

## GUIDE TO THE AQUATIC HETEROPTERA OF SINGAPORE AND PENINSULAR MALAYSIA. VIII. LEPTOPODOMORPHA, FAMILIES SALDIDAE, LEPTOPODIDAE, AND OMANIIDAE

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**ABSTRACT.** — This is the eighth part in a series of papers constituting a Guide to the Aquatic Heteroptera of Singapore and Peninsular Malaysia, and treats the families Leptopodidae, Omaniidae and Saldidae in the infraorder Leptopodomorpha. Keys are provided to the regional families and genera of Leptopodomorpha, and new distributional records are provided for many of the constituent species occurring in the region. *Rupisalda thailandana* (Cobben, 1986), new combination, is proposed for *Saldula thailandana* Cobben, 1986.

**KEY WORDS.** — Leptopodidae, Omaniidae, Saldidae, *Valleriola*, *Leotichius*, *Corallocoris*, *Salduncula*, *Saldoida*, *Pentacora*, *Rupisalda*, *Saldula*, *Micracanthia*, Singapore, Peninsular Malaysia, keys, distributional records

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### INTRODUCTION

This contribution is the eighth in a series of papers constituting a Guide to the Aquatic Heteroptera of Singapore and Peninsular Malaysia (Cheng et al., 2001a, 2001b; Andersen et al., 2002; Nieser, 2002, 2004; Yang & Zettel, 2005; Yang & Murphy, 2011; Zettel et al., 2011), and treats the families Saldidae, Leptopodidae, and Omaniidae in the infraorder Leptopodomorpha. The Leptopodomorpha as a whole are generally long winged, ovate bugs, possessing large, transverse hind coxae, and a broad coxal cavity. They inhabit a variety of littoral habitats, including muddy or sandy shores and hygropetric seeps. Certain species are distinctly halophilic, being found on rocky intertidal shores, or along the margins of mangrove estuaries.

As currently interpreted the Leptopodomorpha contains 4 families, 42 genera, and 381 species, with the majority of these species inhabiting temperate regions, and only 28 species known from tropical or subtropical Asia (J. Polhemus & D. Polhemus, 2008). The most recent treatment of Southeast Asian Leptopodomorpha is that of J. Polhemus and D. Polhemus (1999), which dealt specifically with Thailand but provided general distributional data for the entire region. The key references in regard to taxonomy for tropical Asian species are the world catalogue of Leptopodomorpha by Schuh et al. (1987) and the Leptopodomorpha treatment in

the first volume of the catalogue of Palearctic Heteroptera (Lindskog, 1995), with few additional taxa having been described from the region subsequent to these publications. The morphology of Saldidae at the family level was discussed in detail by J. Polhemus (1985), along with a comprehensive treatment of the Mesoamerican biota, which contains many cosmopolitan genera also found in Southeast Asia. Cobben (1970) provided a similarly detailed treatment for Omaniidae on a world basis. By contrast, no equivalently comprehensive treatment for Leptopodidae currently exists except for the long outdated treatment by Horváth (1911b); the most recent work on any adjacent region is that of J. Polhemus & D. Polhemus (1987) for *Valleriola* in Melanesia, which provided an updated discussion of ecology and distribution for that genus as a whole.

The geographic scope of this work includes the island of Singapore, and the Malay Peninsula south of the Isthmus of Kra. Keys are provided to the regional families and genera of Leptopodomorpha, notes are given to separate the constituent species occurring in the region, and new distributional records are provided for many of these species. Because the Leptopodomorpha fauna of Singapore and Peninsular Malaysia is insufficiently sampled, it should be anticipated that species not treated herein will be encountered in future collections from the region.

As noted above, the Leptopodomorpha of this region include many species that are either marine or halophilic (Polhemus, 1976). Among the former are *Corallocoris marksae* (Woodward) and *Salduncula murphyi* J. Polhemus which inhabit rocky intertidal coasts, while the latter comprise *Pentacora malayensis* (Dover) and *Saldula sonneveldti* Blöte which are halophilic, occurring along the margins of estuaries and mangrove swamps. Other species in the regional assemblage are cavernicolous, such as *Leotichius speluncularum* China, or hygropetric, such as *Rupisalda thailandana* (Cobben). The remaining regional species, including representatives of the genera *Valleriola*, *Saldoida*, *Saldula*, and *Micracanthia*, occupy freshwater riparian or littoral zones, which are considered to be the “typical” habitats of Leptopodomorpha as a whole.

### MATERIAL AND METHODS

New and clarified distributional records are provided under the individual treatments for each species, including in some cases new extralimital records which establish broader distributional context; the latter are listed under “Extralimital material examined”. The specimens listed are housed in the collections of the National University of Singapore, Zoological Reference Collection (ZRC), the J. T. Polhemus Collection in Englewood, Colorado (JTPC), the Bishop Museum, Honolulu, Hawaii (BPBM), and The Natural History Museum, London (BMNH).

In the Material Examined sections local conventions have been used in regard to geographic names without translation

to English, so that the Malay “Sungai Gombak” is retained, rather than being translated to “Gombak River”. The most common of these retained Malay terms are: sungai = river, gunung = mountain, bukit = hill, and kampung = village. In certain cases additional notations have been added in brackets to provide clarity in cases where original label data was insufficiently detailed. For material in JTPC, the CL numbers following localities refer to a collection locality numbering scheme allowing cross-referencing of photographs and other metadata to specific collecting localities described in the collection journals.

Morphological terminology follows J. Polhemus (1985). All measurements are given in millimeters. Synonymies provided under species are nomenclatural only.

### KEY TO FAMILIES AND GENERA OF LEPTOPODOMORPHA OCCURRING IN SINGAPORE AND MALAYSIA

1. Tiny species, with body less than 2 mm long; forewings coleopteroid, hardened; eyes very large, reaching to about one-third length of pronotum (Fig. 9); marine in habit, occurring among intertidal rocks at low tide. (Family Omaniidae) ..... *Corallocoris*
- Larger species than above, with body more than 2.2 mm long; forewings never coleopteroid or completely hardened, with some portion of the wing membrane always present (Figs. 3, 8, 10, 11, 15, 17, 19, 20); eyes smaller, reaching only to pronotal collar or slightly beyond; occurring in a variety of marine, littoral, or terrestrial habitats ..... 2
2. Antennae as long as or longer than body (Figs. 3, 8); rostrum short, reaching at most to apex of fore-coxae, often only to base of fore-coxae; lithophilic in habit, occurring on large riparian boulders or bedrock faces, or in association with caves. (Family Leptopodidae, Subfamily Leptopodinae) ..... 3

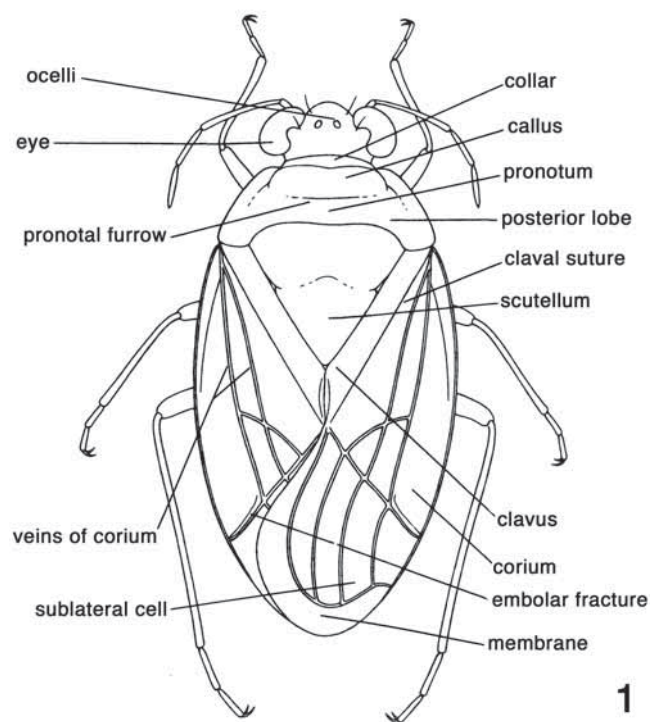


Fig. 1. *Saldula pallipes* (Fabricius), dorsal view, showing typical characters of Leptopodomorpha discussed in key and text (after J. Polhemus, 1985).

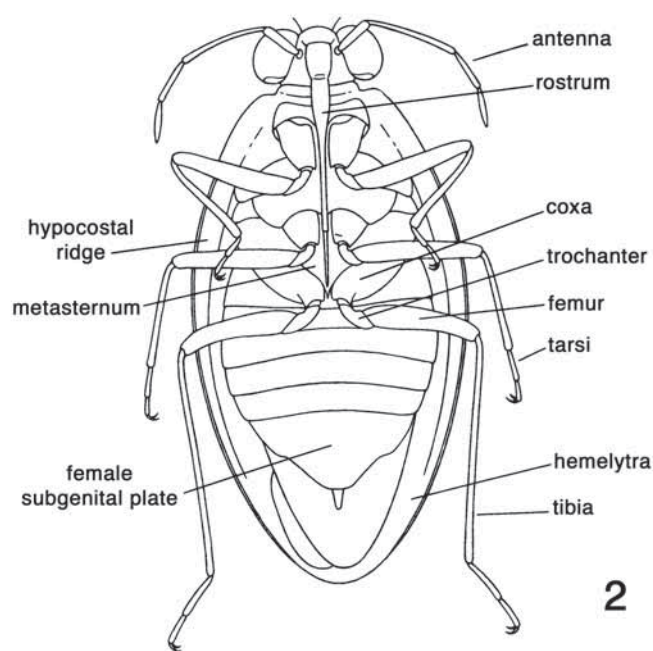


Fig. 2. *Saldula pallipes* (Fabricius), ventral view, showing typical characters of Leptopodomorpha discussed in key and text (after J. Polhemus, 1985).

- Antennae shorter than body (Figs. 10, 11, 15, 17, 19, 20); rostrum long, tapering, reaching base of hind coxae or beyond; littoral or intertidal in habit, occurring along margins of ponds and streams, or on rocky seacoasts. (Family Saldidae) ..... 4
- 3. Eyes dorsally chitinous, opaque and non-functional (Fig. 8) ..... *Leotichius*
- Eyes dorsally normal, enlarged (Fig. 3), set with ommatidia, functional ..... *Valleriola*
- 4. Hemelytral membrane with five closed cells (Fig. 11); halophilic species occurring on sea beaches or along the margins of saline estuaries. (Subfamily Chiloxanthinae) ..... *Pentacora*
- Hemelytral membrane with four closed cells (Figs. 10, 16, 17, 19, 20); ecological preferences diverse. (Subfamily Saldinae) ..... 5
- 5. Pronotum short, quadrate (Fig. 10); intertidal species occurring along rocky sea coasts (Tribe Saldunculini) ..... *Salduncula*
- Pronotum longer, tapering anteriorly; littoral species occurring along the margins of both freshwater and saline ecosystems (Figs. 15, 17, 19, 20). (Tribe Saldoidini) ..... 6
- 6. Pronotum strongly narrowed anteriorly (Fig. 15), with a pair of large, pointed dorsal projections (Fig. 16) ..... *Saldoidea*
- Pronotum not strongly narrowed anteriorly, without a pair of dorsal long dorsal projections (Figs. 17, 19, 20) ..... 7
- 7. Hemelytra without a secondary hypocostal ridge (Fig. 14) ..... *Rupisalda*
- Hemelytra with a secondary hypocostal ridge (Fig. 12) ..... 8
- 8. Corial veins reduced, with only the radius and unforked medial veins visible ..... *Micracanthia*
- Corial veins fully developed, extending entire length of corium, medial vein clearly forked (Figs. 19, 20) ..... *Saldula*



Fig. 3. *Valleriola javanica*, male, specimen from Malaysia, Perak, Kerunai River nr. Grik, CL 2078.

**Family Leptopodidae Brullé, 1836**

**Discussion.** — As noted previously, no modern revision of this family or its constituent tribes or subfamilies exists. A revised key to the genera of Leptopodini was provided by J. Polhemus & D. Polhemus (1991).

**Tribe Leptopodini Costa, 1853**

**Genus *Valleriola* Distant, 1904**

***Valleriola javanica* Drake & Hottes, 1951**

(Figs. 3, 4)

*Valleriola javanica* Drake & Hottes, 1951: 22

**Material examined.** — MALAYSIA, **Perak:** 3 males, 4 females, Kerunai River, 9 km N. of Grik, 19 Aug.1985, CL 2078, coll. D. A. & J. T. Polhemus (JTPC). **Kelantan:** 6 males, 1 female, Pergau River at upper bridge, 24 km W. of Jeli, 20 Aug.1985, CL 2082, coll. D. A. & J. T. Polhemus (JTPC); 10 males, 3 females, waterfall 10 km NW of Pasir Putih, 21 Aug.1985, CL 2084, coll. D. A. & J. T. Polhemus (JTPC). **Selangor:** 8 males, 1 female, Gombak River below Genting Highlands, 750 ft., 10 Mar.1983, coll. R. T. Schuh & B. Massie (JTPC).

**Extralimital material examined.** — HONG KONG, **New Territories:** 2 males, 2 females, rocky stream in Ho Chung Valley, 21 Nov.1985, CL 2206, coll. D. A. & J. T. Polhemus (JTPC). THAILAND, **Chiang Mai Prov.:** 2 males, 1 female, Fang Dist., rocky trib. to Nam Chai River, above Fang Horticultural Station, 500 m., 15 Nov.1985, CL 2202, coll. D. A. & J. T. Polhemus (JTPC).

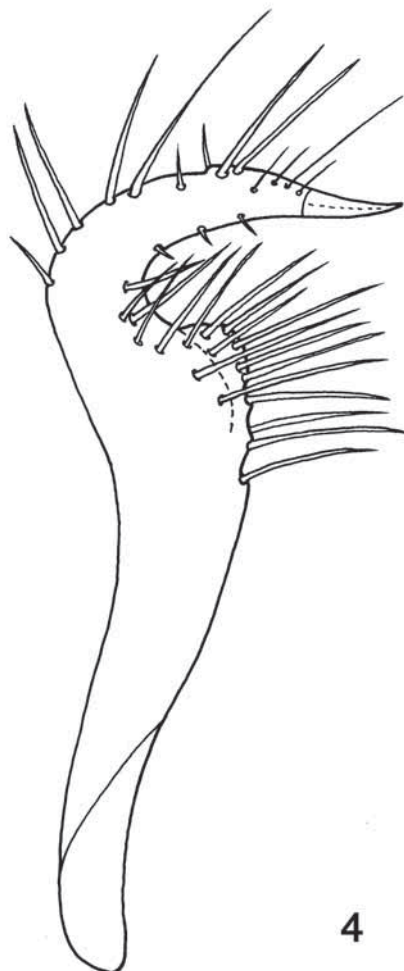


Fig. 4. *Valleriola javanica*, male paramere, specimen from Malaysia, Perak, Kerunai River nr. Grik, CL 2078.



INDONESIA, **Jawa Barat Prov.**: 1 female, Java, Buitenzorg [Bogor], 11 May 1930, coll. R. W. Becking (JTPC).

**Diagnosis.** — Male length 5.05–5.55, maximum width (across hemelytra) 1.25–1.40; female length 5.10, maximum width (across hemelytra) 1.20. General colouration dark blackish grey; head with frons shining black, eyes and ocelli red, post-ocellar ovate medial patch dark yellow, antennae with segment I dark yellow, segments II–IV very slender and elongate, dark brown; pronotum with anterior section black, posterior section dark brown with humeri black, extreme posterior margin and a broad ovate patch along longitudinal midline dark yellow; scutellum dark brown, central section pruinose grey, extreme posterior apex dark yellow; hemelytra dark blackish grey, clavus broadly marked with dark yellow on inner section and onto posterior apex; corium bearing 3 pale spots of progressively decreasing size moving posteriorly, most anterior of these patches largest, elongate ovate, dark yellow, the 2 posterior patches broadly ovate, white; legs pale straw yellow, posterior margins of all femora longitudinally streaked with black; ventral surface dark brown, intersegmental membranes of abdomen pale; male paramere strongly hooked (Fig. 4).

**Distribution.** — Originally described from Java (Drake & Hottes, 1951), with subsequent records from Hong Kong, Burma, Thailand, and Peninsular Malaysia (J. Polhemus & D. Polhemus, 1999). The records above are the first specific records for the Malaysian states of Kelantan, Perak, and Selangor, and given the currently documented range, the species is likely to occur in Singapore as well.

**Discussion.** — Among the regional assemblage of Leptopodomorpha, *Valleriola javanica* is easily recognised by its large size (body length exceeding 5 mm), bulging eyes, and elongate appendages (Fig. 3). The male paramere, which has not been previously illustrated, is distinctively hooked at the apex (Fig. 4).

**Ecological notes.** — Members of the genus *Valleriola* occur on large, dry boulders along stream courses, running on the vertical sides or beneath overhanging sections. Being very active and quick to flight, these insects are challenging to capture, and must often be chased onto an open rock face where a net can be swiftly set over them, allowing them to fly outward into the net bag, from which the specimen may subsequently be retrieved. Due to their atypical habitat preferences and elusive nature, individuals of *Valleriola* are easily overlooked by aquatic collectors concentrating on only wetted habitats, and as such are probably more widespread and abundant in Singapore and Malaysia than current records indicate.

**Tribe Leotichiini Schuh, 1986**

**Genus *Leotichius* Distant, 1904**

***Leotichius speluncularum* China, 1941**  
(Figs. 5–7)

*Leotichius speluncularum* China, 1941: 200

**Material examined.** — MALAYSIA, **Perlis**: 3 males, 1 female, Gua Barang, Nov.1940, running on deposits of bat guano in limestone cave, coll. H. T. Pagden (holotype and paratypes, BMNH).

**Diagnosis.** — Male length 2.30, maximum width (across hemelytra) 1.00; female length 2.45, maximum width (across hemelytra) 1.00. General coloration dark brown, overlain with powdery white waxes and pale grey pubescence; head dark brown, eyes reddish, antennae with segments I and II dark yellow, segments III and IV dark brown; pronotum dark brown with lateral humeri grayish-white; scutellum dark brown, apex white; hemelytra dark brown, corium with alternating broad transverse bands of dark brown and greyish-white, wing membrane translucent on basal half, infuscated on distal half; legs yellowish brown, each tibia with a slightly darker annulus on distal half, tibial apices infuscated; ventral surface dark brown with acetabulae and propleurae yellowish-grey. Male paramere elongate, distal section gently curved, apex rounded (Fig. 6).

**Distribution.** — Known only from the type locality, Gua Barang, in the Perlis state of Peninsular Malaysia.

**Discussion.** — This species is known only from the type series of 3 males and 1 female, taken on bat guano in a limestone cave (China, 1941). We have examined these specimens, and know of no subsequent collections. We have reproduced the figure from China's (1941) original description (Fig. 5), and

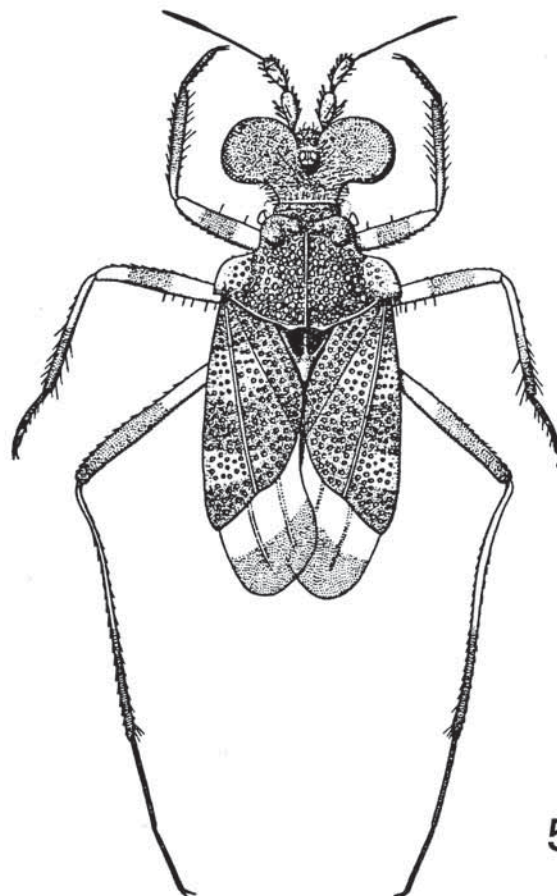
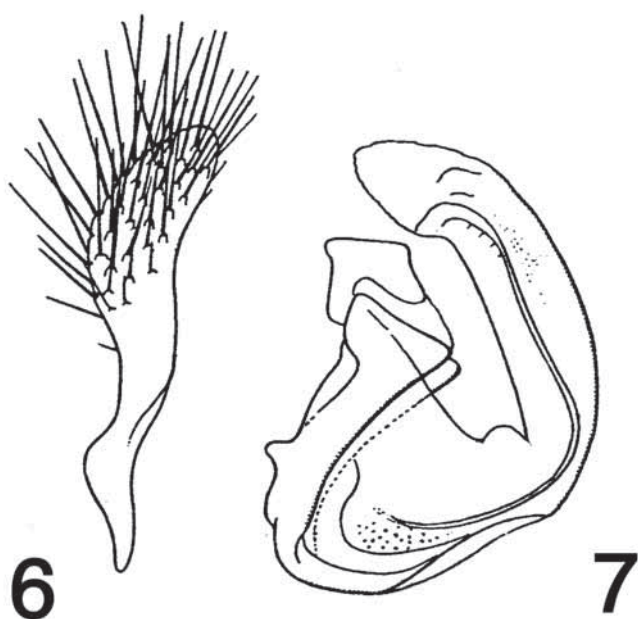


Fig. 5. *Leotichius speluncularum*, dorsal habitus (after China, 1941).

have also provided a colour photograph of the similar species *L. shiva* J. Polhemus & Schuh, 1995 (Fig. 8), which occurs along the margins of ant lion pits on Bali (J. Polhemus & Schuh, 1995), to more clearly depict the unique structure and colouration of this unusual genus.



Figs. 6, 7. *Leotichius speluncularum*, details of male genitalia: 6, paramere; 7, endosoma (after China, 1941).



Fig. 8. *Leotichius shiva*, dorsal habitus. Specimen from Indonesia, Bali, Pura Kehen temple, CL 2169.

**Family Omaniidae Cobben, 1970**

**Genus *Corallocoris* Cobben, 1970**

***Corallocoris marksae* (Woodward, 1958)  
(Fig. 9)**

*Omania marksae* Woodward, 1958: 104  
*Omania samoensis* Kellen, 1960: 495; syn. by Cobben, 1970: 66  
*Corallocoris marksae*: Cobben, 1970: 66

**Material examined.** — SINGAPORE: 20 males, 20 females, Sentosa Island, large intertidal rocks, 14 Oct.1996, CI 2216, coll. J. T. Polhemus & D. A. Polhemus (JTPC).

**Diagnosis.** — Tiny insects with coleopteriform hemelytra (Fig. 9). Male length 1.15–1.45, maximum width (across hemelytra) 0.55–0.75; female length 1.50–1.60, maximum width (across hemelytra) 0.80–0.90. Colouration black, marked with bluish grey; head black, eyes and ocelli red; pronotum black, anterior collar pale bluish-grey; scutellum black, hemelytra black with a broad, pale bluish-grey transverse fascia centrally.

**Distribution.** — Originally described from Australia (Woodward, 1958), with subsequent records from Samoa (Kellen, 1960, as *Omania samoensis*), New Caledonia, Malaysia, and Singapore (Cobben, 1970). We have further specimens in hand from the Philippines (Luzon).

**Discussion.** — This species is unmistakable among the regional suite of Leptopodomorpha, given its small size, coleopteriform forewings, and black ground colour with a broad grey fascia across the hemelytra (Fig. 9). Cobben (1970) provided detailed figures of the immatures, and of the adult leg structures and male and female genitalia.

**Ecological notes.** — Detailed notes on the ecological preferences of this species (as *Omania samoensis*) in Samoa were provided by Kellen (1960), who noted: “The sordid adults and nymphs were found frequenting small holes and crevices in the volcanic rocks. Interestingly, only those rocks lying in a rather narrow band of the intertidal zone were inhabited; apparently the acceptability of a particular rock is greatly influenced by the moisture conditions obtained in the pores when they are exposed to sun at low tide. Those rocks lying at the broad extremes of the intertidal zone presumably are either too dry or too wet for habitation.”

**Family Saldidae Amyot & Serville, 1843**

**Subfamily Chiloanthinae Cobben, 1959**

**Genus *Pentacora* Reuter, 1912**

**Discussion.** — The genus *Pentacora* has a semi-cosmopolitan distribution, occurring in North America, Australia, Melanesia, South Asia, the Caribbean, and certain Pacific Islands (Galapagos), but being naturally absent from Europe and Africa (although *Pentacora sphacelata* Uhler has been

introduced to Morocco and the island of Sardinia). Ten species are known worldwide (Schuh et al., 1987), most occurring in association with saline habitats. A single species, *Pentacora malayensis* (Dover), is currently described from Southeast Asia.

***Pentacora malayensis* (Dover, 1929)**

(Fig. 11)

*Salda malayensis* Dover, 1929: 398

*Saldula malayensis*: Drake & Hoberlandt, 1951: 8

*Pentacora malayensis*: Drake, 1958: 307

*Saldula korangiensis* Hamid & Sultana, 1972: 282; syn. by Cobben, 1980: 117

**Material examined.** — SINGAPORE: 2 males, 8 females, S. Sembawang, mangrove swamp, KLY, 7 Oct.1994, collector unknown (JTPC). MALAYSIA, **Pahang**: 1 male, Maku waterfall, Pulau Tioman, 20 Jun.1994, coll. C. M. Yang (ZRC). **Kelantan**: 3 males,

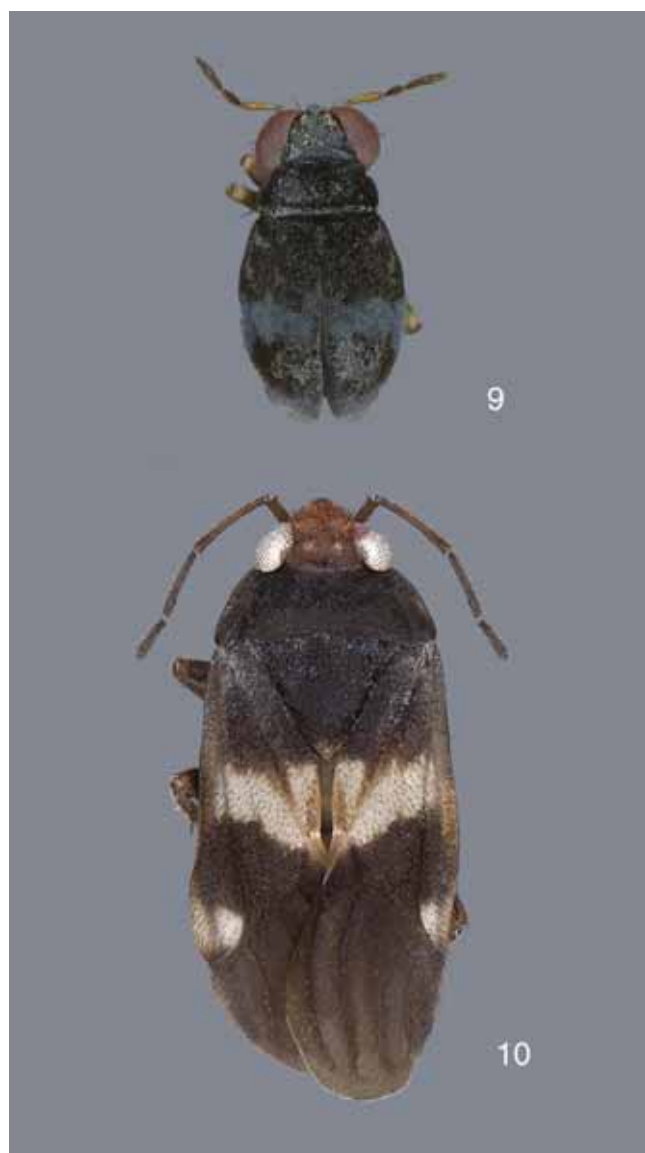
1 female, brackish lagoon behind Beach of Passionate Love, near Kota Bharu, 20 Aug.1985, CL 2083, coll. D. A. & J. T. Polhemus (JTPC). **Kedah**: 1 male, West Coast, Langkawi Is., 14 Apr.1928, collector unknown (JTPC).

**Diagnosis.** — Male length 3.50–3.60, maximum width (across hemelytra) 1.60–1.70; female length 4.25, maximum width (across hemelytra) 1.85. Head with vertex black, frons dark yellow marked with a pair (1+1) of longitudinal dark stripes to either side of midline; pronotum dark centrally, dark yellow laterally; scutellum mostly black, apex dark yellow; hemelytra dark brown, extensively marked with dark yellow on outer corium external to vein R + M, clavus and inner corium each with 2–3 large dark yellow spots, hypocostal ridge present and well-developed (Fig. 13); wing membrane including veins dark brown, marked with a few dark yellow patches basally; legs pale yellow with black spines; antennae with segments I and II pale brown, segments III and IV dark brown.

**Distribution.** — Originally described from Kuala Langkat, a district of southwestern Selangor (Dover, 1929), with subsequent records from Pakistan (Hamid & Sultana, 1972, as *Saldula korangiensis*). New records are provided above for Singapore, and the Malaysian states of Pahang, Kelantan and Kedah.

**Discussion.** — Recognised among the regional assemblage of Saldidae by the 5 closed cells in the membrane of the forewing, the well-developed hypocostal ridge (Fig. 13), the relatively pale color pattern (Fig. 11), and a preference for saline habitats.

**Ecological notes.** — This is a halophilic species that occurs on damp sand beaches and firm alluvial shorelines bordering



Figs. 9, 10. Intertidal Leptopodomorpha, dorsal habitus: 9, *Corallocoris marksae*, specimen from Singapore, Sentosa Island, CL 2216; 10, *Salduncula murphyi*, specimen from Singapore, Labrador Park, CL 2055.



Fig. 11. *Pentacora malayensis*, dorsal habitus. Specimen from Malaysia, Kelantan, E. of Kota Bharu, CL 2083.



saline estuaries and mangrove swamps. Dover (1929) noted in his original description that this species was “common at the edges of pools in mangrove swamp about half a mile from the sea-beach”.

### Subfamily Salidinae Amyot & Serville, 1843

#### Tribe Saldunculini J. Polhemus, 1985

##### Genus *Salduncula* Brown, 1954

**Discussion.** — A key to the currently described species was provided by J. Polhemus (1991).

##### *Salduncula murphyi* J. Polhemus, 1991

(Fig. 10)

*Salduncula murphyi* J. Polhemus, 1991: 156

**Material examined.** — SINGAPORE: 7 males, 4 females, Labrador Park, rock beach, 12 Aug.1985, CL 2055, coll. J. T. & D. A. Polhemus (paratypes, JTPC); 1 male, 1 female, rocky seashore, Labrador, Feb.1961, coll. D. H. Murphy (paratypes, JTPC).

**Diagnosis.** — Male length 2.60–2.75, maximum width (across hemelytra) 1.15–1.20; female length 2.80–3.00, maximum width (across hemelytra) 1.15–1.25. Head reddish brown, eyes pale; pronotum and scutellum dull black; hemelytra dull black, with a transverse white fascia extending across outer and inner corium to broadly subtend posterior apex of clavus, posterior apex of outer corium external to vein R + M also bearing a prominent white spot (Fig. 10); wing membrane including veins uniformly dark fumate; antennae uniformly medium brown; legs with coxae, trochanters and femora dark blackish brown, tibiae and tarsi medium brown; ventral surface dull black.

**Distribution.** — Described from Singapore (J. Polhemus, 1991) and at present known only from the type locality.

**Discussion.** — Easily recognised among the regional species of Saldidae by its short, nearly quadrate pronotum, distinctive colour pattern with a transverse white fascia cutting across the black hemelytra (Fig. 10), and intertidal habits.

**Ecological notes.** — This marine saldid is found on rocky shores, where individuals run about on spray-wetted rock faces above the water line. In general, *Salduncula* species prefer isolated large boulders or bedrock outcrops surrounded by water or beach sands. Individuals are active and challenging to capture with an aspirator, but long series may occasionally be taken from vertical rock shorelines by holding a net at the water line and then splashing water onto the rock face above, thus dislodging the insects and allowing them to be netted from the water surface.

#### Tribe Saldoidini Reuter, 1912

##### Genus *Saldoidea* Osborn, 1901

**Discussion.** — The genus *Saldoidea* has a global distribution, with 3 species in North America, one in Africa, and one in tropical and subtropical Asia. Cobben (1987) provided figures of selected morphological features for 4 of the 5 described species (excluding the North American *S. turbaria* Schuh, which is known only from females).

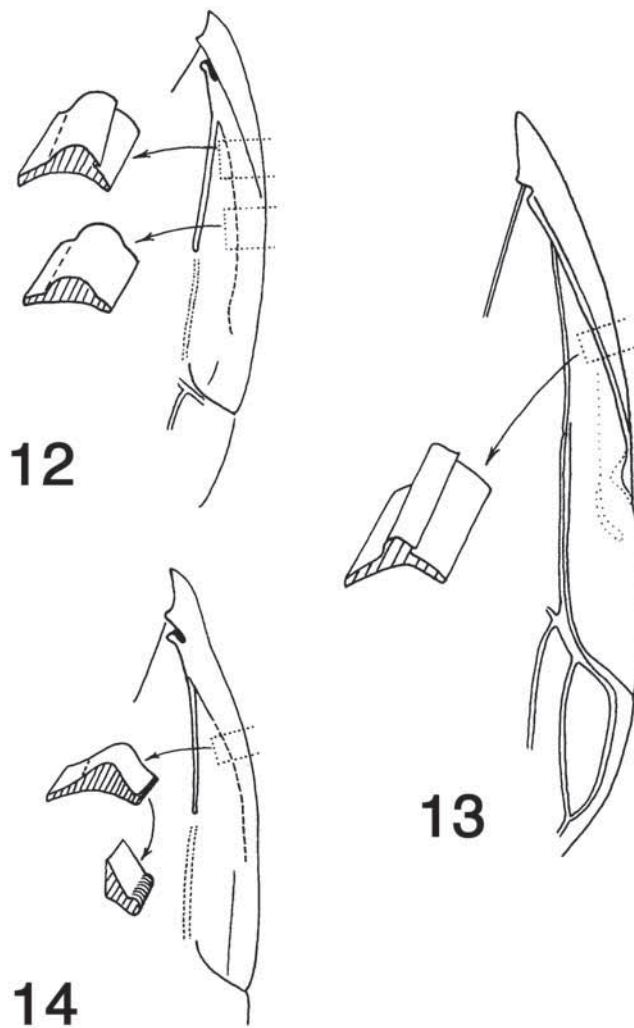
##### *Saldoidea armata* Horváth, 1911a

(Figs. 15, 16)

*Saldoidea armata* Horváth, 1911a: 334

*Saldoidea bakeri* Poppius, 1914: 52; syn. by Drake & Maa, 1954: 265

**Material examined.** — SINGAPORE: 2 males, 1 female, Chu Kang site #4, mangrove forest, 18 May 1987, “on *Thasallina* mound, very active”, coll. D. H. Murphy (JTPC). WEST MALAYSIA, **Selangor**: 1 male, Templer Park, N. of Kuala Lumpur, small stream, CL 2070, 17 Aug.1985, coll. J. T. & D. A. Polhemus (JTPC).



Figs. 12–14. Hypocostal ridge structures of saldid genera: 12, *Saldula*; 13, *Pentacora*; 14, *Rupisalda* (all after J. Polhemus, 1985).

**Extralimital material examined.** — MALAYSIA, **Sabah:** 1 male, 1 female, Borneo, Samalang River, 7 km. S. of Ranau, 3 Aug.1985, CL 2026, coll. D. A. & J. T. Polhemus (JTPC). INDONESIA, **Bali Prov.:** 1 male, 1 female, Bali, Kab. Bangli, Melangit River, E. of Bangli, 400 m., 17 Oct.1985, CL 2170, coll. D. A. & J. T. Polhemus (JTPC). **Maluku Prov.:** 1 male, 1 female, Ambon, Kab. Maluku Tengah, Kec. Baguala, Wairea River, nr. Wairea, 0–100 m., 4 Oct.1985, CL 2153, coll. D. A. & J. T. Polhemus (JTPC).

**Diagnosis.** — Male length 3.20–3.30, maximum width (across hemelytra) 0.80–0.90; female length 3.40–3.60, maximum width (across hemelytra) 0.95–1.10. General colouration rusty brown, sparingly marked with black and white. Head brown, vertex black, eyes red, antennae with segment I rusty brown, segment II dark brown, distal 1/4 white suffused with red, segment III white broadly suffused with red, segment IV pale red on basal 1/3, white on distal 2/3; thorax shining medium brown, bearing a pair (1+1) of backward curving horns centrally, areas lateral to these horns pruinose; scutellum shining amber brown; hemelytra dull



Fig. 15. *Saldoida armata*, dorsal habitus. Specimen from Singapore, Chu Kang mangrove forest.

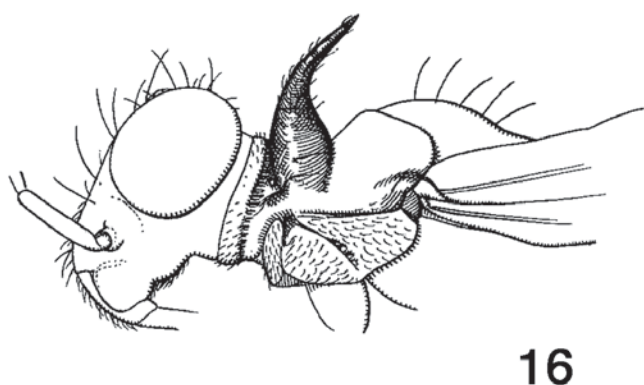


Fig. 16. *Saldoida armata*, lateral view of head and thorax (after Drake, 1961).

rusty brown, outer corium narrowly pale translucent white, inner corium bearing 2 large pruinose patches plus a small white pruinose patch at posterior apex, clavus with a small dark patch centrally, posterior apex bright white; legs with coxae, trochanters and femora medium brown, tibiae and tarsi yellowish-brown

**Distribution.** — Originally described by Horváth (1911a) from Takao, Formosa (Taiwan), with subsequent records from the Philippines (Poppius, 1914, as *Saldoidea bakeri*). Widely distributed in Southeast Asia, with records provided by J. Polhemus & D. Polhemus (1999) for China, India, Thailand, Japan, Taiwan, Borneo, Java, Bali, Sumbawa, Celebes, Ambon, the Philippines (Luzon, Palawan), New Guinea, and Australia, as well as Peninsular Malaysia and Singapore.

**Discussion.** — This species is easily recognised within the regional assemblage of Leptopodomorpha by its ant-like form, rusty brown colouration with scattered pruinose markings (Fig. 15), and sharply curving, pointed processes centrally on the thorax (Fig. 16). Individuals are found on moist earth next to springs, streams, and mangrove swamps, and may be overlooked by bug collectors due to their ant-like appearance as they run across the ground. Cobben (1987) provided detailed figures of the antennae, forewing pattern, and male paramere.

#### Genus *Rupisalda* J. Polhemus, 1985

**Discussion.** — Species in the genus *Rupisalda* were transferred from *Saldula* by J. Polhemus (1985), and may be recognised on the basis of a the strongly raised callus on the pronotum set off by a row of pits, the forewing membrane bearing four cells of approximately equal length, and the simple structure of the hypocostal ridge (compare Figs. 12–14). They also preferentially inhabit rheocrenes and spray-wetted bedrock faces adjacent to waterfalls, rather than the horizontal littoral habitats preferred by *Saldula* species.

#### *Rupisalda thailandana* (Cobben, 1986), new combination (Figs. 17, 18)

*Saldula thailandana* Cobben, 1986: 226

**Material examined.** — MALAYSIA, **Selangor:** 1 male, Gombock River below Genting Highlands, 750', 10 Mar.1983, coll. R. T. Schuh & B. Massie (JTPC). **Penang:** 1 female, near Georgetown, 16 Jan.1983, coll. H. C. Chapman (JTPC). **Kelantan:** 4 males, 3 females, Pergau River at upper bridge, 24 km W of Jeli, CL 2082, 20 Aug.1985, coll. J. T. & D. A. Polhemus. **Johor:** 4 males, 2 females, Johor, Kota Tinggi Waterfall, 16 km NW of Kota Tinggi, CL 2056, 13 Aug.1985, CL 2056, coll. J. T. & D. A. Polhemus (JTPC).

**Extralimital material examined.** — THAILAND, **Nakhon Nayok Prov.:** 1 female, S. Banna, Nakhon, 108 m, 5–10 May 1958, coll. T. C. Maa (paratype, JTPC). HONG KONG, **New Territories:** 1 male, 1 female, Great Falls, Kadoorie Experimental Farm, 23 Nov.1985, CL 2209, coll. D. A. & J. T. Polhemus (JTPC).



**Diagnosis.** — Male length 3.50–3.80, maximum width (across hemelytra) 1.35–1.40; female length 3.90–4.00, maximum width (across hemelytra) 1.45–1.50. General colouration black, sparingly marked with pale yellow and white (Fig. 17). Head shining black, eyes and ocelli red, vertex with a



Fig. 17. *Rupisalda thailandana*, dorsal habitus. Specimen from Malaysia, Kelantan, Pergau River, CL 2082.



Fig. 18. *Rupisalda thailandana*, left hemelytron (after Cobben, 1986).

creamy white spot present to either side of midline in space between eyes and ocelli, antennae with segment I creamy white, segments II and III black, segment IV brown at extreme base and on distal 1/4, central section white; pronotum and scutellum uniformly shining black; hemelytra black, outer margin of corium broadly creamy white basally, this marginal pale colouration narrowing distally, basal section of inner corium dark pruinose grey, bearing 3 white patches, posterior section of inner corium dull black, bearing 2 small white patches near claval apex and another much larger white patch posterolaterally (Fig. 18), clavus dull black, bearing 2 small white patches at anterior and posterior extremities, membrane blackish fumate, each wing cell bearing 2 pale areas; legs pale yellowish-white, blotched with dark brown; thoracic venter shining black, abdominal venter dark brown with intersegmental membranes contrastingly pale.

**Distribution.** — Originally described from Nakhon Nayok Province in southern Thailand (Cobben, 1986), with subsequent records from Hong Kong, Burma, Thailand, Vietnam, and Peninsular Malaysia provided by J. Polhemus & D. Polhemus (1999). We provide the first specific records for the Malaysian states of Selangor, Penang, Kelantan, and Johor.

**Discussion.** — This species was previously known from West Malaysia. Although originally described in the genus *Saldula* (Cobben, 1986), the lack of a secondary hypocostal ridge on the ventral hemelytron, coupled with its general habitus and preference for rheocrenes, places this species in the genus *Rupisalda*.

#### Genus *Saldula* Van Duzee, 1914

**Discussion.** — The genus *Saldula* is the most speciose genus in the Saldidae, and is distributed worldwide, from the tropics to the arctic, occurring on every continent except Antarctica. Diagnostic characters for this genus include the presence of an oblique secondary hypocostal ridge that intersects with the costal margin midway between the embolar base and the fracture (compare Figs. 12–14), reduced ocelli, and the callus of the pronotum bearing a well-defined pit (J. Polhemus, 1985). Two species are known to occur in Peninsular Malaysia.

#### *Saldula niveolimбата* (Reuter, 1900)

(Fig. 19)

*Acanthia niveo-limbata* Reuter, 1900: 156

*Salda insignis* Distant, 1913: 170; syn. Cobben & J. Polhemus, 1966: 393

*Saldula marianarum* Usinger, 1946: 100; syn. J. Polhemus, 1981: 616

*Saldula niveolimбата*: Drake, 1963: 1

**Material examined.** — SINGAPORE: 2 males, 3 females, Selatar Reservoir park, 3 Jan.1991, coll. K. L. Yeo, YKL0723 (ZRC); 2 males, 1 female, same data as previous, except 7 Nov.1990, YKL705 (ZRC); 1 male (head and thorax missing), Nee Soon

Swamp Forest, outflow creek, on sand banks, 1 Jan.1986, coll. D. H. Murphy (ZRC); 1 male, Bukit Panjang, wet sandy area in bright sun, 19 Jan.1976, coll. D. H. Murphy (ZRC). MALAYSIA, **Pahang**: 1 male, 1 female, Selompok, pond, 12 Aug.1926, coll. C. Dover (ZRC). **Trengganu**: 1 female, Rantau Abang, 18 Mar.1992, coll. H. K. Lua, LHK 177 (ZRC). **Selangor**: 1 male, Kepong, FRIM, Sungai Kroh, 15 Jan.2002, coll. H. H. Tan (ZRC).

**Extralimital material examined.** — VIETNAM, **Quang Tri Prov.**: 1 female, 1 mi. N. of Quang Tri, at light, 28 Apr.1970, coll. A. R. Gillogly (JTPC). SAMOA, **Upolu Is.**: 1 male, Slide Rock, Apia, CL 1510, 22 Jan.1978, coll. J. T. & M. S. Polhemus (JTPC); 1 male, stream nr. Poutasi, CL 1508, 21 Jan.1978, coll. J. T. & M. S. Polhemus (JTPC). SEYCHELLES, **Beau Vallon Dist.**: 1 male, Mahe Is., Bean Valley [Beau Vallon Bay], 16 Jul.1952, coll. E. S. Brown (JTPC). KENYA, **Eastern Prov.**: 2 females, Mtito Andei, Apr.1980, coll. E. Heiss (JTPC).

**Diagnosis.** — Male length 2.70–2.80, maximum width (across hemelytra) 1.20–1.30; female length 3.30–3.50, maximum width (across hemelytra) 1.60–1.70. Head, pronotum and scutellum shining black; hemelytra black, outer corium external to vein R + M and portion of corium external to vein Cu entirely pale translucent, inner corium inside of vein Cu brown with 3 small white spots, clavus black with a single very small pale spot near posterior apex; wing membrane pale translucent fumate, veins contrastingly brown, basal section of membrane with darker mottling; antennae with segments I and II medium brown, segments III and IV dark brown; legs pale brown; ventral surface mostly black.

**Distribution.** — Originally described from Senegal (Reuter, 1900), and subsequently reported from Namibia, Angola, Sierra Leone, Nigeria, Ghana, Sudan, Tanzania, the



Fig. 19. *Saldula niveolimбата*, dorsal habitus. Specimen from Samoa, Upolu, CL 1508.

Seychelles, Palau, and Guam (Schuh et al., 1987), and from Peninsular Malaysia by J. T. Polhemus & D. A. Polhemus (1999). We now record this species from Singapore, and have further specimens in hand from Kenya, the Seychelles, Vietnam, and Samoa.

**Discussion.** — Among the two species of *Saldula* currently known to occur in Peninsular Malaysia, *S. niveolimбата* may be recognised by its light colored costal margins on the hemelytra (in contrast to *Saldula sonneveltdti*, which has the costal margins mostly dark with a white spot at the extreme posterior apex; compare Figs. 19, 20), by its pale coloured gular lobes, and by antennal segments II–IV being subequal in length, with each longer than segment I.

### *Saldula sonneveltdti* Blöte, 1947

(Fig. 20)

*Saldula sonneveltdti* Blöte, 1947: 548

**Material examined.** — MALAYSIA, **Kelantan**: 4 males, Beach of Passionate Love, E. of Kota Bharu, estuary, 20 Aug.1985, CL 2083, coll. J. T. & D. A. Polhemus (JTPC).

**Extralimital material examined.** — MALAYSIA, **Sabah**: 1 male, 1 female, Tanjung Tajau, 7 km NW of Kudat, 19 Sep.1983, at black light, coll. G. Hevel & W. Steiner (JTPC). EAST TIMOR, **Dili Dist.**: 2 males, 4 females, Tasitolu wetland complex, W. of Dili, middle lake, sea level, 8°33'43"S, 125°30'29"E, water temp. 32°C., salinity 75 ppt., 1 Sep.2004, 1130–1200 hours., CL 7310, coll. D. A. Polhemus (USNM, BPBM).

**Diagnosis.** — Male length 2.40–2.70, maximum width (across hemelytra) 1.15–1.25; female length 3.00, maximum width (across hemelytra) 1.50. Head satin black, eyes brown; pronotum and scutellum satin black; hemelytra mostly black, outer corium external to vein R + M black except for prominent white spot at posterior end, inner corium black with 3 small indistinct brownish spots, clavus black with a single indistinct brownish spot near posterior apex; wing membrane including veins pale translucent fumate, distal section of membrane with 4 creamy white spots in the posterior apices of the cells; antennae with segment I black, segments II–IV brown; legs with coxae black, trochanters and bases of femora pale brown, central sections of femora black, apices of femora white, tibiae pale brown with white apices, tarsi pale brown; ventral surface black.

**Distribution.** — Originally described from Makassar, Celebes (Blöte, 1947), with subsequent records from Borneo, Celebes, and Peninsular Malaysia. We provide the first specific record for the Malaysian state of Kelantan, and a new country record for East Timor, greatly extending the eastward range limit of this species.

**Discussion.** — Easily recognised by its small size, the generally black colouration with very limited pale markings (Fig. 20), and antennal segment II being longer than either segment III or segment IV.

**Ecological notes.** — *Saldula sonneveltdti* is a small and distinctively coloured halophilic species that occurs along the margins of salt pans behind mangrove estuaries, and forms a component of a distinct halophilic guild of Asian saldid taxa, which often occur in mixed species assemblages. For instance, at the Tasitolu wetland complex near Dili, East Timor, the second author found this species on salt flats along the margins of three hypersaline lakes with measured surface salinities ranging from 75–100+ ppt., where it occurred sympatrically with *Micracanthia ornatula* and an undescribed *Pentacora* species. Similarly, *S. sonneveltdti* was taken along the margins of a mixohaline estuary near Kota Bharu, in the peninsular Malaysian state of Kelantan, in company with *Pentacora malayensis*.

### Genus *Micracanthia* Reuter, 1912

**Discussion.** — Some question remains as to the status of this genus in relation to *Saldula*. The major character separating these two genera, as presented in J. Polhemus (1985), is the reduction of venation in the corium of the forewing of *Micracanthia*, in which only the radial and medial veins are present. Lindskog (1986) considered this diagnostically reduced corial venation to be a potentially homoplasious character and provided evidence that such reductions were also present in some species that he felt were more properly assigned to *Saldula*. Given that this character does hold for the species in the region under study, however, we retain these two genera as separate in the context of the present work.



Fig. 20. *Saldula sonneveltdti*, dorsal habitus. Specimen from Malaysia, Kelantan, E. of Kota Bharu, CL 2083.

### *Micracanthia ornatula* (Reuter, 1881)

(Fig. 21)

*Salda ornatula* Reuter, 1881: 160

*Acanthia ornatula*: Reuter, 1895: 17

*Saldula ornatula*: Drake & Hoberlandt, 1951: 9

*Micracanthia ornatula*: J. Polhemus & D. Polhemus, 1999: 19

*Salda dixonii* Distant, 1904: 405; syn. by Drake & Hottes, 1950: 177

**Material examined.** — SINGAPORE: 1 male, Nee Soon Swamp forest, 15 May 1992, coll. unknown (ZRC). MALAYSIA: **Johor**: 1 female, swamp forest stream 27 km SW of Mersing, 14 Aug. 1985, CL 2058, coll. D. A. & J. T. Polhemus (JTPC).

**Extralimital material examined.** — EAST TIMOR, **Dili Dist.**: 3 males, 1 female, Tasitolu wetland complex, W. of Dili, middle lake, sea level, 8°33'43"S, 125°30'29"E, water temp. 32°C., salinity 75 ppt., 1 Sep. 2004, 1130–1200 hours., CL 7310, coll. D. A. Polhemus (USNM, BPBM). NEW CALEDONIA: 1 male, Yaoué, drying streambed, between small boulders near dry section, 12 Dec. 1965, B. M. 1966-1, collector unknown (JTPC). JAPAN, **Fukuoka Pref.**: 2 females, Kyūshū, Fukuoka, Chikuzen, 7 Jun. 1929, coll. Esaki & Hori (JTPC). RÉUNION, **Saint-Pierre**: 3 males, 7 females, Cilaos [1200 m.], 17 Nov. 1990, coll. E. Heiss (JTPC). MADAGASCAR, **Tananarive Prov.**: 2 males, 1 female, Tananarive, waterfall and seeps nr. Queen's Palace, 1310 m, 24 Oct. 1986, CL 2233, coll. J. T. & D. A. Polhemus (JTPC). SIERRA LEONE, **Kono Dist.**: 1 male, Sefadu [Kono], stream, 8 Jan. 1946, coll. G. A. Walton (JTPC). BURKINA FASO (=UPPER VOLTA), **Centre Region**: 1 male, 1 female, Onagadougou, Sep. 1936, coll. Skulina (JTPC). KENYA, **Rift Valley Prov.**: 1 female, Lake Baringa, 3 Feb. 1980, CL 1662,



Fig. 21. *Micracanthia ornatula*, dorsal habitus. Specimen from East Timor, Tasitolu wetland complex, west of Dili, CL 7310.



coll. J. T. Polhemus (JTPC). PAKISTAN, **Sindh Prov.**: 2 females, West Pakistan, Karachi, 5 mi. before Korangi Creek, no date, coll. A. Hamid (JTPC).

**Diagnosis.** — Male length 2.90–3.20, maximum width (across hemelytra) 1.30–1.50; female length 3.50–3.60, maximum width (across hemelytra) 1.40–1.60. Head, pronotum and scutellum black; hemelytra black, broadly marked with dark yellow patches on outer corium external to vein R + M, and with smaller dark yellow spots on inner corium and posterior end of clavus; wing membrane pale translucent fumate, veins contrastingly dark; antennae with segment I yellowish brown, segments II–IV darker brown; legs pale yellow basally, becoming pale brown distally.

**Distribution.** — Originally described from northern Africa (Nubia) by Reuter (1881), and widespread in the Eastern Hemisphere. Recorded by Schuh et al. (1987) from South Africa, Angola, Tanzania, Sudan, Egypt, Mongolia, India, Ceylon, Burma, and the Philippines, with further records provided by J. Polhemus & D. Polhemus (1999) from Oman, Saudi Arabia, China, Taiwan, Thailand, Laos, Vietnam, Borneo, Indonesia, Papua New Guinea, and Australia. We now provide the first records for Singapore and Peninsular Malaysia, East Timor, New Caledonia, Japan, Madagascar, Reunion, Sierra Leone, Upper Volta, Kenya, and Pakistan.

**Discussion.** — Recognised by its small size (less than 4 mm in both sexes) and predominantly dark colouration, with the head and thorax uniformly rugose, punctate and dull. The records given above for Singapore and Malaysia are the first for this species in those countries, but are not unexpected given the very wide range of this small, highly dispersive species. For a more detailed treatment of the complex synonymy of *Salda dixonii* under this species see Schuh et al. (1987: 339).

**Ecological notes.** — Dover (1929) noted of this species (as *Salda dixonii*): “Mr. Pendlebury took this species in some numbers at the edges of small pools in a mangrove swamp at Telok Kemang in Port Dickson, Negri Sembilan...”, thus documenting the ability of this adaptable species to utilize both freshwater and saline habitats.

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