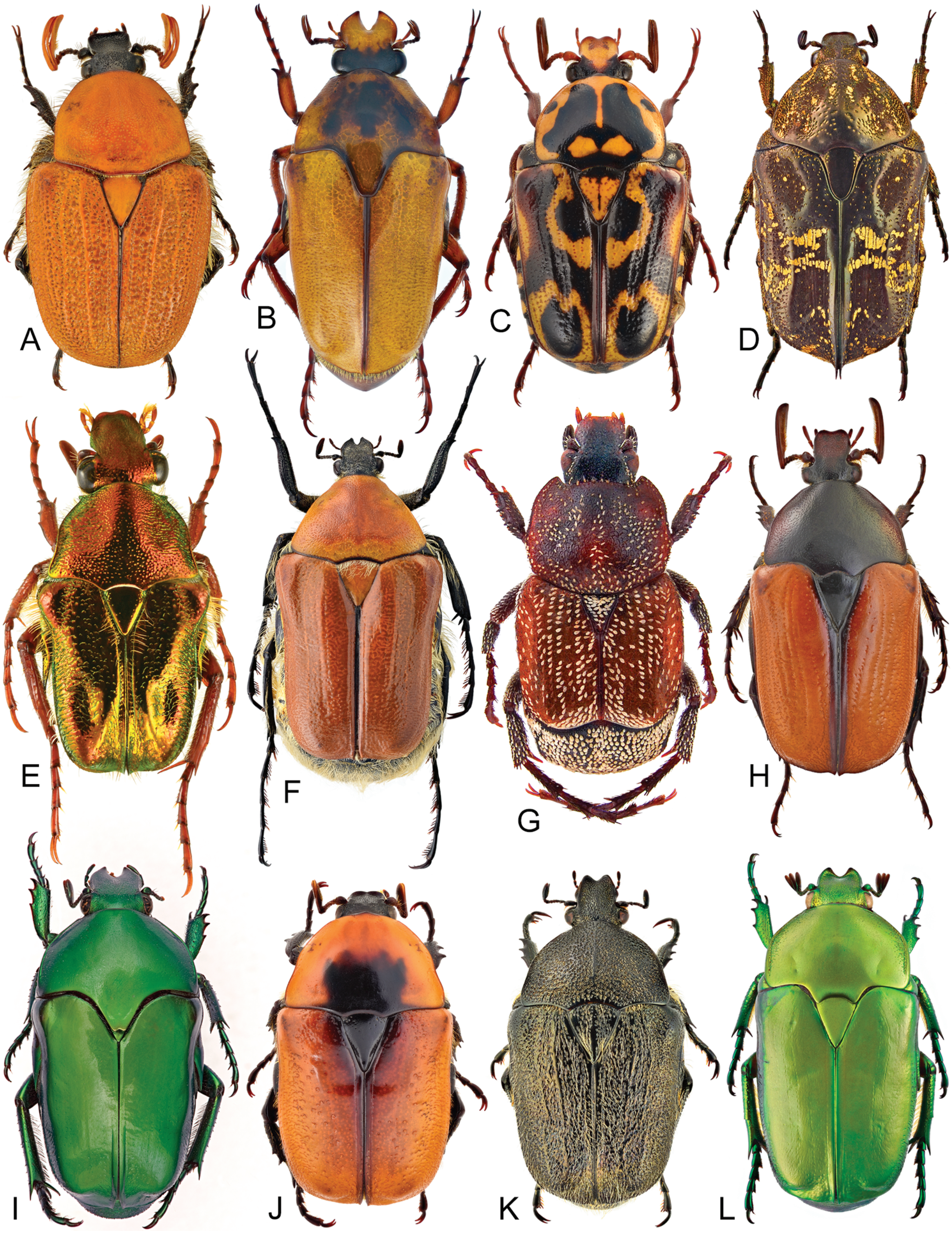


Plate 74. Scarabaeidae: Cetoniinae. A, *Grandaustralis boomerang* Hutchinson & Moeseneder; B, *Lomaptera cinnamomea* Thomson; C, *Lyraphora obliquata* (Westwood); D, *Protaetia acuminata* (Fabricius); E, *Lenosoma fulgens* (Macleay); F, *Hemichnoodes mniszechi* (Janson); G, *Microvalgus* sp.; H, *Macrotina satanas* Schürhoff; I, *Ischiopsopha wallacei* (Thomson); J, *Micropoecila cincta* (Gory & Percheron); K, *Metallesthes metallescens* (White); L, *Hemipharis insularis* (Gory & Percheron).

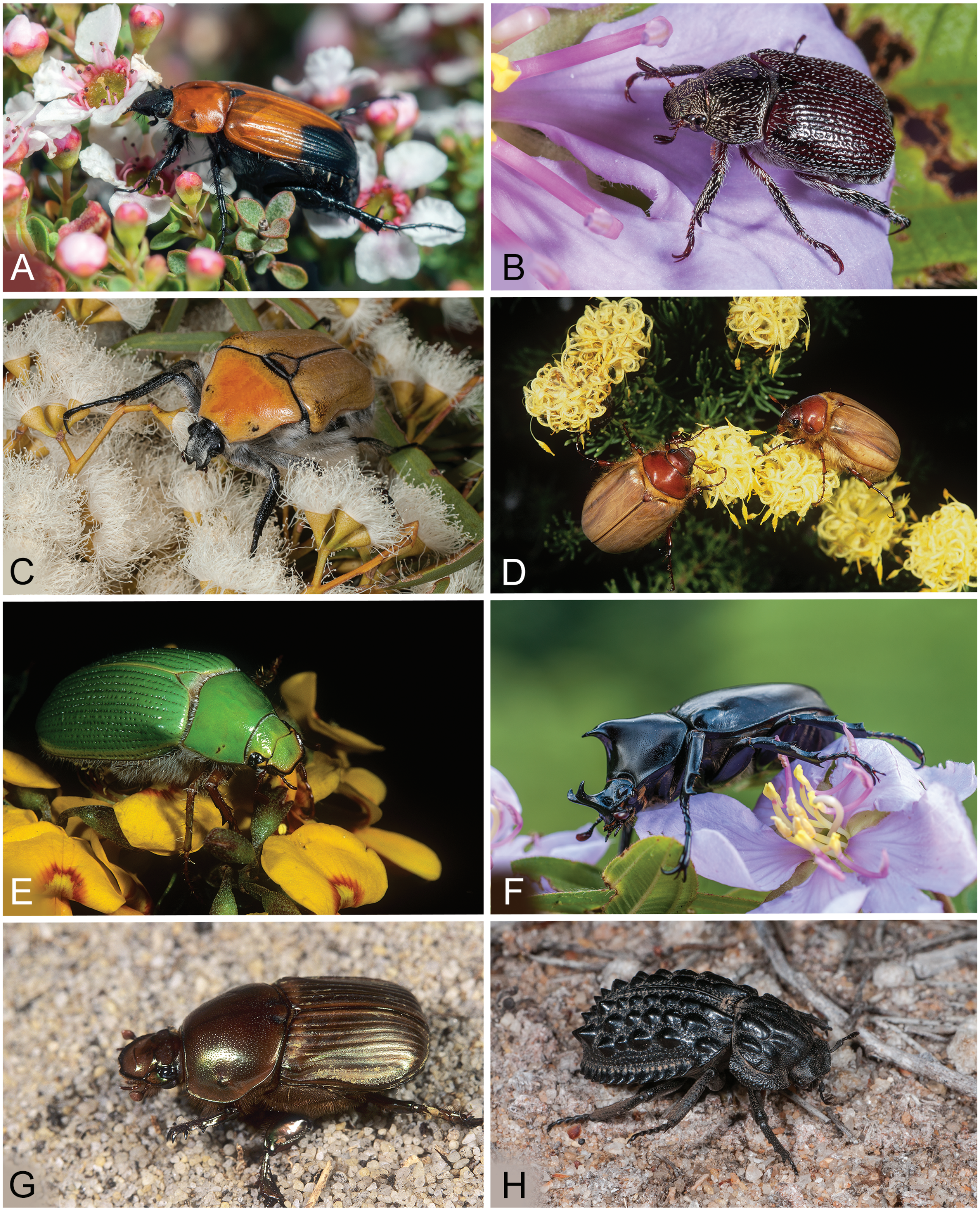


Plate 8. Beetles in their natural habitats. Scarabaeidae (A–G) and Trogidae (H). A, *Phyllotocus* sp. (Melolonthinae); B, *Mimadoretus niveosquamosus* Lea (Rutelinae); C, *Hemichnoodes mniszechi* (Janson) (Cetoniinae); D, *Colpochila* sp. (Melolonthinae); E, *Xylonichus eucalypti* Boisduval (Melolontchinae); F, *Xylotrupes australicus* Thomson Dynastinae); G, *Onitis aygulus* (Fabricius) Scarabaeinae); H, *Omorgus (Omorgus) tatei* (Blackburn). A–H © Jiří Lochman.

Plate 9. Beetles in their natural habitats. Tenebrionidae (A–E) and Scarabaeidae (F–H). A, *Ecnolagria* sp.; B, *Ecnolagria grandis* (Gyllenhal); C, *Lepturridea* sp.; D, *Emcephalus* sp.; E, *Derispia variabilis* (Carter); F, *Xylotrupes australicus* Thomson; G, *Digitonthophagus gazella* (Fabricius); H, *Lepanus* sp. on bird dropping. © Nick Monaghan.