A systematic revision of the plantbug genus *Kirkaldyella* Poppius (Heteroptera: Miridae: Orthotylinae: Austromirini)

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The genus *Kirkaldyella* is revised and thirteen species are described, twelve of which are new: *K. adunca*, *K. anasillosi*, *K. argoantyx*, *K. boweri*, *K. carotarhani*, *K. mcalpinei*, *K. mcmillani*, *K. ngarkati*, *K. notaurantia*, *K. ortholata*, *K. pilosa and K. schuhi*. The type species, *K. rugosa* Poppius is redescribed and illustrated. The biology and host associations of the species are discussed. A cladistic analysis of the species is given with all the relationships fully resolved, aside from the most terminal clade (*K. notaurantia* + *K. schuhi* + *K. rugosa*). The analysis is based primarily on characters of the male genitalia.

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Introduction

The Austromirini were erected as a tribe of Orthotylinae by Carvalho (1976) to include a complex of elongate genera, usually with an acute frons, including *Austromiris* Kirkaldy, *Dasymiris* Poppius and *Zanessa* Kirkaldy. Cassis & Gross (1995) assigned the ant-mimetic genera *Myrmecoridea* Poppius and *Myrmecoroides* Gross to this tribe, but placed *Kirkaldyella* Poppius within the nominotypical tribe. Cassis & Asquith *in preparation* are redefining the tribe and revising the constituent genera, and recognise *Kirkaldyella* as a member of the Austromirini. The austromirines include a complex of ant-mimetic genera that exhibit a range of morphological specialisations. Myrmecomorphy in *Kirkaldyella* Poppius is restricted to the larvae, with the adults possessing less apparent mimetic fascies.

Most of the species of *Kirkaldyella* are morphologically alike, with all species being dark, elongate to elongate-ovoid insects. The male genitalia, particularly the spiculum, separates all the species and is extensively described and illustrated in this work. Supporting external characters include those of the vestiture and colour patterns.

Prior to this work, *Kirkaldyella* comprised the type species *K. rugosa* Poppius alone. We describe 12 new species from temperate Australia, where the genus appears to be confined. Species richness is greatest in New South Wales (6 species) and Western Australia (7), but this may be partially due to extensive collections by one of us (GC) in the heathland and open forest habitats of these states. Many species are broadly distributed, although a few of the Western Australian species have more restricted distributions in the south-western region of the state.

The Austromirini are a dominant group of phytophagous insects in a broad range of Australian environments. The group has received scant taxonomic and no ecological work, yet they are abundant on many plant species. In this work we establish host records for ten species of *Kirkaldyella*. *K. rugosa* Poppius and *K. schuhi* sp. n., have been collected from a monocot species, *Lomandra longfolia* Labill. The host records are from thirteen genera and ten plant families, representing a broad range of unrelated hosts.

Methods and materials

Two hundred and sixty four specimens were examined in this study. This material was borrowed from several Australian and American institutions. The institutional acronyms listed in the species descriptions are:

AM - Australian Museum;
AMNH - American Museum of Natural History;
ANIC - Australian National Insect Collection;
BPBM - Bernice P. Bishop Museum;
CAS - Californian Academy of Science;
MNH - Musei Nationalis Hungarici;
MV - Museum of Victoria;
QM - Queensland Museum;
SAMA - South Australian Museum;
UQIC - University of Queensland Insect Collection;
UZMH - Universty Museum (Zoology) Helsinki;
WAM - Western Australian Museum.

Much of the study material was collected by one of us (GC) and cohorts, and is housed at the Australian Museum. The type material of *K. rugosa* was not examined. However, material compared with the type by the late Jose Carvalho, and his genitalic notes and illustrations were available to us.

The morphological techniques and terminology follow those of Cassis (1995) and references therein. The description of the male genitalia is complex and positional statements refer to the resting position of the components within the pygophore. The pygophore is illustrated with and without the parameres to indicate the resting position of the latter and the presence of processes of the genital opening. The right paramere is illustrated in two positions to indicate diagnostic structures, particularly mesial spines. Illustrations of the aedeagus are given with and without the theca.

All measurements are maximum lengths and in millimetres. The abbreviations for morphometric characters are as follows: BL = body length, HW = head width across eyes, IOD = interocular distance, HL = head length, PL = pronotal length, PW pronotal width at posterior margin, AII = length of second antennal segment, and LL = labial length.

Scanning electron micrographs were prepared using techniques outlined in Bolte (1996) and Swearingen et al. (1997). Illustrations were drafted using a camera lucida and rendered using ADOBE Illustrator software.

For plant specimens collected by us, host plant identifications were provided by botanists at the Royal Botanic Gardens (Sydney) and Western Australian Herbarium (Perth). Vouchers of the host plants are housed in these institutions and registration numbers are available from the authors. Host information from specimens collected by others was transcribed from the data labels and have not been verified. Discussion of host plant associations are made in reference to the angiosperm phylogeny proposed by Soltis et al. (2000). The locality information is given in the 'Specimens examined' section of each species. For specimens lacking latitude and longitude information, coordinates were calculated using ESRI software (ARCINFO and ARCVIEW), and are given in brackets. Data for specimens collected by the senior author and cohorts include *lot* numbers (e.g. WA95-L65). Additional habitat and locality information can be provided by the authors with reference to the lot numbers. Maps were prepared using the above software.

Phylogenetic methods. – All the characters were unweighted and unordered. The data were analysed using Hennig86. Trees were produced using the *m** and *bb* subroutines. Numerous species of an undescribed genus of Austromirini were used as outgroups. Because the coding for all character states for these outgroups was identical only one outgroup is presented in the analysis.

Taxonomic characters. – The dorsal margin of the genital opening of the pygophore generally has one process on the right hand side. *K. mcalpinei* and *K. carotarhani* have an additional process on the left hand side (Fig. 10B-11B). The right hand process can be absent (Fig. 7B), greatly reduced in size (Fig. 10B) or elongate (Fig. 8B). The left paramere is hammer shaped and possesses an apical hook. The apical hook is most commonly orientated toward the lateral margin but can also be orientated toward the medial margin (Fig. 7C and 16C). The right paramere is generally subrectangular and is characterised by an elongate posterolateral process. The medial margin commonly has between four and thirteen teeth, arranged linearly or in an orbicular congregation (Fig. 8E) or a combination of both (Fig. 9D). The aedeagus of *Kirkaldyella* is characterised by three to four elongate spines one of which is commonly bifid. The tip of the longest spine in *K. boweri* and *K. ngarkati* (Fig. 9F-G and 13F-G) has a series of teeth not seen in any other species of *Kirkaldyella*. The shape of the pronotum is an important taxonomic character in the *Kirkaldyella*. Pronotum shape can take three forms, trapeziform (Fig. 10H and 11F), campanulate (Fig. 8H and 9H) or quadrate (Fig. 7F and 16H). The lateral anterior margins are often mildly explanate. The anterior half of the pronotum is characterised in many species by the presence of the callosite region (Fig. 1A) which is composed of two gently raised areas. In many species a pair of small foveae are present between the calli (Fig. 1A).

Table 1. Host plants and habitats of *Kirkaldyella* species.

Kirkaldyella species	Host plant	Plant family	Habitat
anasillosi	*Acacia* sp.	Mimosaceae	flowers
argoantyx	*Echium plantagineum* *Halosarcia indica*	Boraginaceae Chenopodiaceae	unknown unknown
boweri	*Pimelea sylvestris* *Hardenbergia comptoniana*	Thymelaeaceae Fabaceae	flowers unknown
carotarhani	*Elaeocarpus obovatus* *Eucalyptus crebra*	Elaeocarpaceae Myrtaceae unknown	flowers leaves and flower
ngarkati	*Eucalyptus calycogona* *Senecio latus dissectifolius*	Myrtaceae Asteraceae	leaves and flowers leaves and flowers
notaurantia	*Scaevola nitida*	Goodeniaceae	leaves and flowers
ortholata	*Acacia* sp.	Mimosaceae	flowers
pilosa	*Pultenaea tenuifolia* *Allocasuarina campestris* *Conospermum stoechadis* *Phymatocarpus porphyocephalus*	Fabaceae Casuarinaceae Proteaceae Myrtaceae	leaves and flowers leaves flowers leaves and flowers
rugosa	*Lomandra longifolia*	Lomandraceae	leaves and flowers
schuhi	*Lomandra longifolia*	Lomandraceae	leaves and flowers

Biology

The Miridae exhibit a wide variety of feeding behaviors (phytophagy, mycetophagy, carnivory, omnivory). Most species appear to be phytophagous, particularly those belonging to the Orthotylinae and Phylinae. Many species of these two subfamilies are associated with flowers yet it is not clear if they feed on vegetative and/or reproductive plant parts. The genus *Kirkaldyella* feeds on both monocotylodenous and eudicotylodenous angiosperms.

Kirkaldyella rugosa and *K. schuhi* have been taken on *Lomandra longifolia* Labill. species, a genus of monocots that is primarily Australian, but also found in New Caledonia (Clifford 1983). We have collected *K. rugosa* and *K. schuhi* in large numbers on the leaves of *Lomandra longifolia*. When disturbed both species moved very rapidly between upper and lower leaf surfaces. In both species, individuals were found on plants with and without inflorescences. *K. rugosa* was also found with another austromirine species, *Woodwardiola* sp., often on the same individual plant. Monocot feeding in the Heteroptera is not widespread and usually confined to particular suprageneric groups (e.g. Mirinae: Stenodemini, Pachygronthidae) or genera (e.g. *Baclozygum*). Cassis et al. (1999) report that monocot feeding in Australia is possibly more widespread than previously reported. We have examined other species of *Lomandra* but have not encountered other *Kirkaldyella* species.

Species of *Kirkaldyella* have also been taken from the eudicot plant families Asteraceae, Casuarinaceae, Fabaceae, Thymelaeceae, Mimosaceae and Myrtaceae. *K. anasiollosi* and *K. ortholata* have been captured on undetermined species of *Acacia*.

Genus ***Kirkaldyella*** Poppius

Kirkaldyella Poppius 1921: 54; Carvalho 1952: 82 (list); Carvalho 1958: 137 (catalogue); Schuh 1974: 283 (transferred to Orthotylini); Cassis & Gross 1995: 191 (catalogue); Schuh 1995: 128 (catalogue). Type species: *Kirkaldyella rugosa* Poppius, 1921, by original designation.

Diagnosis. – *Kirkaldyella* is recognised by the following combination of characters: elongate-ovoid to ovoid body; largely black, shining; large eyes; transversely rugose pronotum; erect dorsal setae; large left paramere lying on the ventral surface of the pygophore.

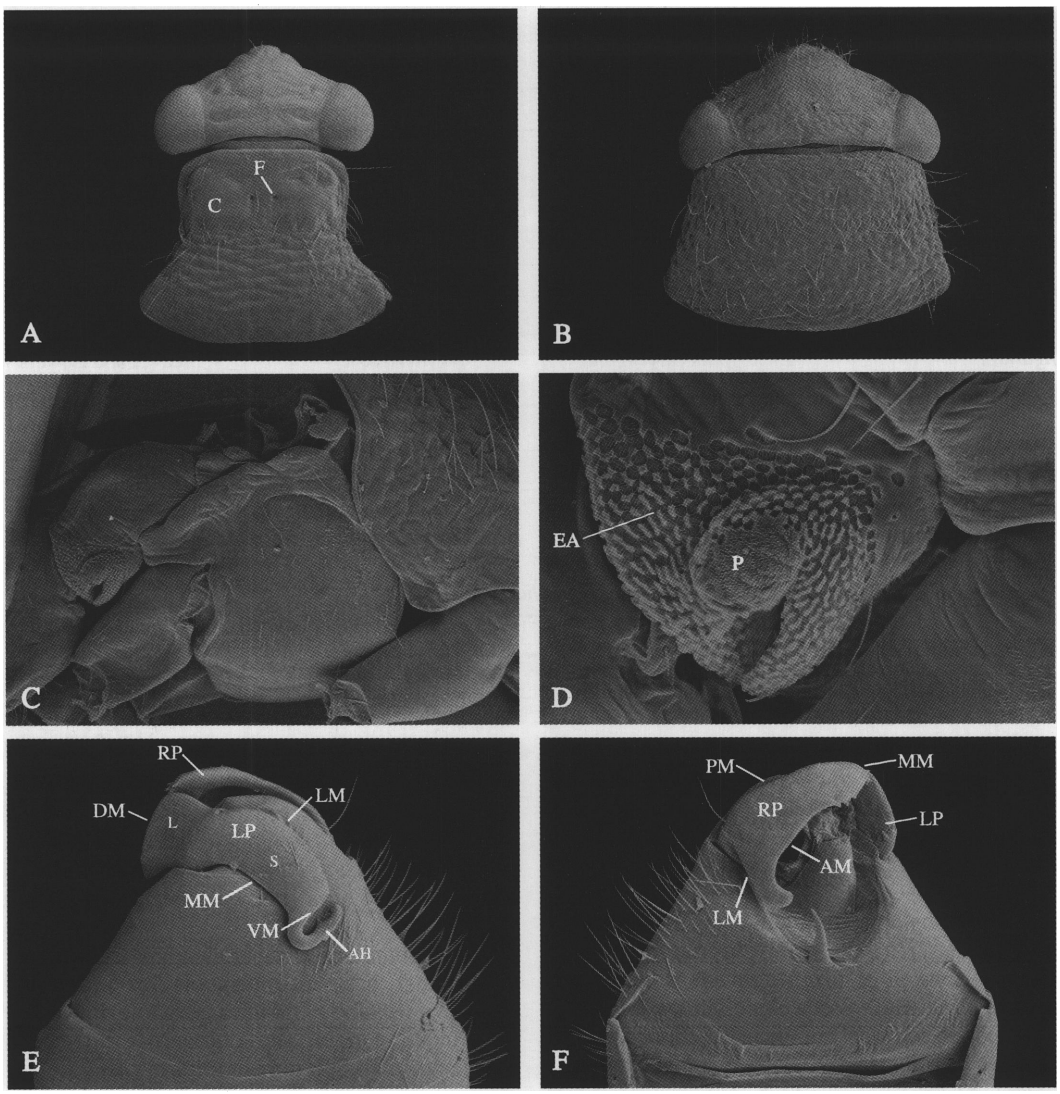

Figure 1. (A) *Kirkaldyella rugosa*, head and pronotum (C = callosite region, F = fovea). (B) *K. anasillosi*, head and pronotum. (C) *K. rugosa*, external efferent system. (D) *K. rugosa*, peritreme and evaporative areas (EA = evaporative areas, P = peritreme). (E) *K. rugosa*, genital opening in ventral view (AH = apical hook, DM = dorsal margin, L = lobe, LM = lateral margin, LP = left paramere, MM = medial margin, RP = right paramere, S = shaft, VM = ventral margin). (F) *K. rugosa*, genital opening in dorsal view (AM = anterior margin, LM = lateral margin, LP = left paramere, MM = medial margin, PM = posterior margin, RP = right paramere).

Distribution. – *Kirkaldyella* has a south temperate distribution within Australia. The species are found in mesic and semi-arid areas of New South Wales, Victoria, Tasmania, and South Australia and southern Western Australia.

Remarks. – *Kirkaldyella* can be distinguished most readily from all other austromirines by the shape and orientation of the left paramere, which is generally hammer-shaped with the shaft oriented along the ventral surface of the pygophore.

Checklist of *Kirkaldyella* species

adunca Cassis & Moulds, sp. n.
anasillosi Cassis & Moulds, sp. n.
argoantyx Cassis & Moulds, sp. n.
boweri Cassis & Moulds, sp. n.
carotarhani Cassis & Moulds, sp. n.
mcalpinei Cassis & Moulds, sp. n.
mcmillani Cassis & Moulds, sp. n.
ngarkati Cassis & Moulds, sp. n.
notaurantia Cassis & Moulds, sp. n.
ortholata Cassis & Moulds, sp. n.
pilosa Cassis & Moulds, sp. n.
rugosa Poppius
schuhi Cassis & Moulds, sp. n.

Key to the species of *Kirkaldyella*

1. Hemelytra with distinct stramineous to orange, triangular to lachyriform markings on the corium and/or the claval commissure 2
– Hemelytra black to fuscous, without distinct stramineous to orange markings on the corium or claval commissure 5
2. Calli weakly to strongly developed (Fig. 1A) 3
– Calli absent (Fig. 1B) 4
3. Vertex weakly concave; AI length equal to interocular distance ..... *carotarhani*
– Anterior half of vertex weakly convex with lateral margins depressed; AI much shorter than interocular distance 12
4. Hemelytra gray-brown with stramineous triangular markings on lateral half of costal fracture and circular marking on claval commissure .... *pilosa*
– Hemelytra fuscous with stramineous triangular markings on exocorium anteriad to costal fracture ..... *anasillosi*
5. Exocorium to R+M vein stramineous ..... *argoantyx*
– Exocorium to R+M vein black to fuscous 6
6. Vertex weakly concave; AI length equal to interocular distance ..... *mcalpinei*
– Anterior half of vertex weakly to moderately convex; AI much shorter than interocular distance 7
7. Pair of small foveae present medially on pronotum (Fig. 1A) 8
– No foveae present medially on pronotum (Fig. 1B) ..... *mcmillani*
8. Distinct yellow to fuscous triangular markings adjoining eyes; proepimeron strongly depressed 9
– Indistinct fuscous band along posterior margin of head; proepimeron weakly depressed .... *ortholata*
9. Body elongate, parallel-sided; bucculae elongate, almost reaching ventral margin of head 10
– Body elongate ovoid; bucculae short, obtaining half length of gular ..... *adunca*
10. Hemelytra strongly declivent beyond costal fracture; teeth on medial margin of right paramere arranged rectilinearly (Fig. 9) 11
– Hemelytra weakly declivent beyond costal fracture; teeth on medial margin of right paramere arranged orbicularly (Fig. 18) ..... *rugosa*

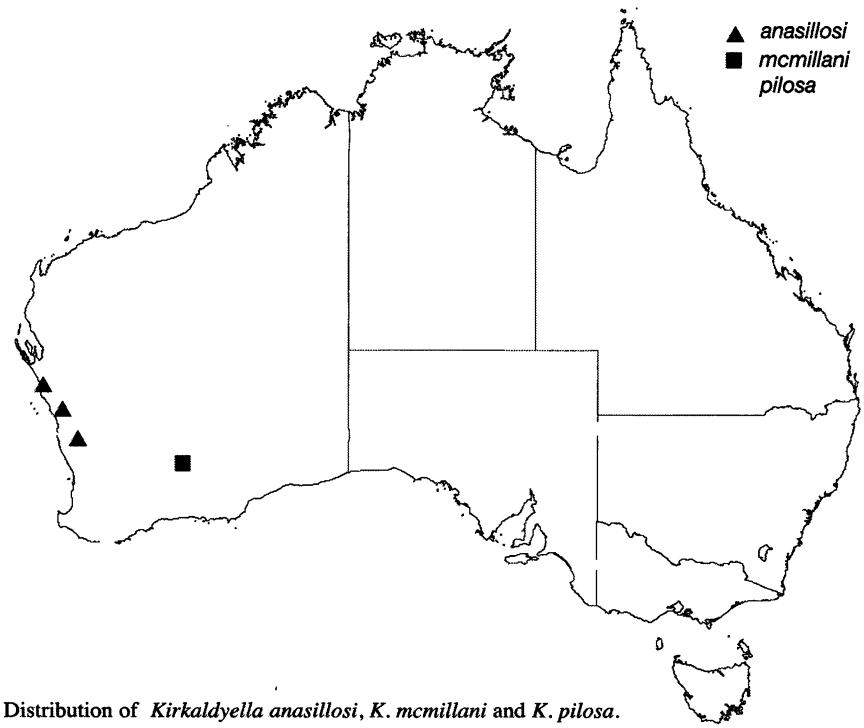

Figure 2. Distribution of *Kirkaldyella anasillosi*, *K. mcmillani* and *K. pilosa*.

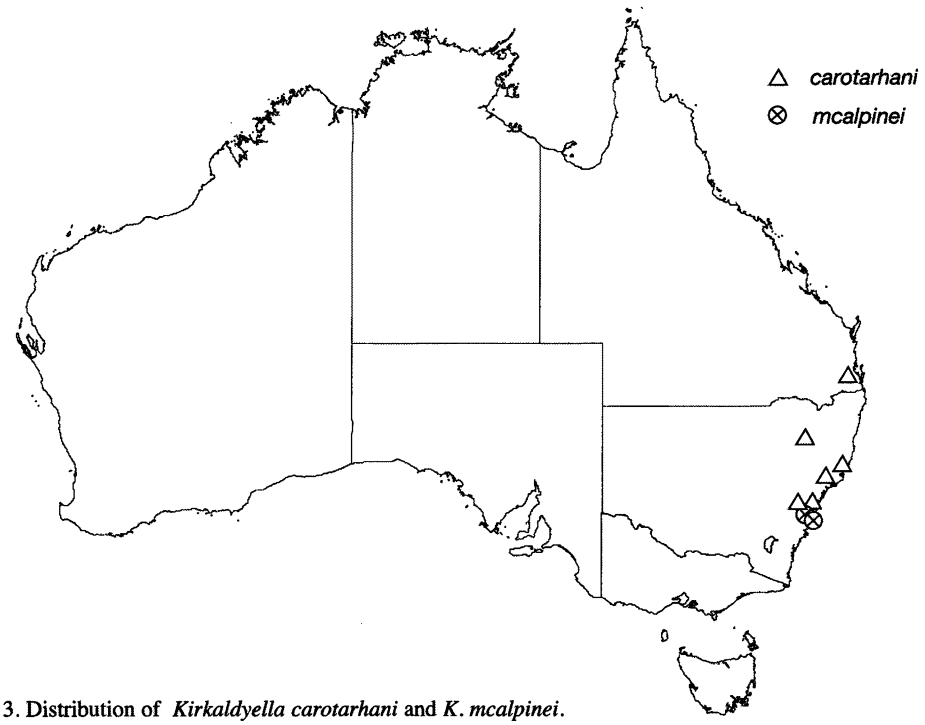

Figure 3. Distribution of *Kirkaldyella carotarhani* and *K. mcalpinei*.

11. Medial margin of right paramere with four teeth (Fig. 9); eight teeth on termination of longest bifid branch of spiculum (Fig. 9) ..... *boweri*
– Medial margin of right paramere with three teeth (Fig. 13); three teeth on termination of longest bifid branch of spiculum (Fig. 13) ... *ngarkati*
12. Orange yellow triangular markings on exocorium anteriorly to cuneus ..... *notaurantia*
– Pale stramineous triangular markings on exocorium anteriorly to cuneus ..... *schuhi*

Kirkaldyella adunca Cassis & Moulds, sp. n.

(Fig. 4, 6A-H)

Diagnosis. – *K. adunca* is recognised by the following combination of characters: body elongate-ovoid; mostly glossy black to fuscous, with yellow-brown to fuscous triangular markings adjoining eyes; bucculae short; and, male genitalic characters (Fig. 6A-G). *K. adunca* is distinguished externally from *K. rugosa* by the shorter bucculae and the more ovoid body shape, and from *K. ortholata* by a more ovoid body shape.

Description. – Colouration. Head, posterior margin of vertex with triangular yellow-brown to fuscous markings adjacent to eyes, occasionally forming band along posterior margin of head; yellow to yellow-brown markings sometimes present between antennifers and eyes. Antennae, AI and AII stramineous to dark brown; AIII stramineous, apices brown to fuscous; AIV dark brown. Pronotum glossy black. Scutellum black. Hemelytra brown to fuscous, cuneus rarely reddish-brown. Legs mostly stramineous; basal third of meso- and metacoxae brown to fuscous.

Dorsal texture. Head weakly rugose. Pronotum rugopunctate. Clavus weakly rugopunctate with submarginal row of punctures parallel to claval furrow; lateral margins of corium rugopunctate.

Vestiture. Body with dense distribution of simple, fine, erect, elongate, pale setae; femora and tibiae also with elongate, semi-erect bristles.

Structure. Elongate-ovoid. Males macropterous, females macropterous or submacropterous. Head, posterior margin rectilinear; dorsal surface of head weakly convex; anterior half of vertex weakly convex, posterior half of vertex flat with lateral

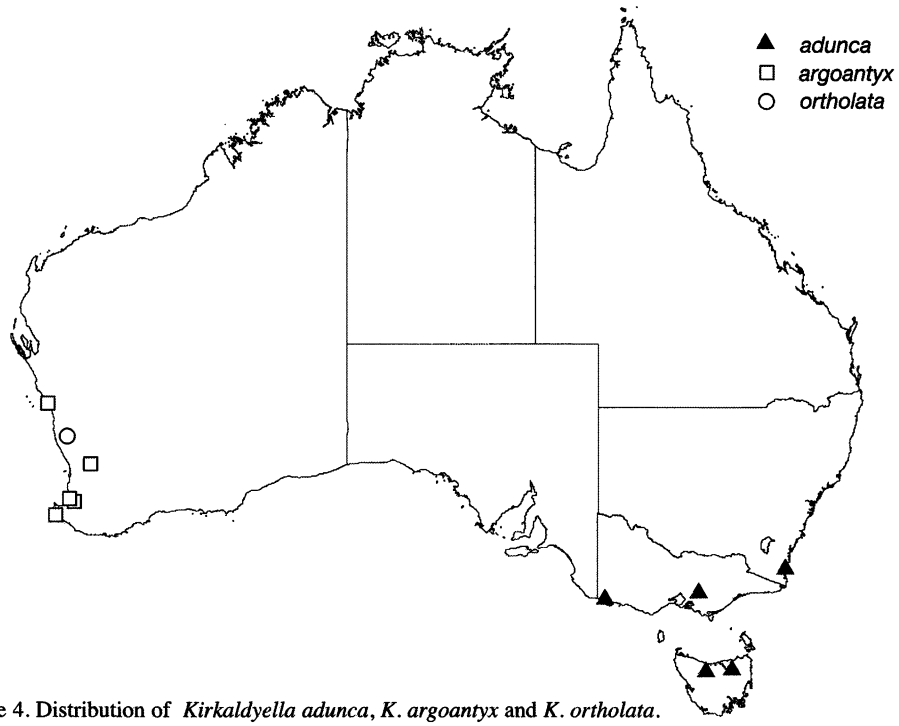

Figure 4. Distribution of *Kirkaldyella adunca*, *K. argoantyx* and *K. ortholata*.

margins foveate. Antennae, AI much shorter than interocular distance. AII generally slightly longer than basal pronotal width in males and generally shorter in females. AII weakly incrassate apically. AIII weakly fusiform. Eyes slightly removed from posterior margin of head. Bucculae short, posterior margin extending to mid-length of gular. Labium extending to base of metacoxae. Pronotum transverse, campanulate (Fig. 6H); collar thin, depressed; calli weakly developed, weakly depressed medially, with pair of submedial small foveae; anterior angles arcuate, explanate; disc moderately convex, posterior margin moderately convex. Mesoscutum small. Scutellum weakly declivent. Hemelytra not depressed beyond costal fracture, clavus moderately tectiform; costal fracture weakly developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme tumid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 6A-G), pygophore subconical (Fig. 6A) with enlarged, terminal, transverse, subrectangular ventral process (Fig. 6B); dorsal margin with acute elongate process (Fig. 6B), near midline of margin, subperpendicular to margin; genital opening large, ovoid. Left paramere (Fig. 6C), lateral margin weakly emarginate; lobe subquadrate with enlarged, obtuse, dorsomedial process; dorsal margin moderately convex with two pairs of teeth; shaft elongate, with prominent apical hook, recurved beneath subapical region of shaft, terminating toward lateral margin. Right paramere (Fig. 6D-E), subrectangular with anterolateral dentate subquadrate process; anteromedial cylindrical process with three teeth distally; anterior margin weakly concave; medial margin with four teeth; posterior margin weakly emarginate, large posterolateral hook-like process with furcate termination. Aedeagus (Fig. 6F-G) with multifurcate spiculum with four primary branches, one of which is bifid; secondary gonopore trough-shaped, caudal to base of two minor branches of spiculum, terminating at base of spiculum.

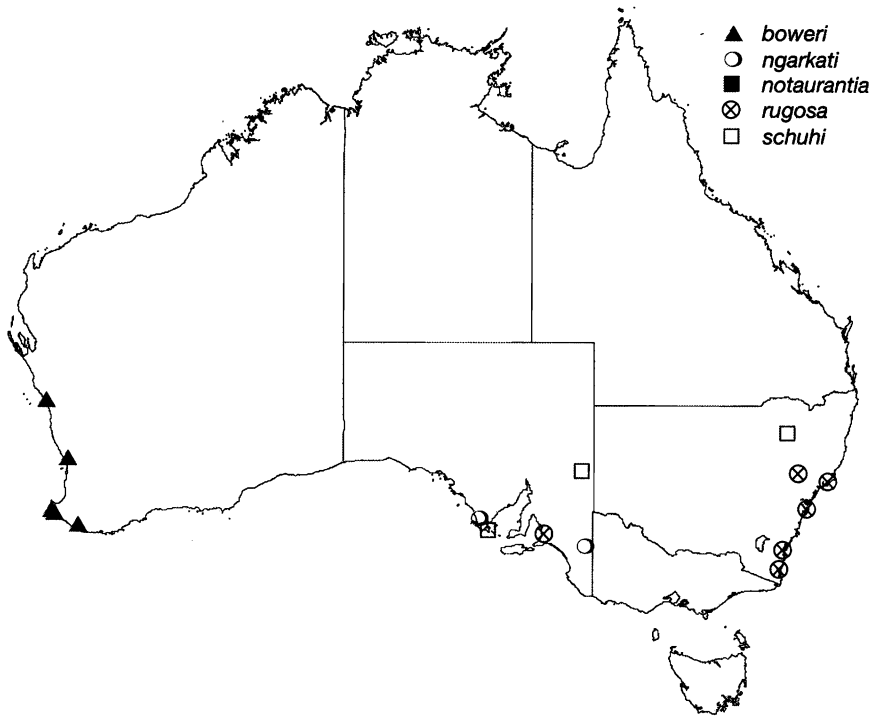

Figure 5. Distribution of *Kirkaldyella boweri*, *K. ngarkati*, *K. notaurantia*, *K. rugosa* and *K. schuhi*.

Measurements. 5♂ BL 3.40-4.25, HW 0.98-1.09, IOD 0.5-0.6, HL 0.60-0.75, PL 0.82-0.91, PW 1.10-1.17, AII 1.16-1.36, LL 0.86-1.67; 5♀ BL 3.72-4.30, HW 1.14-1.17, IOD 0.60-0.66, HL 0.51-0.80, PL 0.82-0.90, PW 1.06-1.16, AII 1.06-1.27, LL 0.96-1.19.

Material examined. – Holotype: TASMANIA: 1♂, Mount Barrow, [41.37°S 147.41°E], [740m], 6 February 1994, suction grass, forest edge, L Hill (AM). Paratypes: TASMANIA: 2♂, Pelion Hut, 3km S Mt Oakleigh, [41.50°S 146.03°E], 5-10 February, ID Naumann (AM, ANIC); 1♂, Mt Barrow, via Launceston [41.37°S 147.41°E], 9-10 February 1967, G Monteith (UQIC); 1♂ 2♀, same data as holotype (AM). VICTORIA: 1♀, Glenelg River, 4 miles NNE of Nelson, [38.05°S 141.19°E], 25 November 1966, A Neboiss (MV); 1♀, Warburton, [37.75°S 145.70°E], FE Wilson, 4080/721, (QM); 1♂, Cobungra [37.10°S 147.43°E], 1 February 1957, A Neboiss (MV).

Host plant. – Unknown.

Etymology. – The specific epithet is based on the Latin 'aduncus' referring to the hook of the apex of the left paramere.

Remarks. – *K. adunca* is restricted to Tasmania and coastal Victoria (Fig. 4). *K. adunca* is recognised in this work as the sister-species of the Western Australian species, *K. argoantyx*. In both species there is an orbicular arrangement of teeth on the medial margin of the right paramere (cf. Fig. 6D and 8D).

Kirkaldyella anasillosi Cassis & Moulds, sp. n.

(Fig. 1B, 2, 7A-F)

Diagnosis. – *K. anasillosi* is recognised by the following combination of characters: body elongate, parallel-sided; glossy black to fuscous, stramineous triangular markings on exocorium above the costal fracture; calli and foveae absent on pronotum; clavus moderately rugose; anterior half of the hemelytra with dispersed clumps of adpressed, flattened scale-like setae. *K. anasillosi* is distinguished from *K. pilosa* by the lack of adpressed, flattened scale-like setae over the entire dorsal surface of *K. anasillosi* and the presence of a circular

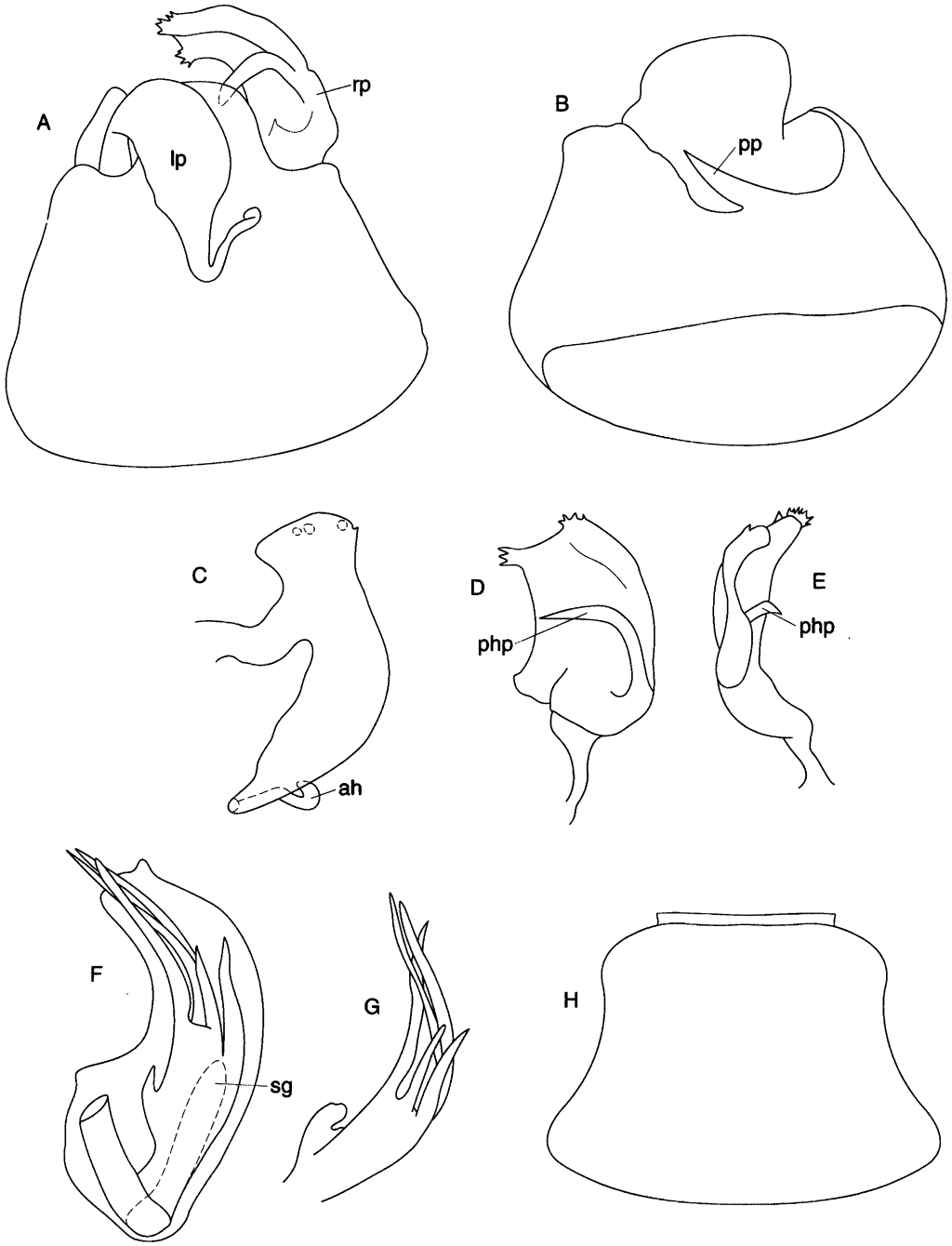

Figure 6. *Kirkaldyella adunca*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar. ah= apical hook, lp= left paramere, php= posterolateral hook-like process, pp= pygophore process, rp= right paramere, sg= secondary gonopore.

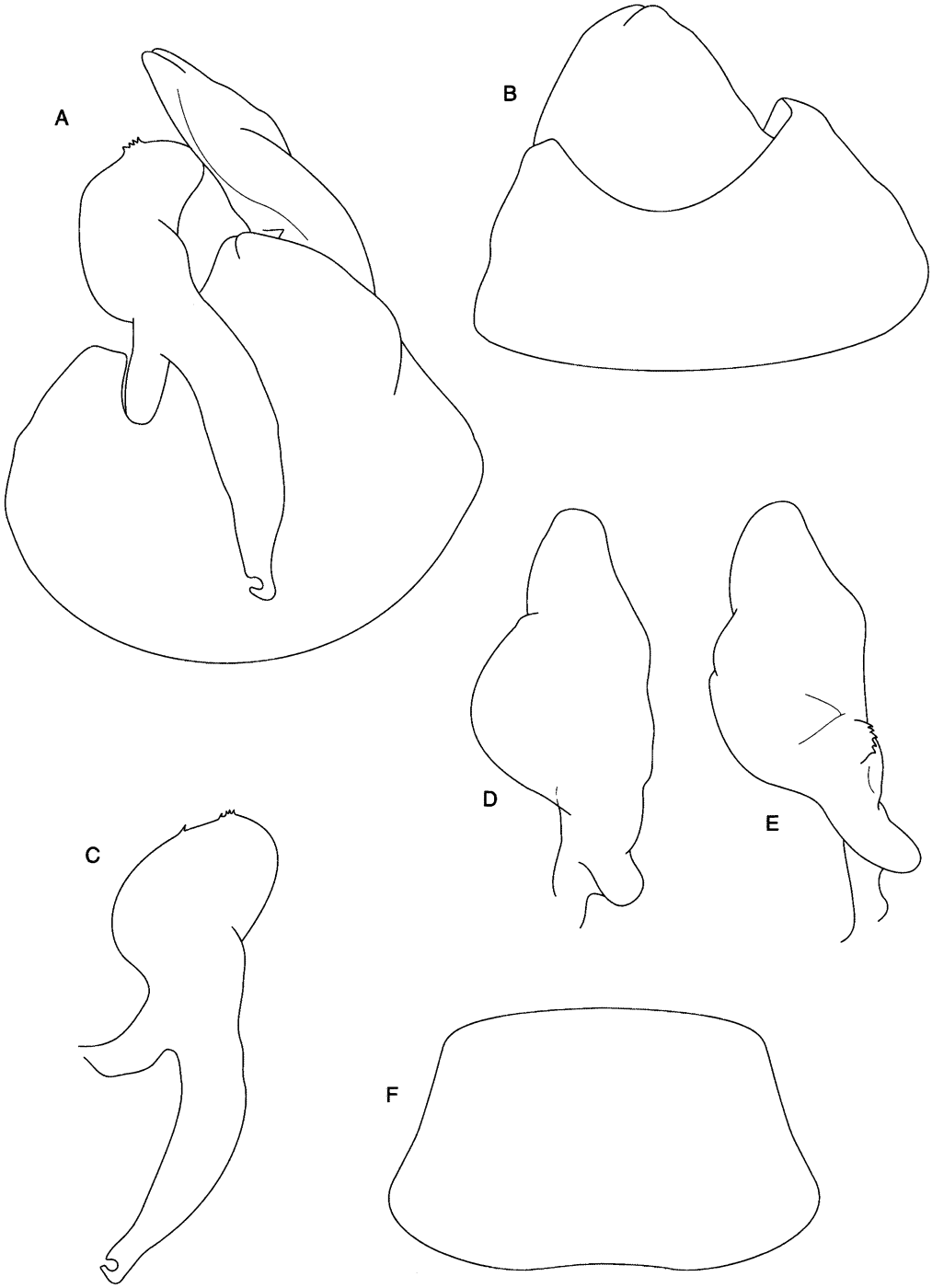

Figure 7. *Kirkaldyella anasillosi*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) pronotum.

stramineous marking on the anterior half of the claval commissure on *K. anasillosi*.

Description. – Colouration. Head, mostly glossy black, with triangular yellow-brown to fuscous markings adjoining eyes. Antennae, AI stramineous, AII-AIV fuscous. Pronotum, glossy black. Scutellum glossy black. Hemelytra, mostly fuscous, with stramineous triangular markings on exocorium above the costal fracture. Legs, mostly fuscous, apices of femora stramineous, basal half of tibiae stramineous.

Dorsal texture. Head moderately rugopunctate. Pronotum rugopunctate. Hemelytra, clavus moderately rugose; endocorium weakly rugose.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae, intermixed with dispersed clumps of dense adpressed, flattened, pale, scale-like setae on anterior half of hemelytra; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided; hemelytra, costal margin weakly convex. Head, posterior margin rectilinear, vertex, anteriorly weakly convex with lateral margins foveate, posterior half of vertex flat. Antennae, AI much shorter than interocular width. AII slightly larger than width of posterior margin of pronotum in male. AII tapered basally. Eyes contiguous with pronotum. Labrum extending to procoxae, labium extending to base of mesocoxae. Posterior margin of bucculae not extending beyond antennifers. Pronotum, transverse, quadrate (Fig. 7F); collar obsolete; calli absent, moderately convex across, without medial foveae; anterior angles obtuse, very weakly explanate; posterior margin weakly excavate medially. Mesoscutum, prominent and strongly convex. Scutellum, posterior half declivent. Hemelytra moderately declivent posteriorly to costal fracture, clavus weakly tectiform, lateral margins explanate; costal fracture moderately developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme tumid, reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 7A-E), pygophore subconical (Fig. 7A) with enlarged, terminal, transverse, obtuse ventral process (Fig. 7B); genital opening large, ovoid. Left paramere (Fig. 7C), elongate, ventral margin nearly reaching anterior margin of pygophore; lateral margin emarginate; lobe subodval with orbicular congregation of four teeth on dorsal margin, small isolated process on dorsal margin; shaft narrow, elongate with prominent apical hook, coplanar with remainder of shaft, terminating near medial margin. Right paramere (Fig. 7D-E), elongate, subtriangular with mesolateral rectangular process; medial margin obtuse; anterior margin mesially dominated by large obtuse process, five teeth on mesioposterior margin.

Measurements. 1♂ BL 4.0, HW 1.2, IOD 0.69, HL 0.7, PL 0.86, PW 1.02, AII 1.1, LL 1.38.

Material examined. – Holotype: WESTERN AUSTRALIA: 1♂, 45km E of Geraldton, [28.77°S 115.07°E], 20-23 August 1987, C Reid, (AM). Paratypes: WESTERN AUSTRALIA: 2♂, Watheroo National Park, [30.16°S 115.83°E], 8 September 1990, ex *Acacia* sp., G Cassis, site WA/005/P7 (AM); 1♀, same data as holotype; 1♂, Kalbarri, [27.66°S 114.17°E], 20-23 August 1987, ex *Acacia* sp., C Reid (AM); 1♂, Uberin Rock [31.00°S 116.59°E], 16 September 1984, RP McMillan (WAM).

Host plant. – *Acacia* sp. (Mimosaceae).

Etymology. – The species name is based on the Latin 'anasillos' referring to the clumps of dense adpressed, flattened, scale-like setae on the anterior half of the hemelytra.

Remarks. – *K. anasillosi* is restricted to coastal Western Australia (Fig. 2). *K. anasillosi* and *K. ortholata* have both been collected on *Acacia* flowers in heathland habitats north of Perth. *K. anasillosi* is recognised in this work as being the sister-taxon of the widely distributed species *K. pilosa*. These two species both have a prominent apical hook that is coplanar with the remainder of the shaft, terminating towards the medial margin (cf. Fig. 7C and 16C) and lack an elongate acute process on the dorsal margin of the genital opening (cf. Fig. 7B and 16B). *K. anasillosi* is easily distinguished from *K. pilosa* by scale-like setae being restricted to the anterior half of the hemelytra and the triangular yellow-brown to fuscous markings adjoining the eyes.

Kirkaldyella argoantyx
Cassis & Moulds, **sp. n.**

(Fig. 4, 8A-H)

Diagnosis. – *K. argoantyx* is recognised by the combination of the following characters: body glossy black to fuscous; embolium and lateral edges of corium to R+M vein stramineous, and male genitalic characters. *K. argoantyx* is distin-

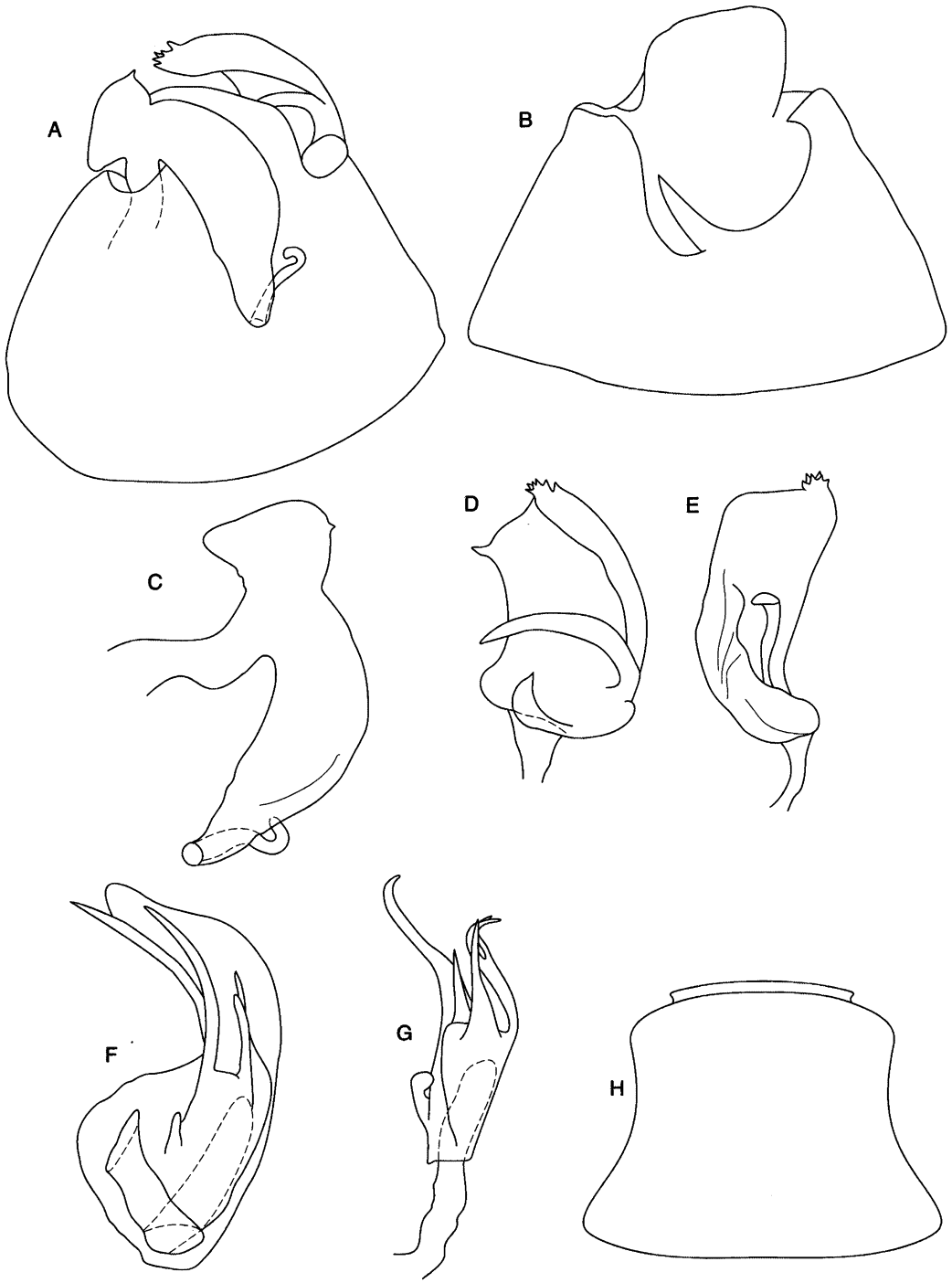

Figure 8. *Kirkaldyella argoantyx*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

guished from *K. rugosa* and *K. schuhi* by the stramineous embolium.

Description. – Colouration. Head, vertex with a triangular to quadrate, red to orange-brown markings adjoining eyes; bucculae occasionally red. Antennae, AI-AIV black, indistinct fuscous band at apex of AI and base of AII. Pronotum, glossy fuscous to black. Scutellum glossy black to orange-fuscous. Hemelytra, fuscous to black; embolium mostly stramineous, occasionally with margins of cuneus reddish-fuscous. Legs, mostly fuscous; femora with stramineous annulation apically; coxae basal third fuscous to black, stramineous apically.

Dorsal texture. Head polished, impunctate. Pronotum moderately rugose. Hemelytra moderately rugopunctate.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae with dense congregations on clavus.

Structure. Macropterous, elongate, parallel-sided. Head, vertex, anterior half moderately convex, posterior half flat, laterally foveate. Antennae, AI much shorter than interocular width. AII slightly longer than width of posterior margin of pronotum in males, a little shorter in females. Eyes slightly removed from head. Labrum extending to anterior margin of procoxae. Labium extending beyond base of metacoxae. Bucculae not extending beyond antennifers. Pronotum, transverse, campanulate (Fig. 8H); collar thin, depressed; calli moderately developed, medially depressed between them with pair of small foveae; anterior angles arcuate, explanate; disc strongly convex, posterior margin weakly excavate. Mesoscutum prominent, strongly convex. Scutellum flat, posterior third declivent. Hemelytra, strongly declivent beyond costal fracture, clavus moderately tectiform; costal fracture very weakly developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially. Metathoracic external efferent system, peritreme tumid, elongate ovoid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 8A-G), pygophore subconical (Fig. 8A) with enlarged, transverse, subrectangular ventral process (Fig. 8B); dorsal margin with small, acute, elongate process (Fig. 8B), near midline of margin, subperpendicular to margin; genital opening large, ovoid. Left paramere (Fig. 8C), lateral margin weakly emarginate; lobe subovoid with enlarged, obtuse, rectangular process mediodorsally, small cylindrical process present, three conical teeth apically; shaft fusiform with prominent apical hook, coplanar with remainder of shaft, terminating towards lateral margin. Right paramere (Fig. 8D-E), subrectangular, with anterolateral subtriangular process; and acute, bifid, elongate posterolateral process; medial margin with thirteen small teeth; posteromedial process with three teeth, one of which is bifid, posterior margin moderately convex. Aedeagus (Fig. 8F-G) with multifurcate spiculum with three primary branches, one of which is bifid; secondary gonopore trough-shaped caudal to base of bifid branch of spiculum, terminating within base of spiculum.

Measurements. 1♂ BL 3.2, HW 1.01, IOD 0.53, HL 0.6, PL 0.77, PW 1.24, AII 1.41, LL 1.23; 3♀ BL 3.72-4.0, HW 1.0-1.1, IOD 0.50-0.58, HL 0.61-0.67, PL 0.80-0.84, PW 1.21-1.39, AII 1.16-1.36, LL 1.04-1.56.

Material examined. – Holotype: WESTERN AUSTRALIA: 1♀, Burekup [33°19'S 115°49'E], 13 December 1989, W Woods, ex *Echium plantagineum* Linnaeus (AM). Paratypes: WESTERN AUSTRALIA: 3♂ 2♀, same data as holotype; 1♂, Donnybrook [33°35'S 115°49'E], 13 December 1989, W Woods, ex *Echium plantagineum* Linnaeus (AM); 1♂ 1♀, 22km S of Watheroo, 400m, [30.43°S 116.04°E], 2 November 1996, RT Schuh and G Cassis, ex *Halosarcia indica* Nees [96-56] (AM); 1♀, Northam, [31°39'S 116°40'E], 1 November 1963, J Sedlacek (BPBM); 1♀, Geraldton, [28°46'S 114°37'E], October 1931, Australian Harvard Expedition Darlington (AMNH); 1♀, Yarranabee, 15km SW of Highbury [33.16°S 117.116°E], 27 November 1975, KA Spence (WAM).

Host plants. – *Echium plantagineum* L. [Boraginaceae]; *Halosarcia indica* ssp. *bidens*. [Chenopodiaceae].

Etymology. – This species name is based on the Greek 'argos' and 'antyx' meaning white edge. This refers to the pale colouration of the embolium.

Remarks. – *K. argoantyx* is restricted to the south-western coast of Western Australia (Fig. 4) where it has been collected on the weed species Patersons Curse. This association is undoubtedly a host-switching event. We have also collected this species near Watheroo, in heathland habitat. A single specimen was taken by general sweeping and the native host plant was not established. *K. argoantyx* is recognised in this work as the sister-species to *K. adunca* as both species have an orbicular congregation of teeth on the medial margin of the right paramere (cf. Fig. 6D and 8D).

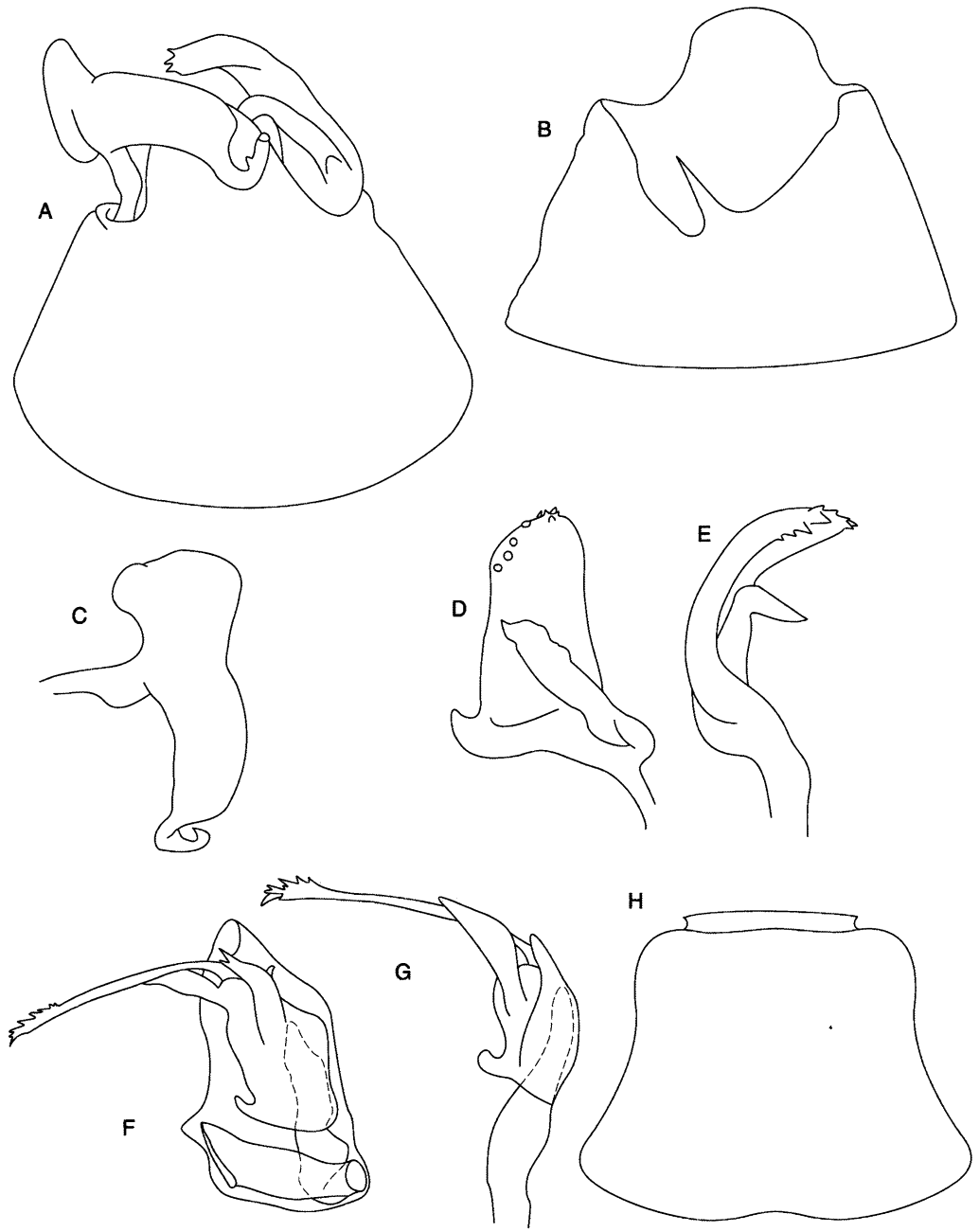

Figure 9. *Kirkaldyella boweri*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

Kirkaldyella boweri Cassis & Moulds, **sp. n.**

(Fig. 5, 9A-H)

Diagnosis. – This species can be recognised by the following combination of characters: body elongate, glossy black to fuscous, metathoracic spiracle visible, mesoscutum prominent and right paramere subtriangular with four teeth along medial margin (Fig. 9D-E). *K. boweri* is distinguished from *K. ngarkati* by the presence of a visible metathoracic spiracle above the peritreme and the presence of four teeth along the medial margin of the right paramere (cf. Fig. 9D-E 13D-E). *K. boweri* is distinguished from *K. rugosa* by the strongly declivent hemelytra.

Description. – Colouration. Head, glossy black; vertex with triangular yellow-brown to orange markings adjacent to eyes. Antennae, AI yellow-brown; AII yellow-brown, apical third fuscous; AIII-AIV fuscous. Pronotum, glossy black. Hemelytra, mostly fuscous, anterior third black; cuneus occasionally reddish-brown. Legs, stramineous; hind femora reddish-orange to reddish-brown, proximal quarter stramineous, apices occasionally stramineous; hind tibiae reddish-orange to reddish-brown, distal third to quarter stramineous. Dorsal texture. Head moderately rugopunctate. Pronotum rugose. Hemelytra moderately rugopunctate, clavus with submarginal row of punctures parallel to claval furrow.

Vestiture. Body with dense distribution of simple, fine, erect, elongate, pale setae; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided, hemelytra, posterior third of costal margin weakly convex. Head, postocular margins rectilinear, dorsal surface of head weakly convex; vertex, anterior half weakly convex, posterior half flat with lateral margins foveate. AI much shorter than interocular width. AII longer than basal pronotal width in males and females. AII tapered proximally. Eyes slightly removed from head. Labrum extending to posterior margin of head, labium extending to mesocoxae; first labial segment extending to posterior margin of head. Bucculae not extending beyond antennifers. Pronotum, transverse, campanulate (Fig. 9H); collar thin, depressed; calli moderately developed, depressed medially with pair of small foveae; anterior angles arcuate, explanate; disc strongly convex, posterior margin moderately excavate medially. Mesoscutum prominent, moderately convex. Scutellum weakly declivent, anterior third flat. Hemelytra strongly declivent caudal of costal fracture, clavus moderately tectiform, lateral margins weakly explanate; costal fracture very weakly developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme tumid, ovoid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 9A-G), pygophore subconical (Fig. 9A) with enlarged, subobovate, ventral process (Fig. 9B); dorsal margin with acute, elongate process (Fig. 9B), acutely positioned, near midline of margin; genital opening large, ovoid. left paramere (Fig. 9C), lateral margin weakly emarginate, lobe subquadrate with enlarged obtuse process dorsomedially, shaft elongate, with prominent apical hook, coplanar with remainder of shaft, terminating towards lateral margin, with short triangular process basally. Right paramere (Fig. 9D-E), elongate, subtriangular with anterolateral subrectangular process; four teeth rectilinearly on medial margin; orbicular congregation of five teeth medioposteriorly; posterior margin moderately emarginate, large posterolateral hook-like process. Aedeagus (Fig. 9F-G) with multifurcate spiculum, with three primary branches, two of which are bifid, longer bifid branch with eight teeth on one branch; secondary gonopore trough-shaped caudal to base of two minor branches of spiculum, terminating within base of spiculum.

Measurements. 4♂ BL 4.15-4.30, HW 1.05-1.12, IOD 0.54-0.60, HL 0.70-0.85, PL 0.92-0.97, PW 1.23-1.29, AII 1.45-1.62, LL 1.20-1.52; 2♀ BL 4.35-4.55, HW 1.16-1.17, IOD 0.63-0.64, HL 0.79-0.85, PL 0.97-1.01, PW 1.29-1.35, AII 1.60-1.66, LL 1.32-1.38.

Material examined. – Holotype: WESTERN AUSTRALIA: 1♂, Point Road, Leeuwin Naturaliste National Park, 34°05'37"S 115°01'27"E, 74m, 3 December 1998, G Cassis, ex *Pimelea sylvestris* [98-L19] (WAM). Paratypes: WESTERN AUSTRALIA: 1♂ 2♀ 4 juveniles, same data as holotype; 2♂, Point Road, Leeuwin Naturaliste National Park, 34°05'3"S 115°00'59"E, 50m, 2 December 1998, ex *Pimelea sylvestris*, G Cassis [98-13] (AM); 6♂, Walunga National Park, 40km NE of Perth, [31°42'S 116°09'E], 26-29 October 1987, Mike E Irwin (CAS); 3♂, Walunga National Park, 40km NE of Perth, [31°42'S 116°09'E], 22-24 October 1987, Mike E Irwin (CAS); 1♂, Geraldton, [28°46'S 114°37'E], October 1931, Australian Harvard Expedition Darlington (AMNH); 1♂, Yanchep National Park, [31°33'S 115°41'E], 8 December 1971, ex *Hardenbergia comptoniana* (Andr.), JA Slater (AMNH).

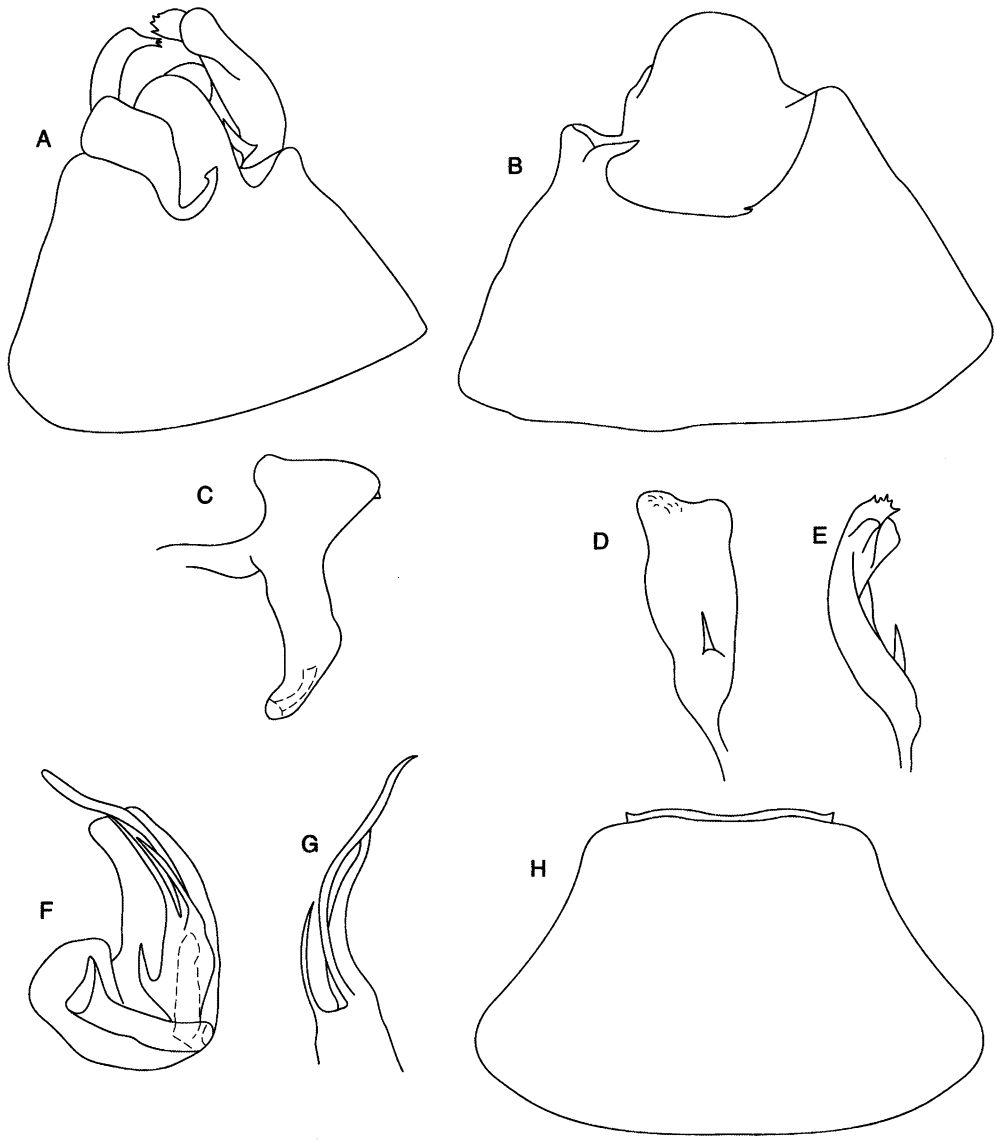

Figure 10. *Kirkaldyella carotarhani*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

Host plants. – *Pimelea sylvestris* R.Br. [Thymelaeaceae]; *Hardenbergia comptoniana* (Andr.) Benth. [Fabaceae].

Etymology. – This species is named in honour of Mr Tony Bower who has provided significant logistical support for all field trips conducted by one of us (GC) in Western Australia.

Remarks. – *K. boweri* is restricted to coastal southwestern Western Australia (Fig. 5), where it has been collected on an understorey species, *Pimelea sylvestris*, in open forest. *P. sylvestris* was abundant and flowering profusely at the time of collection. *K. boweri* was collected in association with

an undescribed species of Orthotylini which was very abundant. *K. boweri* was also found in association with two species of ants; a species belonging to the *Myrmecia urens*-species group and an undetermined species of *Prolasius*. Slater collected a single specimen of this species from a pea species, *Hardenbergia comptoniana*.

K. boweri is recognised in this work as the sister-taxon to *K. ngarkati*. It can be distinguished externally from *K. ngarkati* by the presence of a visible metathoracic spiracle above the peritreme and the presence of four teeth along the medial margin of the right paramere (cf. Fig. 9D and 13E). The spiculum of the former species differs in the apical arrangement of the teeth (cf. Fig. 9G and 13G). *K. rugosa* is also similar in external appearance to *K. boweri* but is clearly distinguished by the simplified spiculum (cf. Fig. 9G and 18G) and by the deeply declivent hemelytra beyond the costal fracture in *K. boweri*.

Kirkaldyella carotarhani Cassis & Moulds, **sp. n.**

(Fig. 3, 10A-H)

Diagnosis. – *K. carotarhani* is recognised by the combination of the following characters: body glossy black, scutellum stramineous to orange, stramineous to orange lachryform markings on hemelytra; bucculae short. *K. carotarhani* is distinguished from *K. mcalpinei* by the stramineous to orange lachryform markings on the hemelytra and the short bucculae.

Description. – Colouration. Head, mostly glossy black to fuscous, yellow to yellow-brown markings on lateral anterior 2/3 of frons adjoining eyes. Antennae, AI yellow-brown; AII fuscous, basal half yellow-brown; AIII–AIV fuscous. Pronotum, glossy black. Scutellum stramineous to orange. Hemelytra, mostly fuscous, stramineous to orange lachryform markings extending from corium to cuneus. Legs, stramineous to orange.

Dorsal texture. Head moderately rugose. Pronotum rugopunctate. Hemelytra weakly rugopunctate, clavus weakly rugose.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided. Head, narrow, posterior margin weakly convex; vertex, weakly concave. Antennae, AI equal to interocular width. AII slightly shorter than basal pronotal width in females. Eyes slightly removed from head. Labrum extending to anterior margin of procoxae, labium extending to anterior margin of mesocoxae. Bucculae short, posterior margin extending to mid-length of gular. Pronotum, transverse, trapeziform (Fig. 10H); collar thin, depressed; calli weakly developed, medially depressed with pair of small foveae; anterior angles obtuse, moderately explanate; disc strongly convex, posterior margin rectilinear medially. Mesoscutum often prominent, moderately convex. Scutellum weakly declivent. Hemelytra, very weakly declivent beyond costal fracture, clavus weakly tectiform; costal fracture very weakly emarginate. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme tumid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 10A-G), pygophore subconical (Fig. 10A) with enlarged, transverse, subobovate, ventral process (Fig. 10B); dorsal margin with small, acute, subhorizontal process (Fig. 10B) near midline of margin; laterodorsal margin with large acute, elongate, acutely angled process; genital opening large, ovoid. Left paramere (Fig. 10C), lateral margin strongly emarginate; lobe subquadrate, enlarged obtuse processes mediodorsally and laterodorsally, elongate cylindrical process, three teeth apically on laterodorsal margin; shaft elongate, prominent apical hook, recurved beneath subapical region of shaft, terminating toward lateral margin. Right paramere (Fig. 10D-E), subtriangular, elongate, medial margin moderately emarginate; enlarged obtuse process medioposteriorly; congregation of nine small conical teeth on medioanterior margin; small, acute process mesioposteriorly. Aedeagus (Fig. 10F-G) with multifurcate spiculum with three primary branches; secondary gonopore trough-shaped (Fig. 10F) caudal to base of branches of spiculum, terminating within base of spiculum.

Measurements. 1♂ BL 3.86, HW 0.98, IOD 0.4, AII 1.66, LL 1.14; 4♀ BL 4.2-4.8, HW 1.03, IOD 0.47-0.51, HL 0.63-0.75, PL 0.92-0.98, PW 1.29-1.48, AII 1.20-1.54, LL 1.20-1.46.

Material examined. – Holotype: NEW SOUTH WALES: 1♀, near Mt Tomah, [33.54°S 150.42°E], 18 December 1983, RW Rodd (AM). Paratypes: NEW SOUTH WALES: 1♀, Upper Williams River, [32.36°S

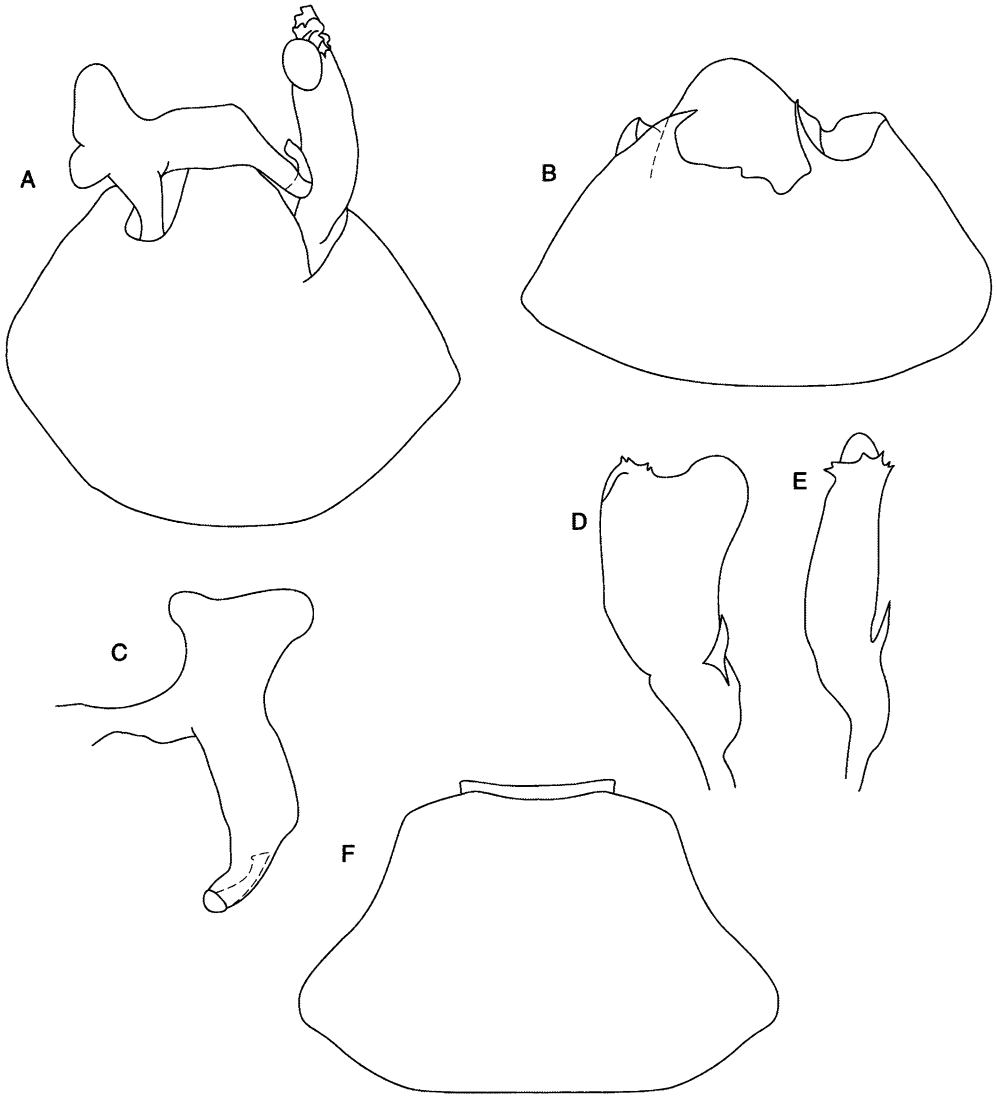

Figure 11. *Kirkaldyella mcalpinei*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) pronotum and collar.

151.74°E], October 1926, Lea and Wilson (SAMA); 1♀, Ashfield, [33.88°S 151.11°E], 15 November 1980, DA Doolan (AM); 1♀, Nandewar Range near Narrabri, [30.49°S 150.74°E], 6-7 November 1932, KC McKeown (AM); 1♀, Scheyville, [33.60°S 150.88°E], October 1987, HF Recher (AM); 1♂ 1♀, approximately 0.5km SE of Lansdowne via Taree, [31.78°S 152.53°E], 29 October 1990, G Williams, ex *Elaeocarpus obovatus* blossom (AM). QUEENSLAND: 1♀, Mount Crosby via Ipswich, [27.55°S 152.80°E], 11 November 1964, HA Rose (UQIC).

Host plants. – *Elaeocarpus obovatus* [Elaeocarpaceae]; *Eucalyptus crebra* F.Muell. [Myrtaceae].

Etymology. – The name of this species is based on the Latin 'carota' and the Greek 'rhanis' referring to the orange lachryform markings on the hemelytra.

Remarks. – *K. carotarhani* is restricted to coastal regions of south-eastern Queensland and eastern New South Wales (Fig. 3) with several records from the Sydney region. Single specimens have been collected from the flowers of *Elaeocarpus obovatus* and by pyrethrum knockdown from *Eucalyptus crebra*.

K. carotarhani is recognised as the sister-taxon of *K. mcalpinei* from which it is easily distinguished by the presence of large, orange to stramineous, lachryform markings on the hemelytra.

Kirkaldyella mcalpinei Cassis & Moulds, sp. n.

(Fig. 3, 11A-F)

Diagnosis. – *K. mcalpinei* is recognised by the following combination of characters: body mostly glossy fuscous, scutellum orange to yellow-brown; vertex weakly concave; bucculae elongate; AI equal to interocular distance. *K. mcalpinei* is distinguished from *K. carotarhani* by the absence of stramineous to orange lachryform markings on the hemelytra and the longer bucculae.

Description. – Colouration. Head, mostly fuscous, yellow markings on lateral margins of frons adjoining eyes. Antennae, AI darkly stramineous, red near basal third; AII-AIV fuscous. Pronotum glossy black to fuscous. Scutellum orange to yellow-brown. Hemelytra, mostly fuscous, cuneus reddish-brown. Legs, mostly stramineous; apical quarter of hind femora with red annulation.

Dorsal texture. Head weakly rugose. Pronotum weakly rugose. Hemelytra, clavus weakly rugose with submarginal row of punctures parallel to claval furrow.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae, corium sparsely distributed; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided. Head, narrow, posterior margin rectilinear; vertex, weakly concave. Antennae, AI equal with interocular width. AII longer than basal pronotal width in males. AII apices weakly incrassate. Eyes slightly removed from pronotum. Labium extending to anterior margin of procoxae. Bucculae not extending beyond antennifers. Pronotum, transverse, trapeziform (Fig. 11F); collar thin, depressed; calli weakly developed, medially depressed with pair of small foveae; anterior angles obtuse, weakly explanate; disc strongly convex, posterior margin rectilinear medially. Mesoscutum prominent. Scutellum, anterior third flat, remainder weakly declivent. Hemelytra, weakly declivent beyond costal fracture, clavus moderately tectiform; costal fracture weakly developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme small, tumid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 11A-E), pygophore subconical (Fig. 11A) with enlarged, terminal, transverse, obtuse ventral process (Fig. 11B); lateral dorsal margin with acute, elongate process (Fig. 11B), subperpendicular to dorsomedial margin; genital opening large, ovoid. Left paramere (Fig. 11C), lateral margin strongly emarginate; lobe subquadrate, enlarged obtuse processes mediodorsally and laterodorsally; dorsal margin weakly emarginate; shaft elongate with prominent apical hook, recurved beneath subapical region of shaft, terminating towards lateral margin. Right paramere (Fig. 11D-E), elongate, subtriangular, medial margin moderately emarginate, enlarged obtuse process mediposteriorly, orbicular congregation of six teeth anteriomedially; small acute process mesoposteriorly.

Measurements. 2♂ BL 4.0-4.7, HW 0.98-0.99 IOD 0.38-0.40, HL 0.64, PL 0.86-0.97, PW 1.36-1.38, AII 1.70-1.72, LL 1.21-1.22.

Material examined. – Holotype: NEW SOUTH WALES: 1♂, Ashfield, [33.88°S 151.11°E], 12 December 1980, DA Doolan (AM). Paratype: NEW SOUTH WALES: 1♂, Otford [34.21°S 151.00°E], 30 October 1965, DK McAlpine (AM).

Host plant. – Unknown.

Etymology. – This species is named in honour of the original collector David McAlpine.

Remarks. – *K. mcalpinei* is restricted to the Sydney region of New South Wales (Fig. 3). This work establishes *K. mcalpinei* and *K. carotarhani* as sister-taxa due to the presence of two processes on the dorsal surface of the genital opening (cf. Fig. 10B and 11B).

Kirkaldyella mcmillani Cassis & Moulds, sp. n.

(Fig. 2, 12A)

Diagnosis. – *K. mcmillani* is recognised by the following combination of characters: body elongate, parallel-sided; glossy black; and, hemelytra

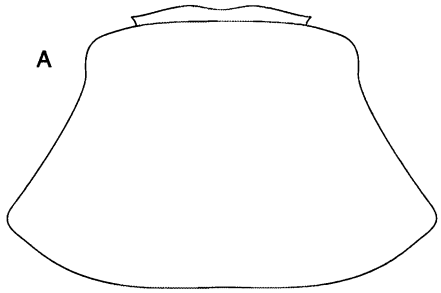

Figure 12. *Kirkaldyella mcmillani*: (A) pronotum and collar.

strongly declivent posteriorly to costal fracture. *K. mcmillani* is distinguished from *K. rugosa* by the absence of foveae on the pronotum and the bucculae in *K. mcmillani* extending to the gular while in *K. rugosa* the bucculae are short.

Description. – Colouration. Head, mostly glossy black, posterior of vertex with indistinct, triangular, fuscous markings adjoining eyes; bucculae red. Antennae, AI fuscous, black annulation basally; AII-AIII black. Pronotum, glossy black. Hemelytra, glossy black to fuscous. Legs, stramineous to fuscous; tibiae mostly fuscous, apical third stramineous; coxae mostly stramineous, basal third fuscous.

Dorsal texture. Head weakly asperous. Pronotum rugopunctate and weakly asperous. Hemelytra rugopunctate.

Vestiture. Body with sparse distribution of simple, fine, erect, elongate, pale setae; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided. Head, posterior margin slightly convex; vertex, anterior half moderately convex, posterior half flat. Antennae, AI much shorter than interocular width. AII is shorter than basal pronotal width in males. Eyes slightly removed from head. Labrum extending to middle of procoxae, labium extending to anterior margin of mesocoxae. Bucculae extending to ventral margin of head. Pronotum, transverse, trapeziform (Fig. 12); collar thin, depressed; calli very weakly developed; anterior angles arcuate, explanate; disc strongly convex, posterior margin rectilinear. Mesoscutum moderately declivent, partially obscured by pronotum. Scutellum weakly convex. Hemelytra, strongly declivent beyond costal fracture, clavus very weakly tectiform, lateral margins weakly explanate; costal fracture weakly emarginate. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme indistinct, ovoid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible.

Measurements. 1♂ BL 3.36, HW 1.03, IOD 0.52, HL 0.6, PL 0.78, PW 1.24, AII 1.06, LL 1.12.

Material examined. – Holotype: WESTERN AUSTRALIA: 1♂, Queen Victoria Rock, [31°18'S 120°56'E], 19 October 1988, R. P. McMillan (WAM).

Host plant. – Unknown.

Etymology. – This species is named in honour of the original collector R. P. McMillan.

Remarks. – *K. mcmillani* is restricted to southern central Western Australia (Fig. 2). *K. mcmillani* is recognised as the sister-taxon to *K. anasillosi* and *K. pilosa*, with all three species lacking foveae on the pronotum. *K. mcmillani* was not dissected in this work and superficially resembles *K. rugosa*, but is distinguished by the absence of foveae on the pronotum. The bucculae in *K. mcmillani* extend to the ventral margin of the head while in *K. rugosa* the bucculae are short.

Kirkaldyella ngarkati Cassis & Moulds, **sp. n.**

(Fig. 5, 13A-H)

Diagnosis. – *K. ngarkati* is recognised by the following combination of characters: body elongate, glossy black, metathoracic spiracle not visible; right paramere subrectangular with three teeth along the medial margin (Fig. 13D-E). *K. ngarkati* is distinguished from *K. boweri* by the recessed

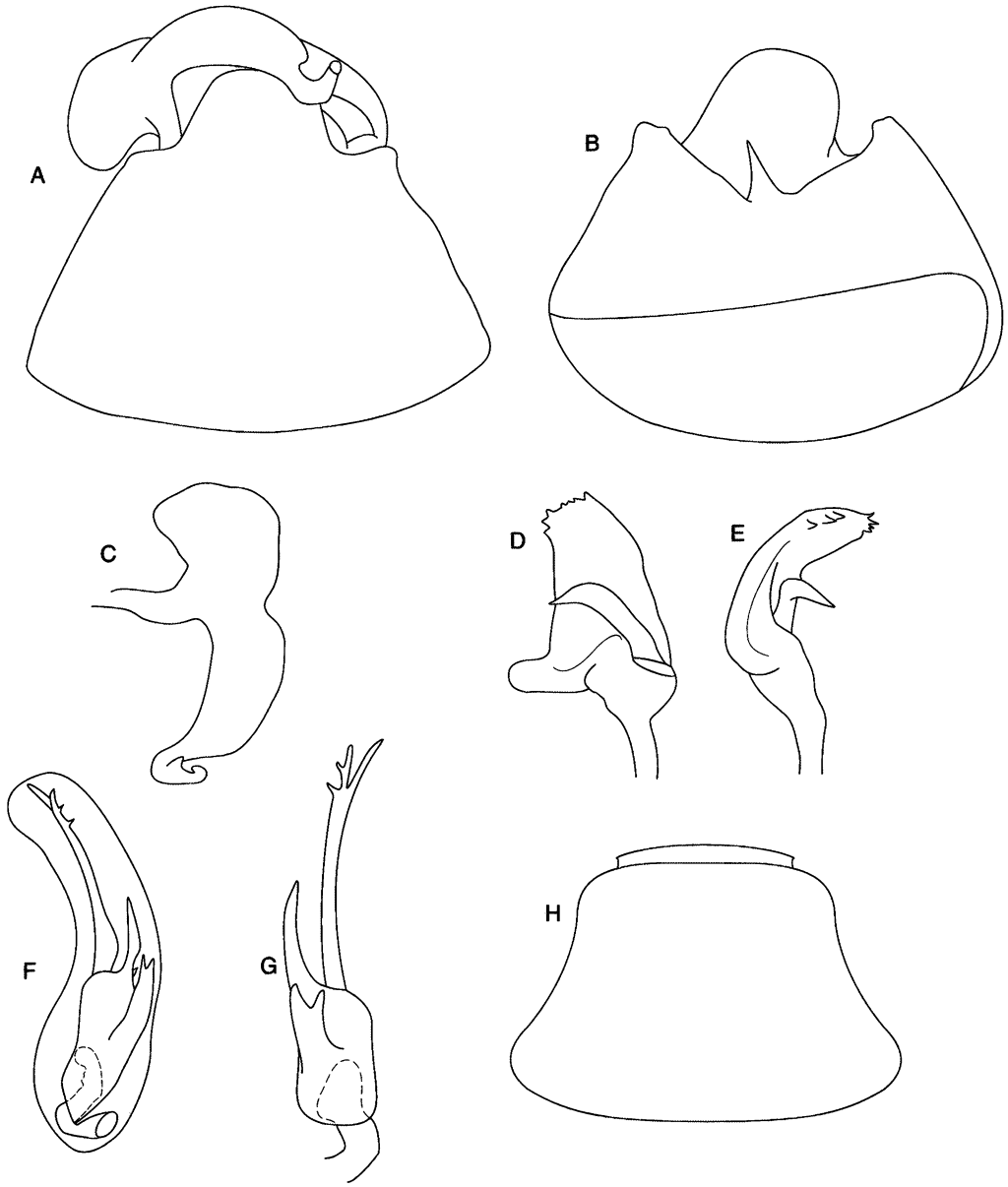

Figure 13. *Kirkaldyella ngarkati*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

metathoracic spiracle above the peritreme and the presence of three teeth on the medial margin of the right paramere (cf. Fig. 9D-E 13D-E). *K. ngarkati* is distinguished from *K. rugosa* by the strongly declivent hemelytra beyond the costal fracture.

Description. – Colouration. Head, glossy black, posterior of vertex with triangular yellow-brown to orange markings adjoining eyes. Antennae, AI-AII stramineous to black. AIII-AIV black to fuscous. Pronotum, glossy black. Hemelytra, glossy

black to fuscous; anterior quarter black. Legs, mostly stramineous; femora stramineous, apical half to third fuscous; tibiae fuscous; coxae stramineous, basal third fuscous.

Dorsal texture. Head moderately rugose. Pronotum strongly rugose. Scutellum weakly rugose. Hemelytra, clavus weakly rugopunctate, endocorium weakly rugopunctate.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided, costal margin slightly convex. Head, posterior margin rectilinear; vertex, anterior half weakly convex, posterior half flat with lateral margins foveate. Antennae, AI much shorter than interocular width. AII slightly longer than basal pronotal width in males and females. Eyes slightly removed from head. Labrum extending to posterior margin of head, labium extending to mesocoxae. Posterior margin of bucculae not extending beyond antennifers. Pronotum, transverse, campanulate (Fig. 13H); collar thin, flat; calli moderately developed, medially depressed with pair of small foveae; anterior angles arcuate, explanate; disc strongly convex, posterior margin medially rectilinear. Mesoscutum prominent, moderately convex. Scutellum moderately declivent, anterior third flat. Hemelytra, strongly declivent beyond costal fracture, clavus moderately tectiform, lateral margins weakly explanate; costal fracture weakly developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme tumid, ovoid, not reaching dorsal margin of evaporative areas; metathoracic spiracle not visible. Male genitalia (Fig. 13A-G), pygophore subconical (Fig. 13A) with enlarged, subobovate, ventral process (Fig. 13B); genital opening large, ovoid; dorsal margin of opening with acute elongate process (Fig. 13B), near midline of margin, subperpendicular. Left paramere (Fig. 13C), lateral margin weakly emarginate; lobe subquadrate, with enlarged obtuse process dorsomedially; shaft elongate, with prominent apical hook coplanar with remainder of shaft, terminating towards lateral margin, short triangular process basally. Right paramere (Fig. 13D-E), elongate, subrectangular, with anterolateral rectangular process; medial margin with three conical teeth rectilinearly; orbicular congregation of five teeth mediposteriorly, large posterolateral hook-like process. Aedeagus (Fig. 13F-G) with multifurcate spiculum with three primary branches, two of which are bifid, longest branch with three teeth on one termination; secondary gonopore trough-shaped caudal to base of two minor branches of spiculum, terminating within base of spiculum.

Measurements. 2♂ BL 3.60-3.64, HW 0.98-1.01, IOD 0.50-0.52, HL 0.70-0.72, PL 0.80-0.83, PW 1.06-1.16, AII 1.08-1.20, LL 1.08-1.09; 1♀ BL 4.0, HW 1.12, IOD 0.62, HL 0.74, PL 0.88, PW 1.3, AII 1.34, LL 1.14.

Material examined. – Holotype: SOUTH AUSTRALIA: 1♂, 18km E of Coffin Bay, [34.37°S 135.40°E], 29 November 1992, I Naumann and J Cardale (ANIC). Paratypes: SOUTH AUSTRALIA: 1♂, 18km S of Bews, Ngarkat Conservation Park, 35°39'35"S 140°26'56"E, 90m, 9 November 1998, RT Schuh, G Cassis & R Silveira, ex *Eucalyptus calycogona*, site 98-38 (AM); 1♀, 38.1km S of Bews, Ngarkat Conservation Park, 35°39'35"S 140°26'56"E, 90m, 9 November 1998, RT Schuh, G Cassis & R Silveira, ex *Senecio latus dissectifolius*, site 98-38 (AM).

Host plants. – *Eucalyptus calycogona* Turcz [Myrtaceae]; *Senecio latus* G. Forster ex Willd. ssp. *dissectifolius* Ali [Asteraceae].

Etymology. – This species is named after the Ngarkat Conservation Park in South Australia.

Remarks. – *K. ngarkati* is restricted to southern South Australia (Fig. 5) and has been collected on *Eucalyptus calycogona* and *Senecio latus*. Both host plants are represented by single specimen collections and are considered to be tentative host association records.

This work recognises *K. ngarkati* as the sister-taxon of the Western Australian species *K. boweri*. Although externally similar these two species can be distinguished by the differing numbers of processes on the medial margin of the right paramere (cf. Fig. 9E and 13E) and the spiculi (cf. Fig. 9G and 13G).

Kirkaldyella notaurantia Cassis & Moulds, **sp. n.**

(Fig. 5, 14A-H)

Diagnosis. – *K. notaurantia* is recognised by the following combination of characters: body elongate, parallel-sided; uniformly glossy black to fuscous, yellow-orange triangular markings on exocorium above the cuneus. *K. notaurantia* is distinguished from *K. schuhi* and *K. rugosa* by the yellow-orange markings on the hemelytra.

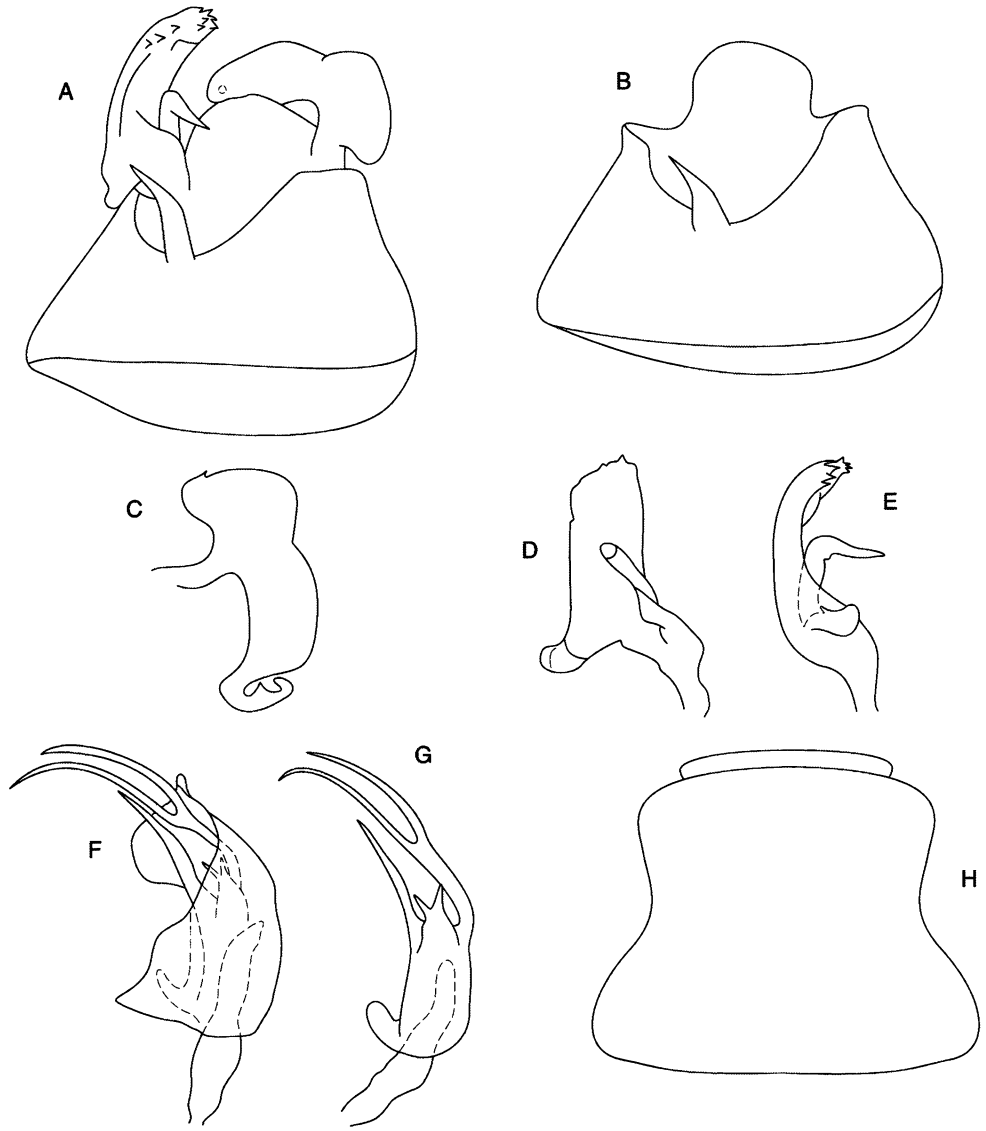

Figure 14. *Kirkaldyella notaurantia*: (A) pygophore dorsal, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

Description. – Colouration. Head, mostly glossy black, posterior of vertex with triangular yellow-orange markings adjoining eyes. Antennae, AI mostly orange-stramineous, basal third fuscous, AII-AIV fuscous. Pronotum glossy black. Scutellum glossy black. Hemelytra mostly glossy black, posterior half fuscous, yellow-orange triangular markings on exocorium above the costal fracture. Legs mostly stramineous, basal third of coxae fuscous, femur mostly stramineous, apical half fuscous, apex of tibiae and femur stramineous.

Dorsal texture. Head moderately rugose. Pronotum rugopunctate. Hemelytra, clavus rugopunctate, endocorium weakly rugose.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided, costal margin weakly convex. Head, posterior margin weakly convex; vertex, posterior half weakly concave with lateral margins foveate. Antennae, AI much shorter than interocular distance. AII slightly shorter than basal pronotal width. AII weakly tapered basally. AIII mildly fusiform. Bucculae short, posterior margin extending to mid-length of gular. Eyes slightly removed from posterior margin of head. Labium extending to anterior margin of mesocoxae. Pronotum transverse, narrowly campanulate (Fig. 14H); collar thin, depressed; calli moderately developed, weakly depressed medially with pair of small foveae; anterior angles arcuate, weakly explanate; disc moderately convex, posterior margin weakly rectilinear, medially. Mesoscutum small. Scutellum weakly declivent near posterior margin. Hemelytra, flat beyond costal fracture, clavus moderately tectiform; costal fracture moderately developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme tumid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 14A-G), pygophore subconical (Fig. 14A) with enlarged, subobovate, ventral process (Fig. 14B); genital opening large, ovoid; dorsal margin with acute elongate process (Fig. 14B), near midline of margin, subperpendicular to margin. Left paramere (Fig. 14C), lateral margin moderately emarginate; lobe subquadrate, with enlarged obtuse process dorsomedially, small process on dorsal margin of lobe; shaft elongate, with prominent apical hook, coplanar with remainder of shaft, terminating towards lateral margin, with short triangular process basally. Right paramere (Fig. 14D-E), elongate, subquadrate, with anterolateral subrectangular process; three teeth on anterior margin; orbicular congregation of four conical teeth medially, large posterolateral hook-like process. Aedeagus (Fig. 14F-G) with multifurcate spiculum with three primary branches, two of which are bifid; secondary gonopore trough-shaped caudal to base of two minor branches of spiculum, terminating within base of spiculum.

Measurements. ♂ holotype BL 3.88, HW 1.01, IOD 0.53, HL 0.72, PL 0.87, PW 1.06, AII 0.98, LL 1.16.

Material examined. – Holotype: WESTERN AUSTRALIA: 1♂, near Gnarabup Beach, [33.99°S 114.99°E], 20m, 3 December 1998, G Cassis, ex *Scaevola nitida* (WA98-21) (AM).

Host plant. – *Scaevola nitida*. R. Br. [Goodeniaceae].

Etymology. – The name of this species is based on the Latin 'nota' and 'aurantium' referring to the orange markings on the hemelytra.

Remarks. – *K. notaurantia* is restricted to coastal south-western Western Australia (Fig. 5) where it has been collected on *Scaevola nitida*. This species is unfortunately based on a single specimen but it is clearly differentiated from all other species on external and male genitalic characters. *K. notaurantia* is closely related to *K. rugosa* and *K. schuhi*, as it resembles both species in the structure of the male genitalia (cf. Fig. 14B-G, 18B-G and 20B-G).

Kirkaldyella ortholata Cassis & Moulds, **sp. n.**

(Fig. 4, 15A-H)

Diagnosis. – *K. ortholata* is recognised by the following combination of characters: body elongate, parallel-sided; glossy black to fuscous; proepimeron weakly depressed medially; metathoracic spiracle not visible; mesoscutum prominent. *K. ortholata* is distinguished from *K. rugosa* and *K. adunca* by the parallel sides of the body and the right paramere (cf. Fig. 15D-E and 18D-E). *K. ortholata* is distinguished from *K. boweri* and *K. ngarkati* by the absence of yellow-brown to orange triangular markings adjoining the eyes.

Description. – Colouration. Head, mostly glossy black, indistinct fuscous band along posterior margin of head, fuscous markings between antennal insertion and eyes. Antennae, AI brown to fuscous, AII mostly fuscous, apical third black, AIII fuscous with black terminations, AIV black. Pronotum, glossy black. Scutellum black. Hemelytra fuscous. Legs stramineous, basal third of coxae fuscous.

Dorsal texture. Head weakly rugose. Pronotum rugose. Hemelytra moderately rugopunctate, clavus with submarginal row of punctures parallel to claval furrow.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae; femora and tibiae with elongate, semi-erect bristles.

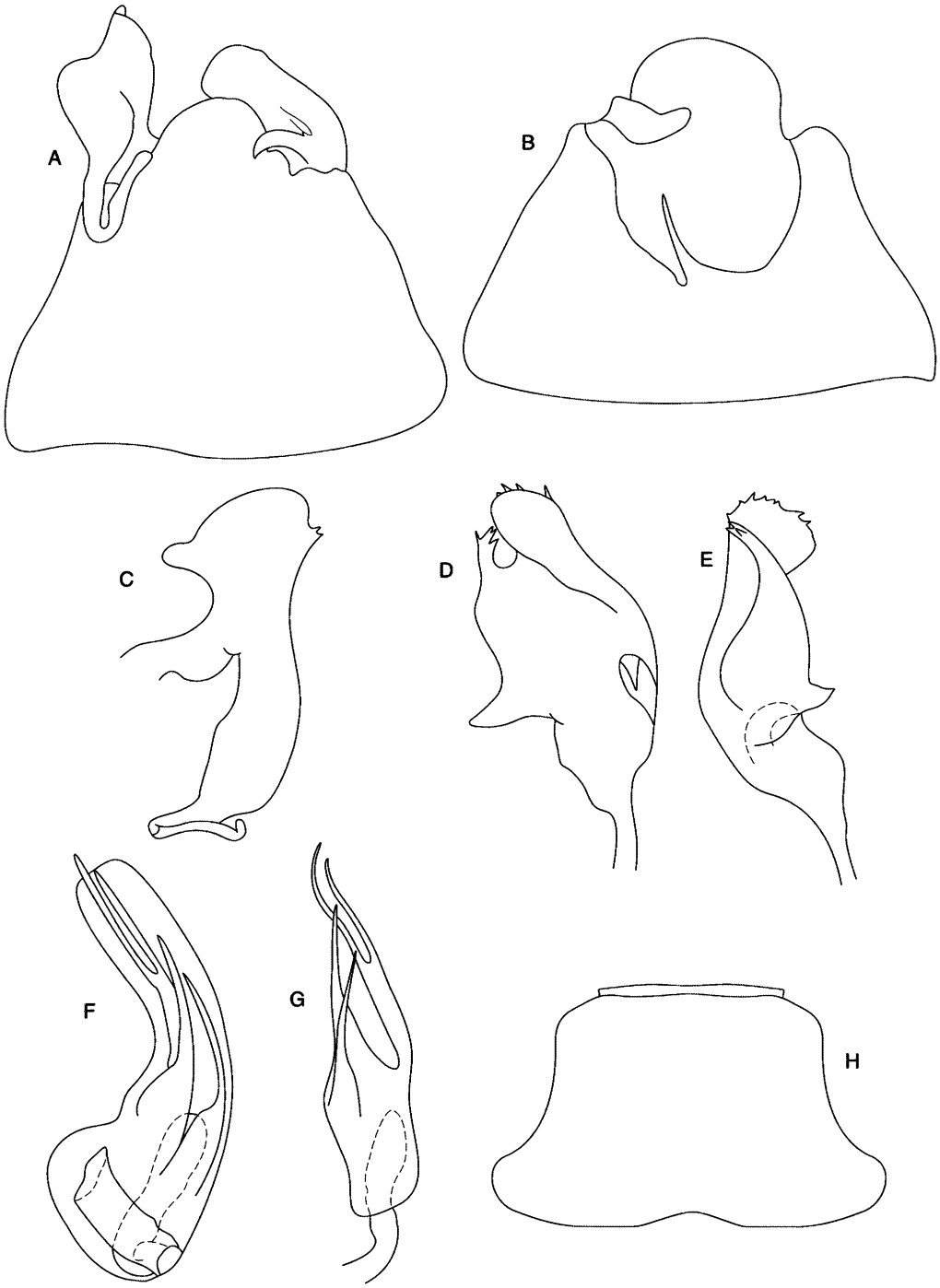

Figure 15. *Kirkaldyella ortholata*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

Structure. Macropterous, elongate, parallel-sided. Head, posterior margin rectilinear, vertex weakly convex, posterior lateral margins depressed. Antennae, AI much shorter than interocular width. AII slightly longer than basal pronotal width in males. Eyes slightly removed from posterior margin of head. Labrum extending to anterior margin of procoxae. Labium extending to anterior margin of mesocoxae. Bucculae not extending beyond antennifers. Pronotum, transverse, campanulate (Fig. 15H); collar thin, depressed; calli strongly developed, medially depressed with pair of small foveae; anterior angles arcuate, explanate; disc weakly convex, posterior margin moderately excavate medially. Mesoscutum prominent, moderately convex. Scutellum moderately declivent. Hemelytra, weakly declivent beyond costal fracture, clavus moderately tectiform; costal fracture not developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron weakly depressed medially; metathoracic external efferent system, peritreme tumid, not reaching dorsal margin of evaporative areas; metathoracic spiracle not visible. Male genitalia (Fig. 15A-G), pygophore subconical (Fig. 15A) with enlarged, transverse, subrectangular ventral process (Fig. 15B); dorsal margin with acute, elongate process (Fig. 15B), acutely positioned near midline of margin, subperpendicular to margin; genital opening large, ovoid. Left paramere (Fig. 15C), lateral margin weakly emarginate; lobe subquadrate, with enlarged, obtuse, dorsomedial process; dorsal margin moderately convex with three conical teeth; shaft elongate, with prominent apical hook, recurved beneath apical region of shaft, terminating towards lateral margin. Right paramere (Fig. 15D-E), subrectangular, with anterolateral subquadrate process; acute, elongate, posterolateral process; orbicular congregation of nine conical teeth medioposteriorly; posterior margin moderately concave with large mesobasal hook-like process. Aedeagus (Fig. 15F-G) with multifurcate spiculum with three primary branches, one of which is apically bifid; secondary gonopore trough-shaped, caudal to base of two minor branches of spiculum, terminating within base of spiculum.

Measurements. 2♂ BL 4.20-4.25, HW 1.09-1.23, IOD 0.59-0.63, HL 0.70-0.73, PL 0.83-0.92, PW 1.20-1.21, AII 1.26-1.29, LL 0.87-1.01.

Material examined. – Holotype: WESTERN AUSTRALIA: 1♂, Watheroo National Park, [30.16°S 115.83°E], 8 September 1990, G Cassis, ex *Acacia* sp. (WA/005/P7) (WAM). Paratype: WESTERN AUSTRALIA: 1♂, same data as holotype (AM).

Host plant. – *Acacia* sp.

Etymology. – The species name is based on the Greek 'orthos' and the Latin 'latus' referring to the parallel costal margins of the hemelytra

Remarks. – *K. ortholata* is restricted to Western Australia (Fig. 4) where it has been collected on the flowers of an unidentified species of *Acacia*. *K. ortholata* is the sister-taxon to *K. adunca* + *K. argoantyx* due to the presence of an anteromedial process on the right paramere (cf. Fig. 6D, 8D and 15D) and the spiculum has multiple processes (cf. Fig. 6F-G, 8F-G and 15F-G).

Kirkaldyella pilosa Cassis & Moulds, **sp. n.**

(Fig. 2, 16A-H, 17)

Diagnosis. – *K. pilosa* is recognised by the following combination of characters: body elongate; head, pronotum and scutellum glossy black, hemelytra gray-brown; body with dense distribution of adpressed, flattened, scale-like setae; AII shorter than basal pronotal width in males and females. *K. pilosa* is distinguished from *K. anasillosi* by the gray-brown colouration on the hemelytra, the presence of stramineous triangular markings on the lateral half of the costal fracture and the stramineous circular marking on the basal third of the claval commissure.

Description. – Colouration. Head, glossy black to fuscous, occasional stramineous to orange fuscous triangular markings on posterior margin of head, contiguous with eyes. Antennae fuscous. Pronotum glossy black. Scutellum black. Hemelytra, gray-brown, lateral margins of basal quarter stramineous, stramineous circular marking on anterior half to third of claval commissure. Stramineous triangular markings on lateral half of costal fracture. Legs mostly fuscous; coxae fuscous to black, apical half occasionally stramineous. Metathoracic external efferent system, peritreme stramineous.

Dorsal texture. Head rugulose. Pronotum rugulose. Hemelytra weakly rugopunctate to impunctate.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae intermixed with dense distribution of adpressed, flattened, pale, scale-like setae, latter less common

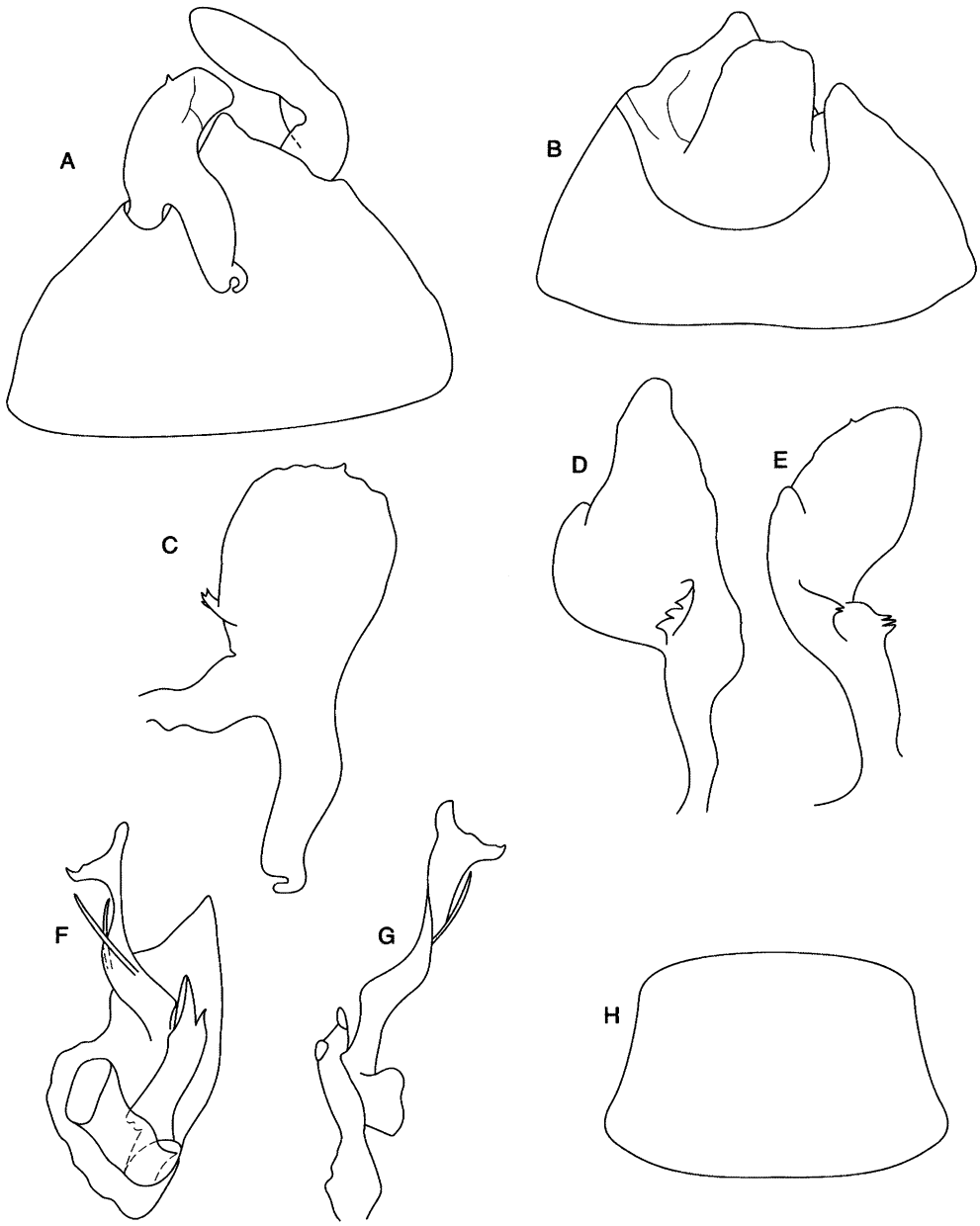

Figure 16. *Kirkaldyella pilosa*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum.

on hemelytra; underside of body and femora with dense distribution of flattened, pale scale-like setae; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided, costal margin weakly convex. Head, posterior margin rectilinear, vertex moderately convex. Antennae, AI much shorter than interocular width.

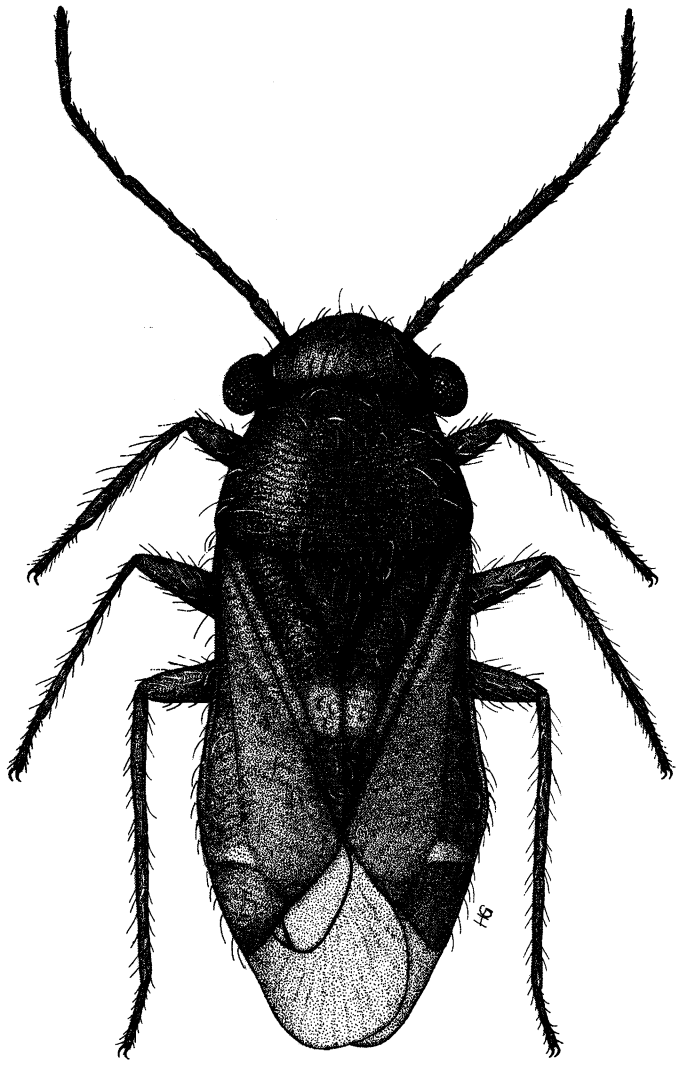

Figure 17. Adult of *Kirkaldyella pilosa*.

AII shorter than basal pronotal width in males and females. AII tapered basally. Labrum extending to posterior margin of head, labium extending to posterior margin of mesocoxae. Bucculae not extending beyond antennifers. Pronotum, transverse, quadrate (Fig. 16H); collar obsolete; calli absent; foveae absent, anterior angles obtuse; disc strongly convex, posterior margin medially rectilinear. Mesoscutum obscured by pronotum. Scutellum flat, posterior third declivent. Hemelytra, strongly declivent beyond costal fracture, clavus moderately to strongly tectiform, lateral margins weakly explanate, costal fracture weakly developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron weakly depressed medially; metathoracic external efferent system, peritreme indistinct, tumid, reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia

(Fig. 16A-H), pygophore subconical (Fig. 16A) with enlarged, transverse, subtriangular ventral process (Fig. 16B); genital opening large, ovoid. Left paramere (Fig. 16C), lateral margin weakly emarginate; lobe enlarged, obovate; elongate, cylindrical process mediodorsally with three to four teeth apically; dorsal margin weakly sinuous, small, acute, elongate process mesodorsally, sometimes with two teeth apically; shaft elongate, with prominent hook, coplanar with shaft, terminating toward medial margin. Right paramere (Fig. 16D-E), subtriangular, elongate; anterior margin strongly convex, with anterobasal triangular process with three teeth, acutely angled to anterior margin; lateral, anterobasal, transverse, triangular process; posterior margin weakly emarginate, small conical process mesobasally. Aedeagus (Fig. 16F-G) with multifurcate spiculum with two to three primary branches, one of which is bifid with five to twelve teeth on a triangular process; secondary gonopore trough-shaped (Fig. 16F), caudal to base of spiculum, terminating outside base of spiculum.

Measurements. 5♂ BL 3.12-3.24, HW 1.03-1.08, IOD 0.60-0.68, HL 0.65-0.74, PL 0.66-0.75, PW 1.03-1.15, AII 0.80-1.08, LL 1.02-1.17; 2♀ BL 3.08-3.96, HW 1.06-1.10, IOD 0.67-0.68, HL 0.61-0.66, PL 0.74-0.78, PW 1.08-1.10, AII 0.80-0.88, LL 1.12-1.20.

Material examined. – Holotype: VICTORIA: 1♂, Little Desert National Park, 14km E on McDonald Highway, [36.14°S 141.14°E], [150m], 4 November 1995, RT Schuh and G Cassis, ex *Pultenaea tenuifolia* (95-52) (AM). Paratypes: VICTORIA: 9♂ 5♀ 1 juvenile, same data as holotype (AM) and (AMNH); 2♀, Little Desert National Park, 5-6km W of McDonald Highway, [36.62°S 141.17°E], [150m], 3 November 1995, RT Schuh and G Cassis, ex *Brachyloma daphnoides* [95-50] (AM) and (AMNH). WESTERN AUSTRALIA: 1 damaged (sex undetermined), Brand Highway 45.9 km S of Dongarra Road, [29.58°S 114.82°E], [100m], 31 October 1996, RT Schuh and G Cassis [96-44] (AM); 1 damaged (sex undetermined), 11km S of Eneabba, Eneabba National Park, [29.90°S 115.24°E], [150m], 1 November 1996, RT Schuh and G Cassis, ex *Allocasuarina campestris* [96-50] (AM); 1♂, 75 km E of Hyden, [32.45°S 119.68°E], 24-27 October 1985, TF Houston, ex *Conospermum stoechadis* (WAM); 1♂, Madfish Bay, William Bay National Park, [35.02°S 117.25°E], [100m], 1 December 1999, RT Schuh, G Cassis & R Silveira (99-54). SOUTH AUSTRALIA: 1♀, 38.1km S of Bews, Ngarkat Conservation Park, [35°39'35"S 140°26'56"E], [90m], 9 November 1998, RT Schuh, G Cassis & R. Silveira [98-38] (AM).

Host plants. – *Pultenaea tenuifolia* R.Br. ex Sims [Fabaceae], *Allocasuarina campestris* (Diels) L.A.S. Johnson [Casuarinaceae], *Conospermum stoechadis* Endl. and *Phymatocarpus porphyocephalus* F. Muell [Myrtaceae].

Etymology. – This species name is based on the Greek 'pilos' referring to the dense distribution of adpressed scale-like setae covering most of the body.

Remarks. – *K. pilosa* is widely distributed across southern Australia (Fig. 2). It has been recorded from coastal Western Australia to the western edges of New South Wales and Victoria on a range of host plants. *K. pilosa* is recognised in this work as being the sister-taxon of *K. anasillosi*. These two species both have a prominent apical hook coplanar with the remainder of the shaft, terminating towards the medial margin (cf. Fig. 7C and 16C) and lack an elongate acute process on the dorsal margin of the genital opening (cf. Fig. 7B and 16B). *K. pilosa* is distinguished from *K. anasillosi* by the gray-brown colouration on the hemelytra, the presence of stramineous triangular markings on the lateral half of the costal fracture and the stramineous circular marking on the anterior third of the claval commissure.

Kirkaldyella rugosa Poppius, 1921

(Fig. 1A, C-F, 5, 18A-H, 19)

Kirkaldyella rugosa Poppius 1921: 55; Carvalho 1952: 82 (type species); Carvalho 1958: 137 (catalogue); Cassis & Gross 1995: 191 (catalogue); Schuh 1995: 128 (catalogue).

Diagnosis. – *K. rugosa* is recognised by the following combination of characters: body elongate, parallel-sided; uniformly glossy, mostly black to fuscous, triangular yellow to fuscous markings adjoining eyes. *K. rugosa* is distinguished from *K. schuhi* by the absence of stramineous triangular markings on the exocorium above the cuneus. *K. rugosa* is distinguished from *K. boweri* and *K. ngarkati* by the weakly declivent hemelytra beyond the costal fracture in *K. rugosa*.

Description. – Colouration. Head, posterior of vertex with triangular yellow to fuscous markings adjoining eyes, occasionally joining to form a band across head. Apex of labium and bucculae occasionally red. Antennae, AI-AII mostly stramineous, apical third of AII-AIV fuscous, basal third of AI occasionally fuscous to reddish-orange. Pronotum, glossy black. Hemelytra glossy fuscous. Legs stramineous, basal third of coxae occa-

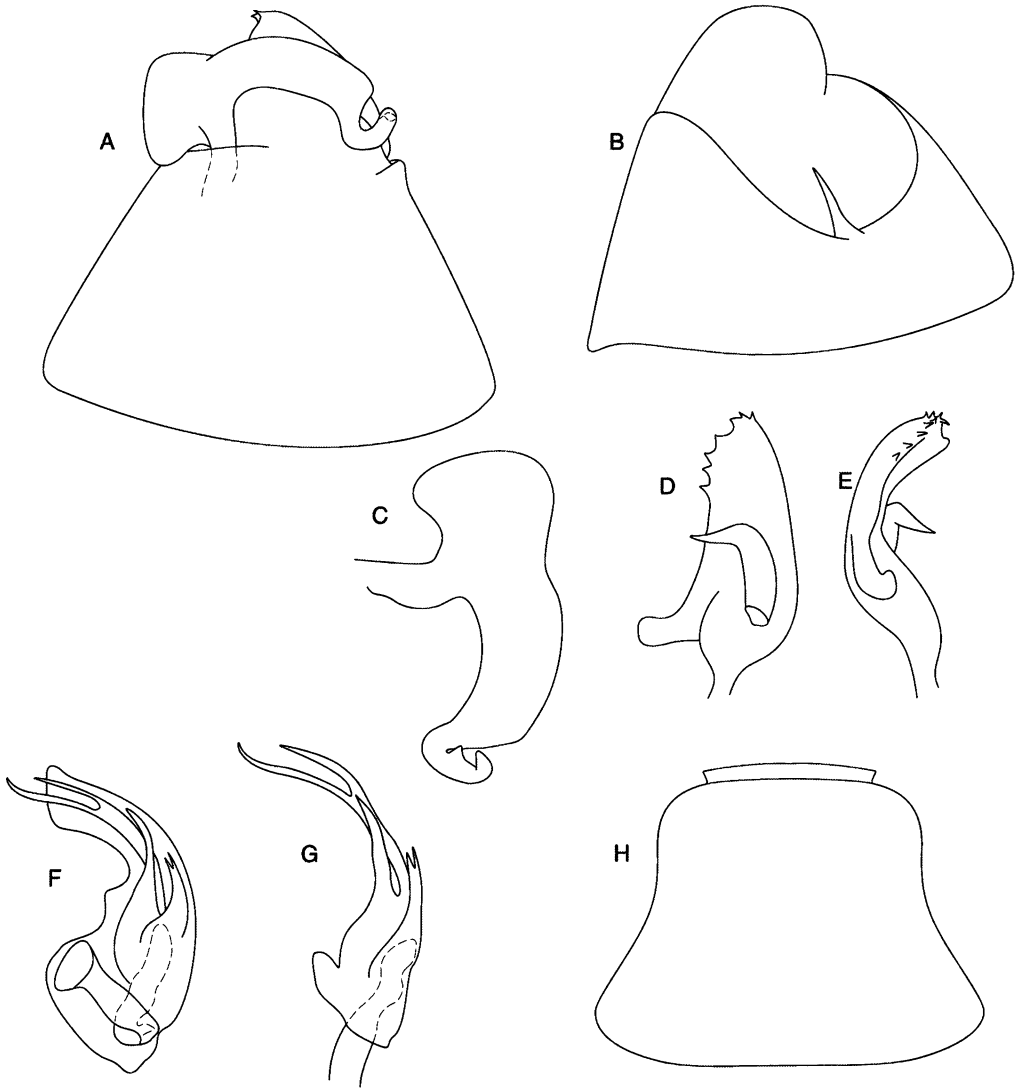

Figure 18. *Kirkaldyella rugosa*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

sionally fuscous; hind femora and tibiae occasionally reddish-yellow to fuscous with yellow apices. Dorsal texture. Head weakly rugose. Pronotum rugopunctate. Hemelytra, clavus weakly rugopunctate with submarginal row of punctures parallel to claval furrow, occasionally endocorium very weakly rugopunctate.

Vestiture. Body with dense distribution of simple, fine, erect, elongate, pale setae; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided, costal margin very weakly convex. Head, posterior margin rectilinear, vertex, anterior half weakly convex with lateral margins foveate, posterior half flat. Antennae, AI much shorter than interocular width. AII slightly larger than width of

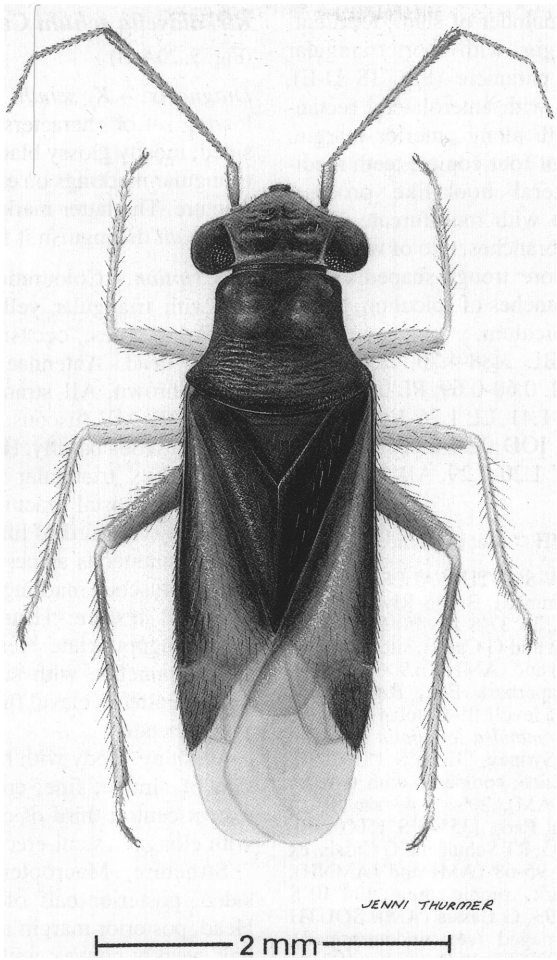

Figure 19. Adult of *Kirkaldyella rugosa*.

posterior margin of pronotum in males and slightly smaller in females. Eyes slightly removed from posterior margin of head. Labrum extending to between head and procoxae, labium extending to between meso and metacoxae. Bucculae not extending beyond antennifers. Pronotum, transverse, campanulate (Fig. 18H); collar thin, depressed; calli weakly developed, medially depressed with pair of small foveae; anterior angles arcuate, explanate; disc moderately convex, posterior margin medially rectilinear. Mesoscutum, small declivent. Scutellum weakly declivent. Hemelytra, weakly declivent beyond costal fracture, clavus moderately tectiform, lateral margins explanate, costal fracture weakly developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron deeply depressed medially; metathoracic external efferent system, peritreme tumid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 18A-G), pygophore subconical (Fig. 18A), with enlarged, subobovate, ventral process (Fig. 18B); dorsal margin with acute, elongate process (Fig. 18B), near midline of margin, subperpendicular to margin; genital opening large, ovoid. Left paramere (Fig. 18C), lateral margin weakly emarginate; lobe subquadrate, with enlarged, obtuse process dorsomedially; shaft elongate, with prominent apical

hook, coplanar with remainder of shaft, terminating toward lateral margin, with short triangular process basally. Right paramere (Fig. 18 D-E), elongate, subtriangular, with anterolateral rectangular process; four teeth along anterior margin; orbicular congregation of four conical teeth medially; large posterolateral hook-like process. Aedeagus (Fig. 18F-G) with multifurcate spiculum with three primary branches, two of which are bifid; secondary gonopore trough-shaped caudal to base of two minor branches of spiculum, terminating within base of spiculum.

Measurements. 5♂ BL 3.88-4.70, HW 1.01-1.04, IOD 0.51-0.58, HL 0.60-0.69, PL 0.83-0.90, PW 1.13-1.20, AII 1.21-1.41, LL 1.26-1.86; 5♀ BL 3.9-4.7, HW 1.04-1.15, IOD 0.55-0.60, HL 0.62-0.84, PL 0.91-0.96, PW 1.20-1.29, AII 1.14-1.26, LL 1.62-1.70.

Syntypes. – MNH ♂, UZMH ♂ (not examined).

Material examined. – NEW SOUTH WALES: 27♂ 24♀ 10 damaged (sex undetermined), Brogo River, Pacific Highway 15km N of Bega, 36°37'S 149°50'E, 50m, 10 November 1995, RT Schuh and G Cassis, site 95-65, ex *Lomandra longifolia* (AM) and (AMNH); 9♂ 5♀, Myall Lakes National Park, Paperbark Flat, Big Gibber, [32°30'S 152°21'E], [nr sea level], 19 October 1995, RT Schuh and G Cassis, ex *Lomandra longifolia* site 95-4 (AM) and (AMNH); 1♂, Sydney, [33.86°S 151.19°E], Dec 1934, D and KK Spence, compared with type by Carvalho 1972, K78885 (AM); 2♂ 1♀, 43 km SE of Braidwood, Deua National Park, [35°43'S 150°07'E], [100 m], 10 November 1995, RT Schuh and G Cassis, ex *Lomandra longifolia,* site 95-68 (AM) and (AMNH); 1♂, Royal National Park, picnic area, [34°10'S 150°10'E], 15 October 1993, G Cassis (AM). SOUTH AUSTRALIA: 2♀ 1 damaged (sex undetermined), Mount Lofty, [34.98°S 138.70°E], 28 December 1973 to 6 January 1974, Boy Scout Jamboree (SAMA).

Host plant. – *Lomandra longifolia* Labill [Lomandraceae].

Remarks. – *K. rugosa* is restricted to south-eastern Australia. It has been recorded from coastal South Australia and New South Wales (Fig. 5) on the monocot species *Lomandra longifolia,* which is also the host plant of *K. schuhi*. These two species are similar in external appearance but are clearly distinguished by differences of the parameres (cf. Fig. 18C-E, 20C-E) and spiculum (cf. Fig. 18G, 20G). *K. rugosa* is recognised in this work as the sister-taxon to *K. schuhi*. *K. rugosa* is externally very similar to *K. boweri* and *K. ngarkati* but can be distinguished by the weakly declivent hemelytra beyond the costal fracture in *K. rugosa* and the differences of the male genitalia.

Kirkaldyella schuhi Cassis & Moulds, **sp. n.**
(Fig. 5, 20A-H)

Diagnosis. – *K. schuhi* is recognised by the following set of characters: body elongate, parallel-sided; mostly glossy black to fuscous, stramineous triangular markings on exocorium above the costal fracture. The latter markings on the exocorium of *K. schuhi* distinguish it from *K. rugosa*.

Description. – Colouration. Head, posterior of vertex with triangular yellow to fuscous markings adjoining eyes, occasionally forming a band across head. Antennae, AI yellow with basal apices brown, AII stramineous, apical third fuscous, AIII-AIV fuscous. Pronotum, mostly glossy black, fuscous basally. Hemelytra, mostly fuscous, stramineous triangular markings on exocorium above the costal fracture. Legs, mostly stramineous, apical third of hind femora reddish-yellow with stramineous apices, basal half of tibiae with red and fuscous markings.

Dorsal texture. Head weakly punctate. Pronotum rugopunctate. Hemelytra, clavus moderately rugopunctate with submarginal row of punctures parallel to claval furrow, endocorium weakly rugopunctate.

Vestiture. Body with moderately dense distribution of simple, fine, erect, elongate, pale setae, except central third of corium; femora and tibiae with elongate, semi-erect bristles.

Structure. Macropterous, elongate, parallel-sided, posterior half of corium weakly convex. Head, posterior margin rectilinear, vertex, anterior half weakly convex with lateral margins foveate, foveae can extend laterally into posterior half. Antennae, AI much shorter than interocular width. AII slightly larger than width of posterior margin of pronotum in males, smaller in females. Eyes slightly removed from head. Labrum extending to procoxae, labium extending to metacoxae. Bucculae not extending beyond antennifers. Pronotum, transverse, campanulate (Fig. 20H); collar thin, depressed; calli moderately developed, medially depressed with pair of small foveae; anterior angles arcuate, explanate; disc moderately convex, posterior margin medially rectilinear. Mesoscutum small, strongly declivent. Scutellum flat, posterior third weakly declivent. Hemelytra, moderately declivent beyond costal fracture, clavus weakly tectiform, lateral margins explanate, costal fracture moderately developed. Thoracic pleura, proepisternum anteriorly orientated; proepimeron

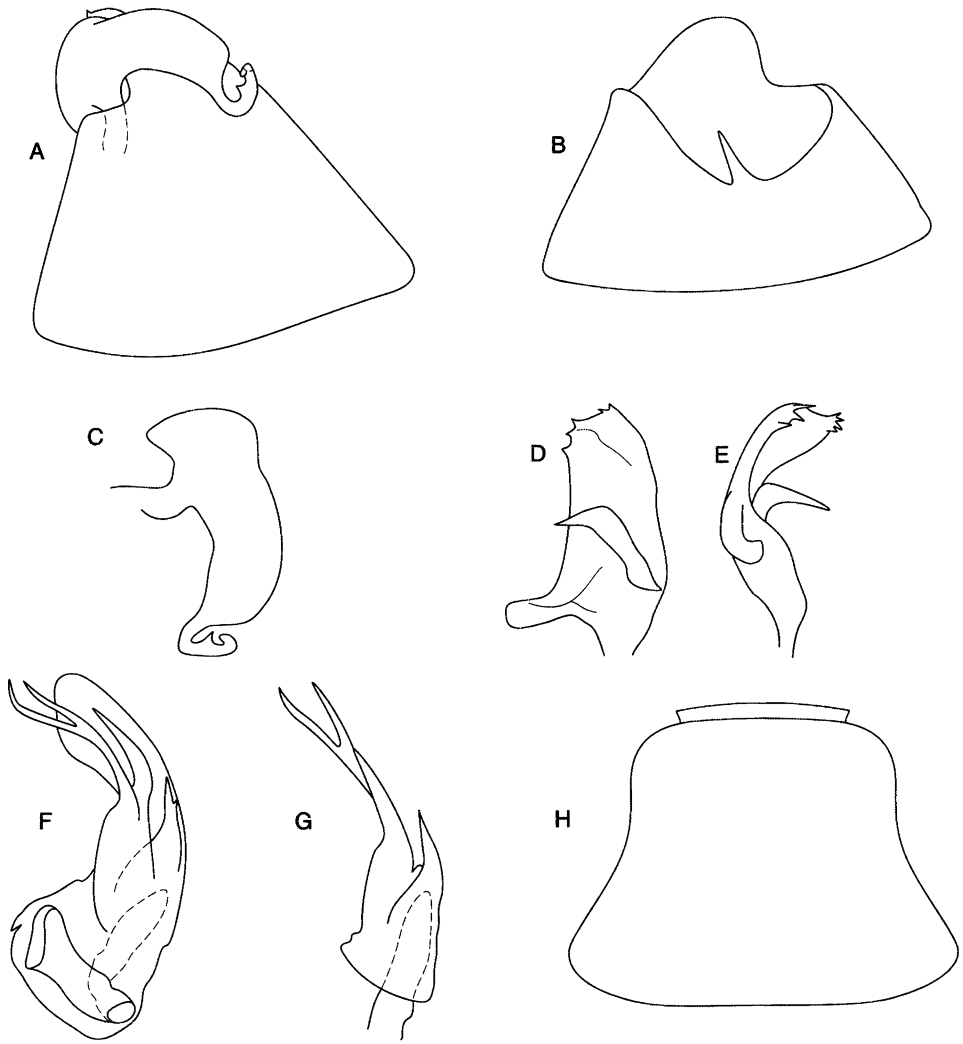

Figure 20. *Kirkaldyella schuhi*: (A) pygophore ventral, (B) genital opening dorsal, (C) left paramere, (D) right paramere, (E) right paramere lateral, (F) aedeagus, (G) spiculum, (H) pronotum and collar.

deeply depressed medially; metathoracic external efferent system, peritreme tumid, not reaching dorsal margin of evaporative areas; metathoracic spiracle visible. Male genitalia (Fig. 20A-G), pygophore subconical (Fig. 20A), with enlarged, terminal, transverse, obtuse, ventral process (Fig. 20B); dorsal margin with acute, elongate process (Fig. 20B), near midline of margin, subperpendicular to margin; genital opening large, ovoid. Left paramere (Fig. 20C), lateral margin weakly emarginate; lobe subquadrate, with enlarged, obtuse, dorsomedial process; dorsal margin with small, subperpendicular, acute process; shaft elongate, with prominent apical hook, coplanar with remainder of shaft, terminating towards lateral margin, with short triangular process basally. Right paramere (Fig. 20D-E), elongate, subrectangular, with anterolateral rectangular process; three

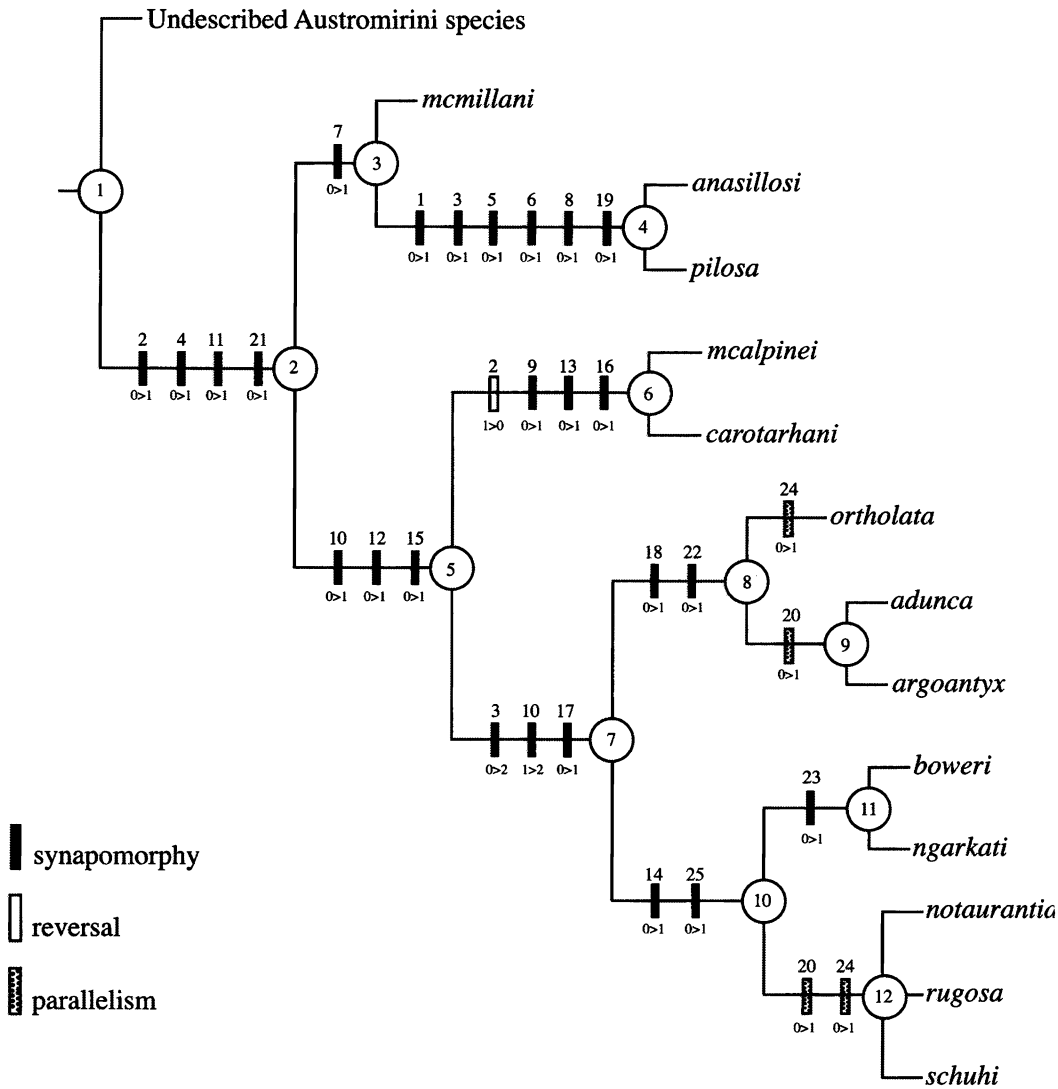

Fig. 21. Cladogram of genus *Kirkaldyella*. Tree length= 31; CI= 87; RI= 92.

teeth along medial margin; orbicular congregation of four conical teeth medioposteriorly; large posterolateral hook-like process. Aedeagus (Fig. 20F-G) with multifurcate spiculum with three primary branches, one of which is bifid; secondary gonopore trough-shaped caudal to base of shortest branch of spiculum, terminating within base of spiculum.

Measurements. 5♂ BL 3.65-3.90, HW 1.03-1.12, IOD 0.53-0.58, HL 0.50-0.64, PL 0.78-0.86, PW 1.02-1.16, AII 1.20-1.35, LL 1.20-1.35; 5♀ BL 4.1-4.3, HW 1.14-1.24, IOD 0.58-0.64, HL 0.66-0.78, PL 0.86-0.94, PW 1.20-1.26, AII 1.01-1.13, LL 1.26-1.58.

Material examined. – Holotype: NEW SOUTH WALES: 1♂, Mt Kaputar National Park, Upper Bullawa Creek Campground, [30°16'S 150°10'E], [450m], 24 October 1995, RT Schuh and G Cassis, ex *Lomandra*

longifolia [95-20] (AM). Paratypes: NEW SOUTH WALES: 39♂ 29♀ 20 juveniles, same data as holotype (AM) and (AMNH). SOUTH AUSTRALIA: 1♀, Binberrie Hill, Boolcoomata Station, [32.08°S 140.31°E], 24 September 1962, P Aitken (SAMA); 1♀, Eyre Peninsula, Lincoln National Park, 2 miles SE of Wanna, [34.90°S 135.86°E], 16 November 1971, JJH Szent-Ivany (SAMA).

Host plant. – *Lomandra longifolia* Labill. [Lomandraceae].

Etymology. – This species is named in honour of Randall T. Schuh who has accompanied the senior author on several field trips during much of the study.

Remarks. – *K. schuhi* is restricted to South Australia and New South Wales (Fig. 5) and has been recorded on the monocot species *Lomandra longifolia,* which is also the host plant of *K. rugosa.* These species are similar in external appearance but are clearly distinguished by the differences of the parameres (cf. Fig. 18C-E, 20C-E) and spiculum (cf. Fig. 18G, 20G).

Phylogenetics

The cladogram result is based on an analysis of 25 morphological characters of all the constituent species of *Kirkaldyella.* The characters and character states are given in Table 2 and the data matrix are given in Table 3. A single minimum length cladogram of 31 steps was computed with a consistency index of 0.87 and retention index of 0.92. The following discussion of sister-group relationships is based on the synapomorphies given at the nodes in Fig. 21.

Node 2 - The monophyly of *Kirkaldyella* is established by the following synapomorphies: transverse head (2-1), pronotum undivided medially (4-1), left paramere hammer-shaped, with shaft positioned along ventral margin of pygophore (11-1) and basal spiculum present (22-1). The broad triangulate head and undivided pronotum also occur in other austromirines but not within the outgroups examined in this analysis. The male genitalic characters are in all likelihood to be the most robust synapomorphies for the genus.

Node 3 - The sister-group relationship of *mcmillani* + (*anasillosi* + *pilosa*) is established by the presence of a pair of foveae on the medio-anterior area of the pronotum (7-1). The proximity of relationship of *mcmillani* may be further supported when more specimens become available and the male phallus is examined.

Node 4 - The sister-group relationship of *anasillosi* + *pilosa* is the most supported in this analysis. The following synapomorphies are proposed: adpressed scale-like setae present (1-1), pronotum quadrate-shaped (3-1), calli absent (6-1), peritreme elongate, reaching the dorsal margin of the evaporative areas, and no teeth are present on the medial margin of right paramere (19-1). These species are very closely related and saliently distinct from other members of the genus. The left paramere shape and position enable their placement in *Kirkaldyella.*

Node 5 - The remainder of species of *Kirkaldyella* are united by synapomorphies of the male genitalia, as follows: dextro-dorsal process present on genital opening (10-1), apical hook on left paramere elongate (12-1) and posterolateral process on right paramere present (15-1).

Node 6 - *K. mcalpinei* and *K. carotarhani* are sister-species on the basis of three synapomorphies of the male genitalia, as follows: sinistro-dorsal process of genital opening present (9-1), termination of apical hook of left paramere arcuate (13-1), posterolateral process of right paramere bent (16-1). This group is also defined by a homoplasy; the interocular region of the head narrow (2-0).

Node 7 - This clade of eight species is defined by two synapomorphies: the campanulate pronotum (3-2) and the anterolateral process of the right paramere present (17-1). All of these species have general similarity in body form and most aspects of the male genitalia.

Node 8 - This clade of three species is supported by two synapomorphies: the right paramere with an anteromedial process (18-1) and multiple apical processes present on the spiculum of the aedeagus (22-1). These species are also externally very similar in morphology and are united by genitalic characters alone.

Node 9 - The sister-species relationship of *K. adunca* and *K. argoantyx* is not supported by any recognised synapomorphy. They are united in this analysis by the presence of an orbicular arrangement of teeth on the medial margin of the right paramere. This character also occurs in the clade (Node 12) containing *K. notaurantia*, *K. rugosa* and *K. schuhi*. The arrangement and shape of the teeth of the aforementioned five species are very similar and have not been discriminated in terms of the current coding of the character states. The

Table 2. Characters and character states used in cladistic analysis of *Kirkaldyella* genera.

1) Adpressed scale-like setae: absent (0); present (1).
2) Head width: narrow AI=IOD (0); wide, AI much shorter than IOD (1).
3) Pronotum shape: trapeziform (0); quadrate (1); campanulate (2).
4) Pronotum: segmented (0); not segmented (1).
5) Pronotal collar: present (0); absent (1).
6) Calli on pronotum: present (0); absent (1).
7) Foveae on pronotum: absent (0); present (1).
8) Peritreme: does not reach the dorsal surface of the evaporative area (0); reaches the dorsal surface of the evaporative area (1).
9) Process on dorsal left hand side of genital opening: absent (0); present (1).
10) Process on dorsal right hand side of genital opening: absent (0); small (1); elongate (2).
11) Left paramere: not hammer shaped, not lying on ventral margin (0); hammer shaped, lying on ventral margin (1).
12) Apical hook on left paramere: short, terminates towards medial margin (0); elongate, terminates towards lateral margin (1).
13) Termination of apical hook on left paramere: straight (0); arcuate (1).
14) Triangular process on apical hook of left paramere: absent (0); present (1).
15) Posterolateral process on right paramere: absent (0); present (1).
16) Posterolateral process on right paramere: straight (0); bent (1).
17) Anterolateral process on right paramere: absent (0); present (1).
18) Anteromedial process on right paramere: absent (0); present (1).
19) Teeth on medial margin of right paramere: present (0); absent (1).
20) Orbicular congregation of teeth on medial margin of right paramere: absent (0); present (1).
21) Basal process on spiculum: absent (0); present (1).
22) More than one process on spiculum excluding the bifid branch: no (0); yes (1).
23) Teeth on longest branch of spiculum: absent (0); present (1).
24) Longest branch of spiculum bifid, with bifid apex not shorter than remaining length of branch: no (0); yes (1).
25) Basal branch of spiculum: not furcate at termination (0); furcate at termination (1).

many differences of other characters preclude any alternative phylogenetic arrangement of these five species as a clade.

Node 10 - This monophyletic group contains two clades, both of which are supported by the following synapomorphies: the presence of a triangular process on the apical hook of the left paramere (14-1) and the basal branch of the spiculum is furcate apically (25-1). These species are very similar externally, apart from colour markings of the dor-

Table 3. Character matrix of one outgroup, thirteen *Kirkaldyella* species and 25 characters. Missing data = ?.

	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Undescribed Austromirini sp.	0	0	0	0	0	0	0	0	?	?	0	0	0	0	0	?	0	0	0	?	0	?	0	0	0
adunca	0	1	2	1	0	0	0	0	0	2	1	1	0	0	1	0	1	1	0	1	1	1	0	0	0
anasillosi	1	1	1	1	1	1	1	1	0	0	1	0	0	?	0	?	0	0	1	?	?	0	?	0	?
argoantyx	0	1	2	1	0	0	0	0	0	2	1	1	0	0	1	0	1	1	0	1	1	1	0	0	0
boweri	0	1	2	1	0	0	0	0	0	2	1	1	0	1	1	0	1	0	0	0	1	0	1	0	1
carotarhani	0	0	0	1	0	0	0	0	1	1	1	1	1	0	1	1	0	0	0	0	1	0	0	0	0
mcalpinei	0	0	0	1	0	0	0	0	1	1	1	1	1	0	1	1	0	0	0	0	?	0	?	0	?
mcmillani	0	1	0	1	0	0	1	0	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?	?
ngarkati	0	1	2	1	0	0	0	0	0	2	1	1	0	1	1	0	1	0	0	0	1	0	1	0	1
notaurantia	0	1	2	1	0	0	0	0	0	2	1	1	0	1	1	0	1	0	0	1	1	0	0	1	1
ortholata	0	1	2	1	0	0	0	0	0	2	1	1	0	0	1	0	1	1	0	0	1	1	0	1	0
pilosa	1	1	1	1	1	1	1	1	0	0	1	0	0	?	0	0	0	0	1	?	1	0	0	0	0
rugosa	0	1	2	1	0	0	0	0	0	2	1	1	0	1	1	0	1	0	0	1	1	0	0	1	1
schuhi	0	1	2	1	0	0	0	0	0	2	1	1	0	1	1	0	1	0	0	1	1	0	0	1	1

sum in two of the species (*K. notaurantia* and *K. schuhi*). The sister-group relationships are again presently confined to genitalic characters.

Node 11 - The sister-species relationship between *K. boweri* and *K. ngarkati* is based on the presence of teeth on the apex of the longest branch of the spiculum (23-1). This is a seemingly minor character differentiation between the aforementioned species and the clade of Node 12. However, the character states of both clades for this character are without variation.

Node 12 - This clade is an unresolved trichotomy which is defined on the basis of two homoplasious characters: orbicular congregation of teeth on the medial margin of the right paramere (20-1) and the configuration of the longest spiculum of the aedeagus (24-1); the bifid component is short (Fig. 14G, 18G and 20G). Character states 20-1 also occur in the clade of Node 9 (*K. adunca* + *K. argoantyx*) and 24-1 in *K. ortholata*. Again, alternative phylogenies on these character states are not supported by the total evidence.

Biogeography

At present the highest taxonomic diversity of described Heteroptera is known from the tropical regions of north Queensland (Cassis & Gross 1995, Cassis & Gross in press). However, this is undoubtedly confounded by a sampling bias, as true bug collections have favoured these regions. Our recent collections indicate that the species diversity of true bugs in the temperate regions, particularly in the heathlands and other semi-arid vegetation types, is very high. Sampling in these places has revealed many heteropteran groups that are both endemic to temperate subregions and bear no apparent relationships to tropical areas of endemism. These data support the notion of Platnick (1991) that the biodiversity of southern temperate regions have been under-estimated in relation to latitudinal gradients.

Kirkaldyella has a transcontinental distribution pattern in temperate mainland Australia and Tasmania (Fig. 2-5). This distribution pattern is common for a number of true bug groups that we have recently examined (e.g. Brailovsky & Cassis 1999 - Coreidae: Agriopocorini, Cassis et al. 1999 - *Baclozygum* Bergroth and *Onymocoris* Drake & Slater, Cassis & Silveira 1995 - *Nerthra alaticollis* species-group). The phylogenetic relationships of the species of *Nerthra* and *Kirkaldyella* however do not indicate areas of endemism that are particularly correlative with areas for other groups (e.g. Cracraft 1991, Weston & Crisp 1994). Additionally, *K. pilosa* and *K. schuhi* are broadly distributed in the Murray-Darling basin and adjacent drainage basins. These distributions could be interpreted as widespread but could equally be considered, a priori, as a novel area of endemism. *K. pilosa* is also found in southwestern Western Australia, which is not consistent with the east-west barrier of the Nullarbor Plain as suggested by Cracraft (1991).

Furthermore the area relationships derived from a preliminary subtree analysis (not presented here; sensu Nelson & Ladiges 1996) of *Kirkaldyella* reveal multiple possible patterns of a southwestern Western Australia area of endemism with putative endemic areas in central-southern and southeastern Australia that do not resolve into three-taxon statements. The multiple east-west area relationships determined from the *Kirkaldyella* phylogeny are not considered artefactual as all but one node (Fig. 21, Node 12) are strongly supported by at least two synapomorphies.

Acknowledgments

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The following curators are thanked for the loan of specimens: Mr Gordon Nishida (BPBM), Dr Paul Arnaud (CAS), Dr Ken Walker (MV), Dr Gordon Gross and Ms Jan Forrest (SAMA), Dr Margaret Schneider and Mr Greg Daniels (UQIC), and Dr Terry Houston (WAM). The plant identifications were provided by the Royal Botanical Gardens (Sydney) and the Western Australian Herbarium (Perth). In this regard, Dr Tim Entwistle, Dr Neville Marchant, Mr Gary Chapple and Ms Sue Carroll are particularly thanked. Mr Tony Bower and Ms Jane Livesey are greatly thanked for their support of our fieldwork in Western Australia.

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