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First record of the intertidal dwarf bug family Omaniidae from China, with description of a new species (Heteroptera: Leptopodomorpha)

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Abstract

A new intertidal dwarf bug, *Corallocoris xishaensis* Luo, Wang & Chen **sp. nov.**, from Xisha Islands of South China Sea is described, and is the first record of the family Omaniidae Cobben, 1970 from China. The new species can be distinguished from its allied Austro-Oriental species *C. marksae* (Woodward, 1958) by the colour of its body and legs, and the genitalic structures of both sexes. Photographs of the habitus, head, thorax, abdomen, appendages and genitalic structures are provided, additional scanning electron micrographs of the body surface are presented as well. A key to all the species of Omaniidae and distributional maps based on the known records for all species of this family are provided.

Key words: Hemiptera, Omaniidae, *Corallocoris xishaensis* **sp. nov.**, Xisha Islands, taxonomy

Introduction

Living secretly in the intertidal zone, the marine true bug family Omaniidae, or intertidal dwarf bugs, are minute organisms with a body size of 1.15–1.59 mm, and a similar appearance to some coleopteriform Schizopteridae (Cobben 1970, Schuh & Slater 1995, Schuh & Weirauch 2020). Until now, this family comprises only two genera and five species worldwide (Schuh & Slater 1995). *Omania coleoprata* Horváth, 1915, the first genus and species of this group, was described based on a single female specimen which was later shown to be a male by Cobben (1970). It was collected from Muscat, Oman, and placed in the family Saldidae. Subsequently, China (1938) described a new genus and species, *Dollfusella minutissima* China, 1938, based on a single male specimen [which also was shown to be a female by Cobben (1970)] from the Sinai Peninsula, Egypt; it was synonymized by Poisson and Poisson (1943) with *O. coleoprata*. The second species of this genus, *Omania marksae* Woodward, 1958, was described based on a series of specimens from Low Isles to Heron Island of the Great Barrier Reef. Further, Kellen (1960) described a new species, *O. samoensis* Kellen, 1960, from Samoa, studied the morphology of eggs and nymphs, and also described its habitat and biology. Miyamoto (1963) later described *O. satoi* Miyamoto, 1963 based on a single female collected from the Tokara Islands of Japan. A few years later, Herring and Chapman (1967) described *O. nauruensis* Herring & Chapman, 1967 from Nauru. Cobben (1987) later described the last new intertidal dwarf bug, *Corallocoris aldabrae* Cobben, 1987, from Aldabra Atoll in the western Indian Ocean.

The most significant study of Omaniidae was provided by Cobben (1970). He revised all the species described at that time and carried out an extensive morphological study. As a result, (1) he established a new genus, *Corallocoris* Cobben, 1970, into which he transferred *Omania marksae*, *O. satoi*, and *O. nauruensis* based on the following characteristics: collar of head demarcated from vertex by a broadly arcuate line, forewing with claval and R+M suture, male abdominal segment III with a deep laterotergal cleft, and ponticulus basalis of phallus without dorsal projection; (2) *Omania samoensis* was proposed as the junior synonym of *O. marksae*; (3) *Omania* was raised to

family rank to hold the genera *Omania* and *Corallocoris* based on the morphological evidence of eggs, and external and internal adult structures; and (4) he proposed an evolutionary diagram of Omaniidae and pointed out that Omaniidae represents a remote lineage of Leptopodomorpha (Cobben, 1970). Subsequently, Schuh and Polhemus (1980) proposed a higher classification of Leptopodomorpha by employing 47 morphological characters. In their study, the family rank of Omaniidae was supported, and the group was placed in the superfamily Leptopodoidea. This classification has been widely accepted (Schuh *et al.* 1987, Lindskog 1995, Schuh & Slater 1995, Polhemus & Polhemus 2012, Weirauch & Schuh 2020).

In this paper, the family Omaniidae is reported from China for the first time, and *Corallocoris xishaensis* **sp. nov.** is described as new to the known marine invertebrate fauna.

Material and methods

The present study is based on materials collected by the last author during expeditions to the Xisha Islands in the South China Sea, which were organized by Sun Yat-sen University in 2019, and collected by the first and second author from another expedition to the Xisha Islands in 2019. In addition, specimens in the insect collection of the Netherlands Centre of Biodiversity (NCB) Naturalis, Leiden were available for comparative study.

Specimens were preserved in 75% ethanol in the field. After being taken to the laboratory, the specimens were soaked for about three hours in warm distilled water, and then dry and mounted on cards. External structures were examined by using a Zeiss Discovery V20 stereomicroscope. Genitalic structures were examined by using a Zeiss Discovery V20 and a Zeiss Scope A1 microscope. Measurements (in mm) were taken using Zeiss ZEN 2.5 pro software.

Photographs of the habitus, head, thorax, abdomen, forewing and legs were taken by using a Canon EOS 7D Mark II camera equipped with an extension tube and a Mitutoyo M Plan Apo 10 × objective lens. Photographs of the male and female genitalic structures were taken using a Zeiss Scope A1 microscope combined with a Zeiss AxioCam camera and the Axio Vision SE64 program on a Windows PC. Optical images were then aligned and stacked by Helicon Focus 6.7.1. Scanning electron micrographs were prepared using a Hitachi S-3400N Scanning Electron Microscope. All photographs were edited using Adobe Photoshop CS5. The morphological terminology follows Miyamoto (1963), Cobben (1970), Schuh & Polhemus (1980) and Andersen (1982).

Abbreviations used in the figures are: a1–4 = antennal segments I to IV; aa = articulatory apparatus; ac = accessory canal; ba = basal aulla; ch = collar of head; cp = capitate process; cs = claval suture; ct1–4 = cephalic trichobothria 1 to 4; de = ductus ejaculatorius; en = endosoma; gy = gynatrium; la1–4 = labial segments I to IV; lip = ligamentous processes; lp = left paramere; lr = labrum; pa = parandria; mt1–8 = abdominal mediotergites I to VIII; ph = phallus; pht = phalotheca; pr = proctiger; pt1–3 = pronotal trichobothria 1 to 3; py = pygophore; rms = R+M suture; rp = right paramere; sa = setose area; sp = spermatheca; ss = sclerotized strip; st1–8 = abdominal sternites I to VIII; t1–3 = tarsal segment I to III

Abbreviations for depositories:

BMNH	The Natural History Museum, London, United Kingdom
ELKU	Entomological Laboratory, Kyushu University, Fukuoka, Japan
HNHM	Hungarian Natural History Museum, Budapest, Hungary
MNHN	Muséum National d'Histoire Naturelle, Paris, France
QM	Queensland Museum, Brisbane, Australia
RMNH	Naturalis Biodiversity Centre, Leiden, the Netherlands
SYSBM	Museum of Biology, Sun Yat-sen University, Guangzhou, China
USNM	United States National Museum of Natural History, Washington, D.C. USA

The first author has examined a male specimen of *C. marksae* from the former collection of Laboratory of Entomology, Wageningen University, The Netherlands, and now held in the collection of Naturalis (RMNH). Note that the former insect collection of Wageningen University was subsequently merged into the collection of Naturalis recently, hence the revised designation of the depository.

Taxonomy

Family Omaniidae Cobben, 1970

Omaniidae Cobben, 1970: 61. Type genus: *Omania* Horváth 1915.
(Figs. 1–9, Tables 1–3)

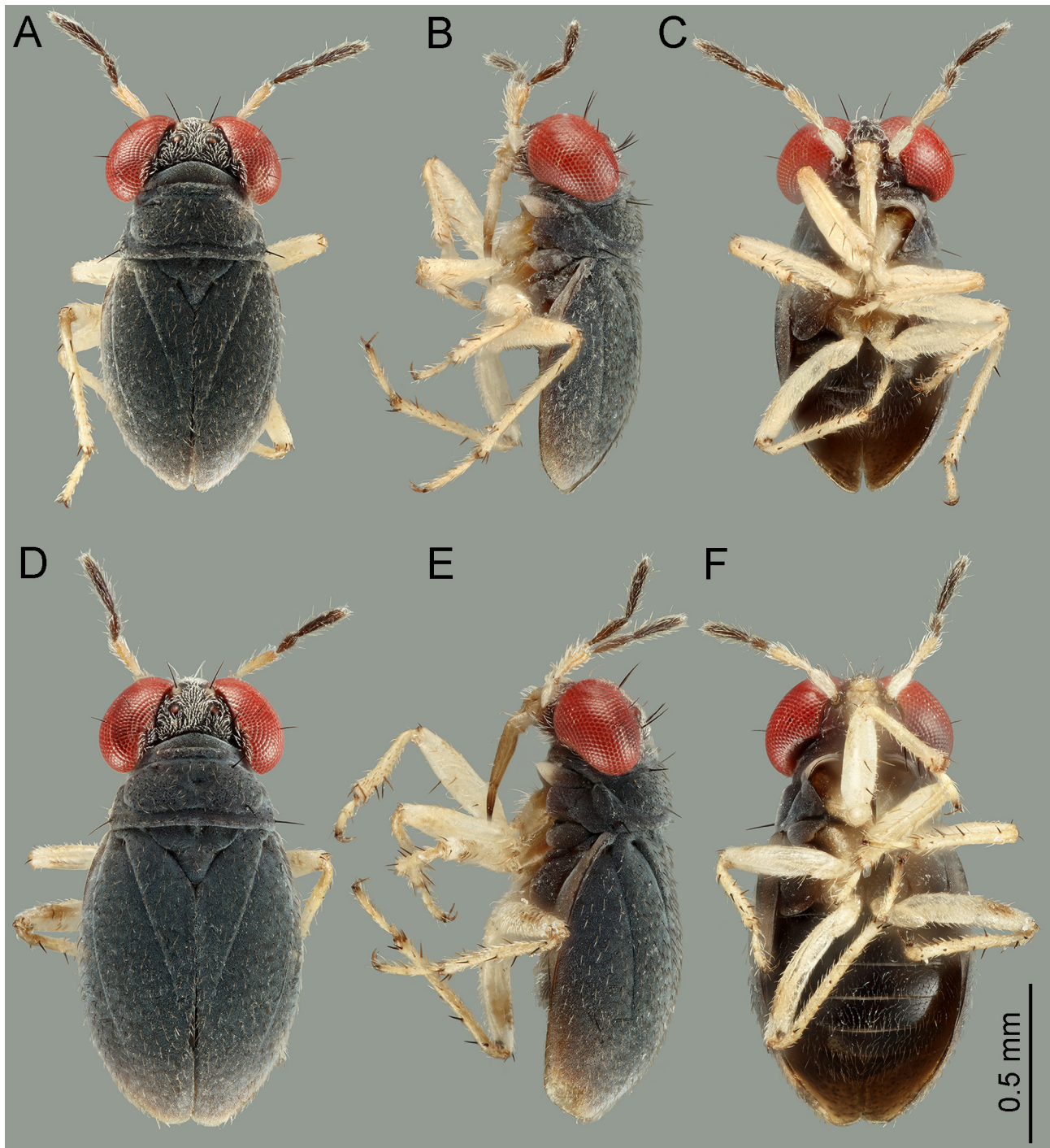


FIGURE 1. Habitus of *Corallocoris xishaensis* sp. nov.: A–C, male holotype; D–F, female paratype. A, dorsal view; B, lateral view; C, ventral view; D, dorsal view; E, lateral view; F, ventral view.

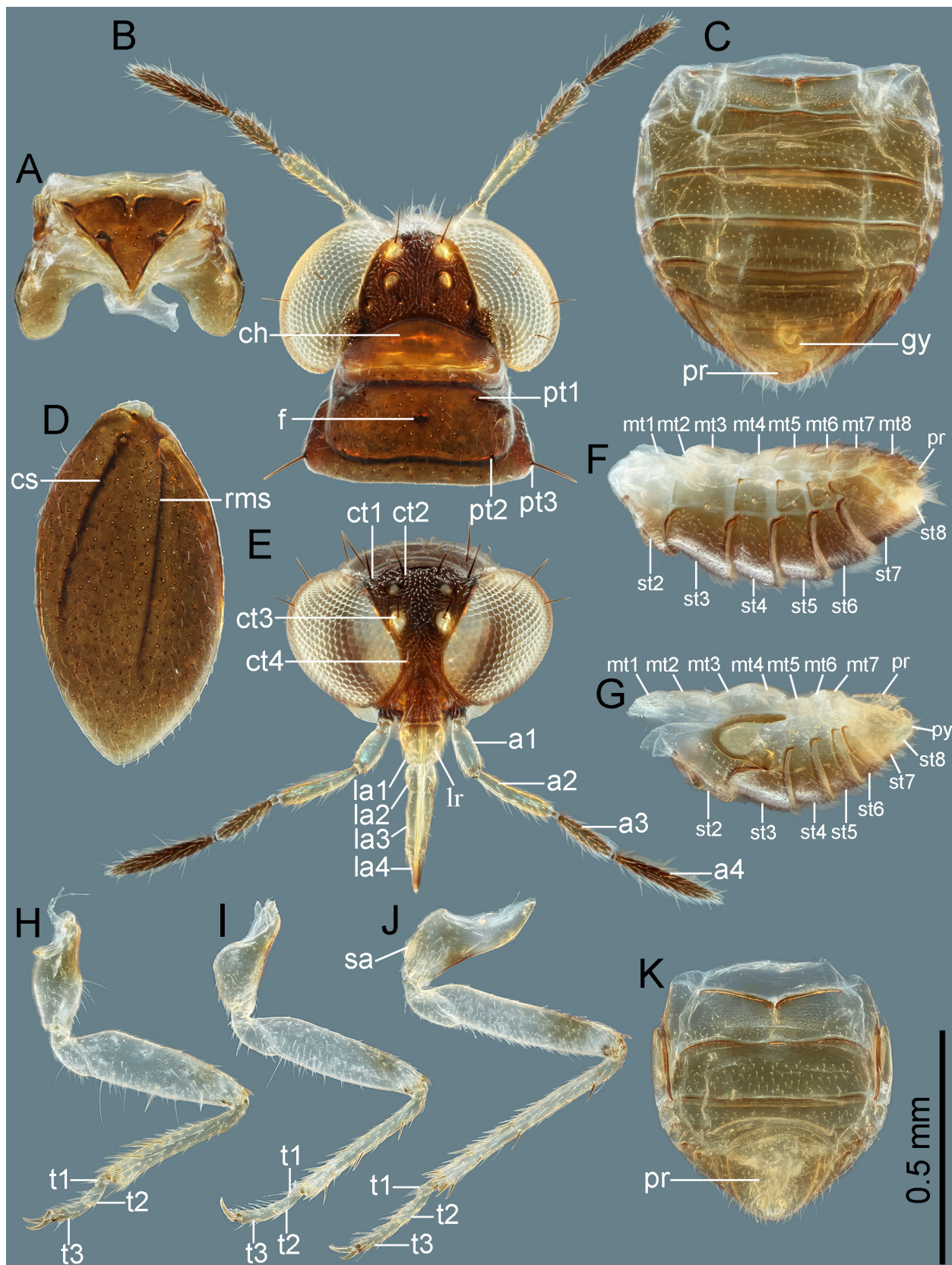


FIGURE 2. Morphological structures of *Corallocoris xishaensis* sp. nov.: A, G, K, male paratype; B–F, H–J, female paratype. A, meso- and metathorax in dorsal view; B, head and prothorax in dorsal view; C, abdomen in dorsal view; D, right forewing in dorsal view; E, head and prothorax in frontal view; F, abdomen in lateral view; G, abdomen in lateral view; H, foreleg; I, middle leg; J, hind leg; K, abdomen in dorsal view. See Materials and methods for structure abbreviations.

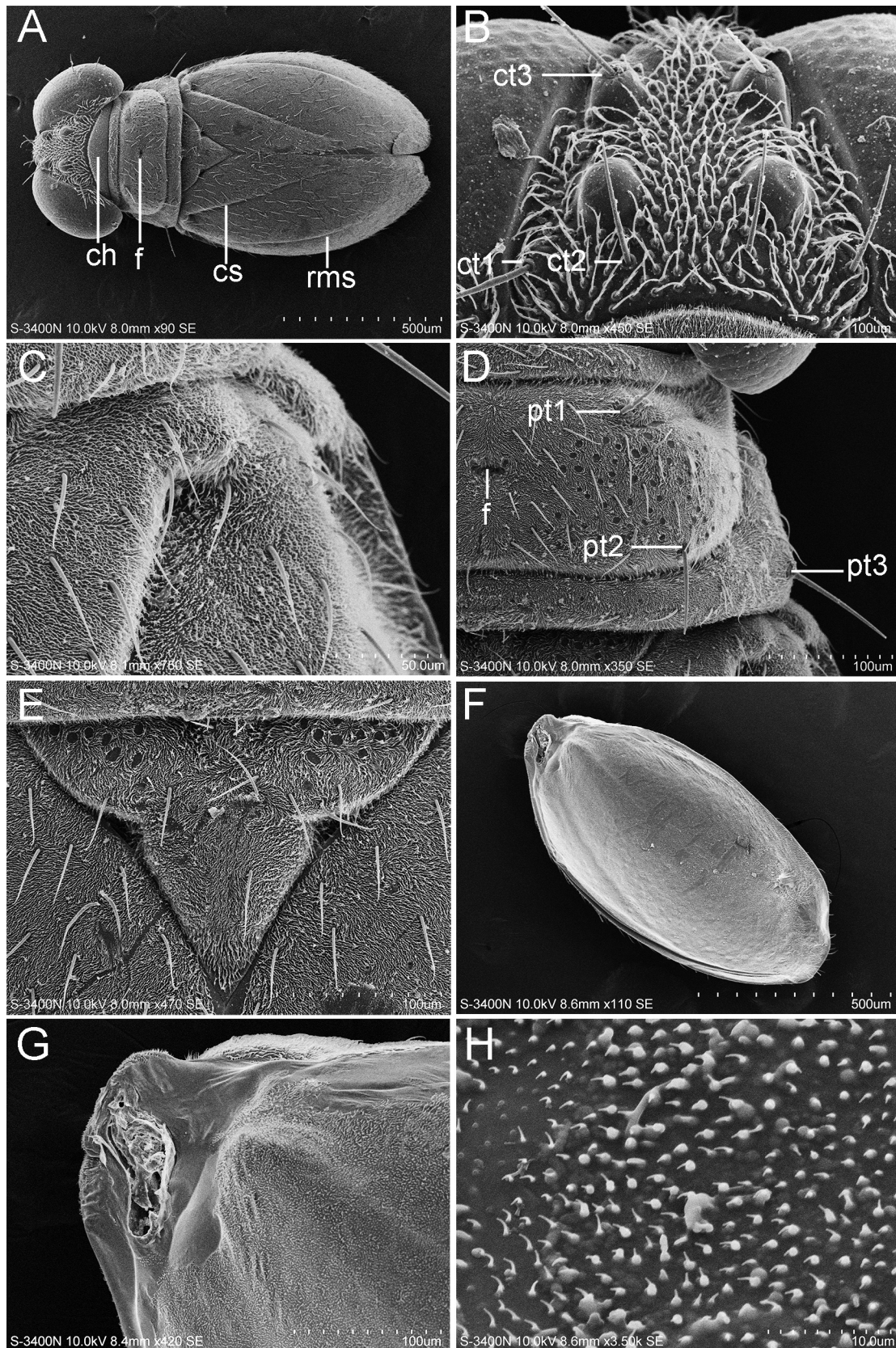


FIGURE 3. Scanning electron micrographs of morphological structures of *Corallocoris xishaensis* sp. nov., female non-type specimen: A, body; B, vertex of head in dorsal view; C, base of forewing in dorsal view; D, forewing in dorsal view; E, scutellum in dorsal view; F, lower surface of forewing; G, base of lower surface of forewing; H, microtrichia on lower surface of forewing. See Materials and methods for structure abbreviations.

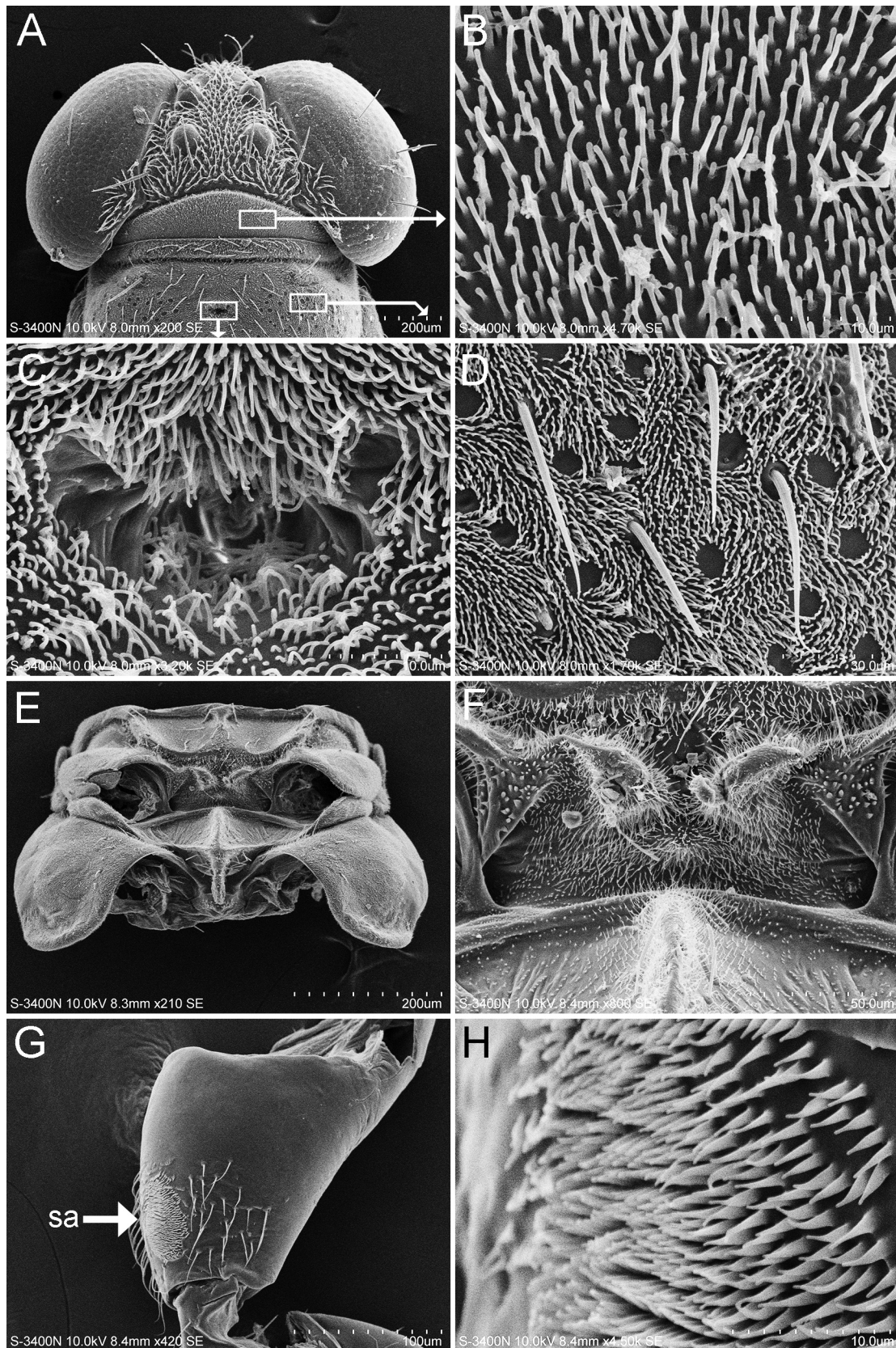


FIGURE 4. Scanning electron micrographs of morphological structures of *Corallocoris xishaensis* sp. nov., female non-type specimen: A, head and part of pronotum in dorsal view; B, microtrichia on collar of head; C, fovea of pronotum; D, microtrichia and setae on pronotum; E, meso- and metathorax in ventral view; F, structure on mesosternum; G, hind coxa (sa = setose area); H, setose area.

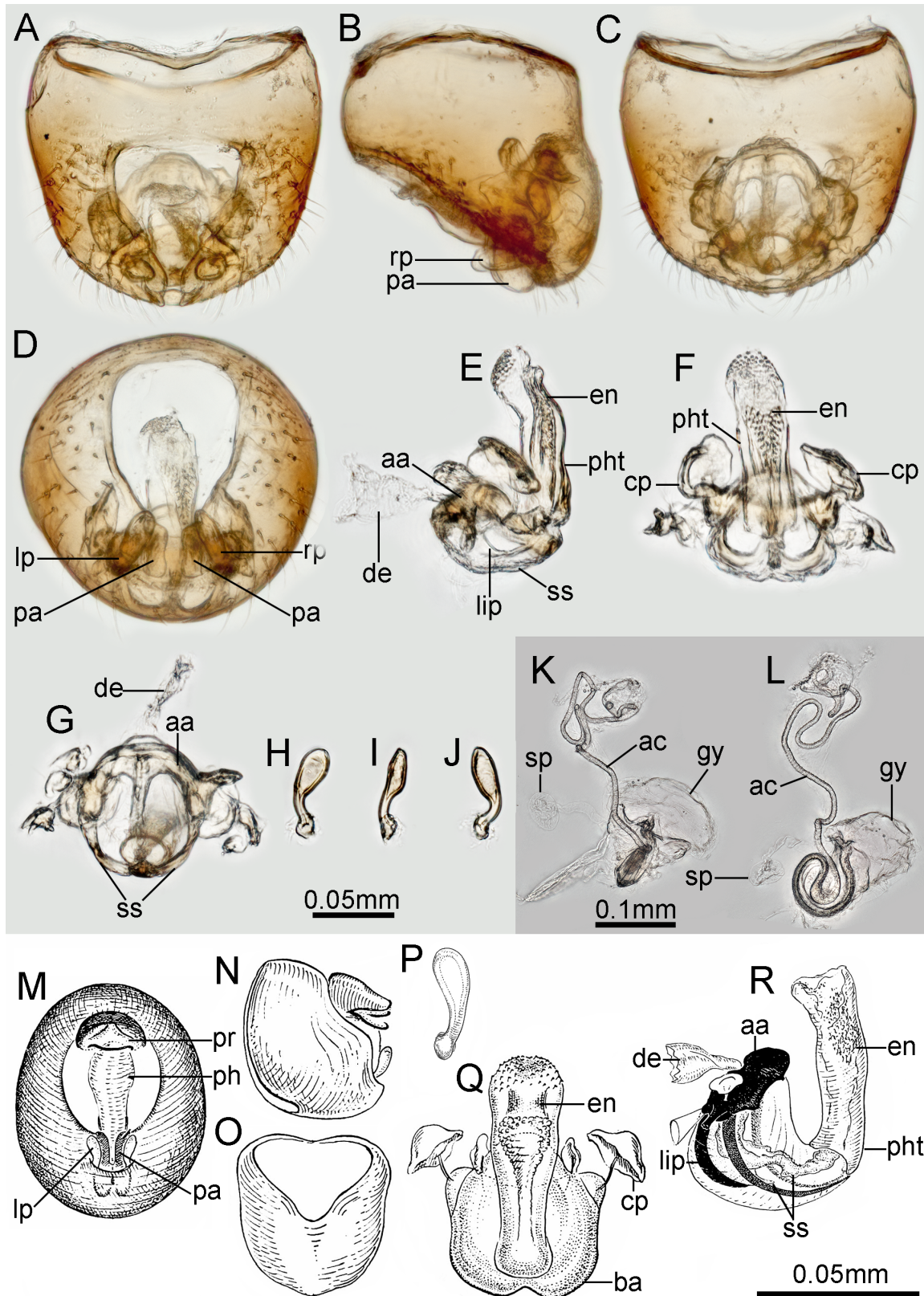


FIGURE 5. Genitalia structures of *Corallocoris xishaensis* sp. nov. and *C. marksae*: A–J, male paratype of *C. xishaensis*; K–L, female paratype of *C. xishaensis*. A, segment IX in dorsal view; B, segment IX in lateral view; C, segment IX in ventral view; D, segment IX in caudal view; E, phallus in lateral view; F, phallus in caudal view; G, phallus in ventral view; H–J, three different aspects of left paramere; K–L, two different aspects of female genital tract; M–R, *C. marksae* (modified from Cobben [1970]: fig. 11A, B, C, D, G, I); M–O, pygophore in posterior view, ventral view and lateral view; P, paramere; Q–R, phallus in caudal view and lateral view. (last scale bar only for R). See Materials and methods for structure abbreviations.

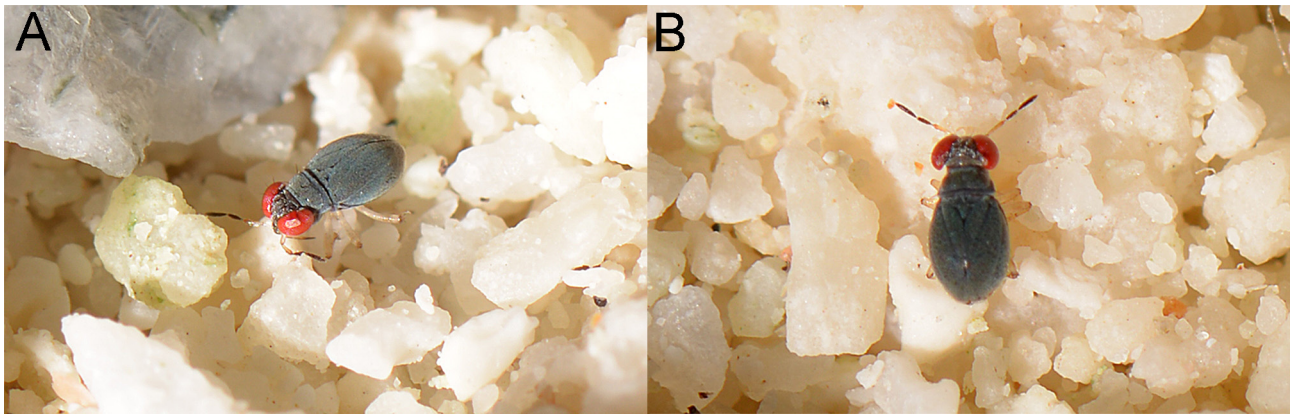


FIGURE 6. Habitat of *Corallocoris xishaensis* sp. nov.

Key to the species of Omaniidae Cobben, 1970

Modified from Cobben (1970).

1. Body longer than 2.0 mm; forewings with well-developed membrane or flap-like leaving most of abdominal dorsum exposed; eye without trichobothria in adults. Families **Aepophilidae**, **Leptopodidae** and **Saldidae**
- Body shorter than 2.0 mm; forewings elytra-like without membrane (Figs. 1, 2D); eye with 3 trichobothria in adults (Fig. 2B, E) **Omaniidae** Cobben 2
2. Collar of head sharply projecting medially into the vertex region (Fig. 8A, also see Horváth 1915: fig. 1; Cobben 1970: figs. 1A, 6A); ocelli not circular (see Cobben 1970: fig. 6A); forewing without sutures (Fig. 8A–B, also see Cobben 1970: fig. 1A). Femora entirely stramineous (Egypt; Saudi Arabia; Oman; Pakistan). **Omania** Horváth: **O. coleoptrata** Horváth
- Collar of head with broadly arcuate anterior margin (Figs. 2B, 4A); ocelli circular (Figs. 2B, 3B, 6E); forewing with two longitudinal sutures (Figs. 2D, 6A–B). Femora with dark area and light apex **Corallocoris** Cobben 3
3. Cephalic trichobothria pair 2 in front of pair 1 (see Miyamoto 1963: Plate fig. 1A); cephalic trichobothria pair 3 not arising from light spots (see Miyamoto 1963: Plate fig. 1A) (Japan). **C. satoi** (Miyamoto)
- Cephalic trichobothria pairs 1 and 2 in a straight line (Figs. 2B, E, 3B, 6D); cephalic trichobothria pair 3 arising from light elevated spots (Figs. 2B, E, 3B, 6D–E) 4
4. Pronotum and scutellum with light areas (Fig. 8C); median fovea of pronotal dome dividing the dome posteriorly (Fig. 8C) (Nauru) **C. nauruensis** (Herring & Chapman)
- Pronotum and scutellum concolorous (Figs. 1A, D, 6A); median fovea of pronotal dome present as a simple pit (Figs. 1A, D, 3A, D). 5
5. Elevated spots on frons distinctly larger than ocelli, contact with eyes; base of hypocostal lamina clearly notched along ventral side (Seychelles). **C. aldabrae** Cobben
- Elevated spots on frons not distinctly larger than ocelli, and not contact with eyes (Figs. 2B, E; 7D, E); base of hypocostal lamina clearly without notched along ventral side. 6
6. Forewing with distinct grey transverse fascia and grey apical margin (Figs. 7A–B, F); entire trochanters and femora except for apices dark-brown (Fig. 7B–C) (Australia; Philippines; Samoa; Singapore) **C. marksae** (Woodward)
- Forewing nearly concolorous, with apical margin paler (Fig. 1A–B, D–E); entire trochanters and femora except for subapices whitish-yellow (Fig. 1B–C, E–F) (China: Xisha Islands) **C. xishaensis** sp. nov.

Genus *Omania* Horváth, 1915

Omania Horváth, 1915: 598. Type species: *Omania coleoptrata* Horváth, 1915 by monotypy. Drake & Hoberlandt (1951): 5 (catalogue, distribution); Kellen (1960): 494 (distribution); Stichel (1960): 125 (catalogue); Drake (1961): 302 (distribution, ecology, habitat); Herring & Chapman (1967): 354 (distribution, in key); Cobben (1970): 64, 66 (distribution, morphology), 69 (in key); Polhemus (1976): 239 (distribution, diagnosis); Schuh & Polhemus (1980): 19 (distribution, habitat, phylogenetic relationships); Schuh *et al.* (1987): 261 (catalogue, distribution); Lindsog (1995): 140 (catalogue, distribution).

Dollfusella China 1938: 255. Type species: *Dollfusella minutissima* China 1938 by original designation; (synonymized by Poisson & Poisson 1943: 123 (synonymy)).

TABLE 1. Measurements (mm) of *Corallocoris xishaensis* sp. nov.

Body part	Male holotype	Male (n=5)	Female (n=5)
length of body	1.20	1.13–1.22	1.24–1.38
greatest width of body	0.59	0.54–0.59	0.63–0.70
median length of head	0.22	0.20–0.21	0.21–0.23
greatest width of head across eyes	0.58	0.55–0.57	0.58–0.61
minimum interocular distance	0.08	0.07–0.08	0.08–0.10
vertex width across ocelli	0.22	0.21–0.22	0.22–0.23
length of antennal segment I	0.13	0.11–0.13	0.11–0.13
length of antennal segment II	0.16	0.16–0.17	0.16–0.18
length of antennal segment III	0.13	0.12–0.13	0.13–0.14
length of antennal segment IV	0.21	0.20–0.21	0.21–0.22
total length of labium	0.48	0.43–0.47	0.47–0.52
length of labial segment I	0.07	0.06–0.08	0.07–0.08
length of labial segment II	0.06	0.05–0.06	0.06–0.07
length of labial segment III	0.21	0.18–0.21	0.18–0.22
length of labial segment IV	0.14	0.13–0.15	0.15–0.17
median length of pronotum	0.24	0.21–0.22	0.22–0.24
humeral width	0.47	0.43–0.46	0.47–0.50
length of scutellum	0.18	0.16–0.17	0.16–0.20
width of scutellum	0.25	0.24–0.25	0.25–0.28
length of forefemur	0.38	0.36–0.38	0.37–0.41
length of foretibia	0.33	0.31–0.33	0.33–0.36
length of foretarsus	0.14	0.14–0.15	0.14–0.16
length of mid femur	0.43	0.36–0.39	0.39–0.42
length of mid tibia	0.35	0.32–0.34	0.35–0.37
length of mid tarsus	0.15	0.15–0.16	0.15–0.17
length of hind femur	0.44	0.40–0.45	0.44–0.48
length of hind tibia	0.51	0.49–0.51	0.53–0.58
length of hind tarsus	0.21	0.19–0.22	0.21–0.23
length of forewing	0.77	0.73–0.76	0.82–0.92
greatest width of abdomen	0.47	0.47–0.50	0.55–0.63

***Omania coleoptrata* Horváth, 1915**

(Figs. 8A–B, 9A, Table 3)

Omania coleoptrata Horváth, 1915: 598. Holotype: ♂, Oman, Muscat; HNHM. Poisson and Poisson (1943): 123. (distribution, synonymy); Drake & Hoberlandt (1951): 5 (catalogue, distribution); Filippi (1957): 41 (distribution); Kellen (1960): 494 (distribution, habitat); Stichel (1960): 125 (catalogue, distribution); Schuster (1965): 125 (distribution); Cobben (1970): 63, 67, 70, 72, 76, 79, 85 (figures), 64 (diagnosis, distribution, morphology), 69 (in key), 71 (habitat); Cobben (1987): 25 (distribution); Schuh & Polhemus (1980): 6 (figures); Schuh *et al.* (1987): 261 (catalogue, distribution); Lindskog (1995): 141 (catalogue, distribution).

Dollfusella minutissima China, 1938: 257. Holotype: ♂, Saudi Arabia, Sanafir Island; MNHN (synonymized by Poisson & Poisson 1943: 123).

Material examined: EGYPT: 50 km N. of M. Alam, leg. Linnavuori, 1 ex.; Rotes Meer, Gubal strait, winter 1961/1962, 1 ♀; “*Omania coleoptrata*” 1 ex. [no further information]; (all in RMNH).

Diagnosis: Body length of male (1.28–1.38), female (1.44–1.48). This taxon can be distinguished from the

species of *Corallocoris* by the following characteristics: the body surface is uniformly black (Fig. 8A–B); a collum-like area of the head is demarcated from the vertex by a line that makes a sharp triangular incision anteromedially; the forewing lacks claval and R+M sutures (Fig. 8A–B); the grasping structure of the male is simple; the ponticulus basalis of the phallus has a dorsal bridge-like projection (see Cobben 1970).

Habitat. *Omania coleoptrata* was found in rock crevices below the high tide level of the intertidal zone (China 1938), and in one instance was found living with a species of Ptiliidae (Coleoptera) and *Halophiloscia* sp. (Crustacea: Isopoda) in the same rock pieces (Schuster 1965).

Distribution: Egypt (African Egypt, Sinai Peninsula); Oman (Muscat); Pakistan (the coast of Pakistan); and Saudi Arabia (Sanafir Island) (Fig. 9A, Table 3).

TABLE 2. Diagnostic characteristics of *Corallocoris marksae* (Woodward, 1958), *C. xishaensis* **sp. nov.**, and *C. satoi* (Miyamoto, 1963).

	<i>C. marksae</i>	<i>C. xishaensis</i> sp. nov.	<i>C. satoi</i>
1	body nearly black, forewing with distinct transverse grey fascia and grey apical margin	body greyish-black, forewing without distinct grey fascia	
2	cephalic trichobothria pairs 1 and 2 of head in a straight line		cephalic trichobothria pair 2 in front of pair 1
3	cephalic trichobothria pair 3 arising from light elevated spots		cephalic trichobothria pair 3 not arising from light spots
4	antennal segment IV 1.2–1.7× length of III		antennal segment IV 2× length of III
5	coxae, entire trochanters, and femora except apices dark-brown	coxae yellowish-brown, whole trochanters, and femora except subapices whitish-yellow	coxae except for bases, whole trochanters, and femora except for apices dark-brown
6	proepisternum nearly black	proepisternum whitish-yellow	proepisternum greyish-black
7	pygophore high from caudal view	pygophore round from caudal view	unknown
8	posterior sternite of pygophore round expand	posterior sternite of pygophore expand and protrudent	unknown
9	paramere slightly curved near middle	paramere curved near middle	unknown
10	base of ligamentous processes of phallus not wide	base of ligamentous processes of phallus distinctly wide	unknown

Genus *Corallocoris* Cobben, 1970

Corallocoris Cobben, 1970: 62. Type species: *Omania marksae* Woodward, 1958 by original designation. Polhemus (1976): 240 (distribution, note); Schuh & Polhemus (1980): 19 (distribution, habitat, phylogenetic relationships); Schuh *et al.* (1987): 260 (catalogue, distribution); Lindskog (1995): 140 (catalogue, distribution).

Corallocoris aldabrae Cobben, 1987

Corallocoris aldabrae Cobben, 1987: 24. Holotype: ♀, Seychelles, Aldabra Atoll, Middle Island [= Passe Houareau, Malabar Island]; BMNH. Polhemus (1990): 7 (habitat), 9 (in key), 14 (distribution).

Diagnosis: Body length of female (1.50). This species is closely related to *C. marksae*, but can be distinguished from the latter by the following characteristics: two elevated spots on the frons are distinctly larger than the ocelli and are somewhat elongate and contact the eyes; the femora predistally are weakly fuscous; the base of hypocostal lamina is clearly notched ventrally (Cobben, 1987).

Distribution: Seychelles (Aldabra Atoll) (Fig. 9A, Table 3).

TABLE 3. Known distribution records of Omaniidae.

Species	Locality	References
<i>Omania coleoptrata</i> Horváth, 1915	Oman: Muscat	Horváth (1915)
	Saudi Arabia: Sanafir Island	China (1938)
	Egypt: Mersa Alam	Linnavuori (1964)
	Egypt: Gubal Strait	present paper
	Egypt: Al-Ghardaqa	Schuster (1965)
	Pakistan: 'the coast of Pakistan'	Polhemus (1976)
<i>Corallocoris aldabrae</i> Cobben, 1987	Seychelles: Aldabra Atoll, Malabar	Cobben (1987); Polhemus (1990)
<i>Corallocoris marksae</i> (Woodward, 1958)	Australia: Queensland, Low Isles	Woodward (1958)
	Australia: Queensland, Heron Island	Woodward (1958)
	New Caledonia: Îlot Croissant	present paper
	Samoa: Tutuila Island	Kellen (1960)
	Malaysia: Malaya	Cobben (1970); Polhemus and Polhemus (2012)
	Singapore: Pulau Blakang Mati (Sentosa Island)	Cobben (1970); Polhemus and Polhemus (2012)
	Philippines: Luzon Philippines: Badian	Polhemus and Polhemus (2012) Bendanillo <i>et al.</i> (2016)
<i>Corallocoris nauruensis</i> (Herring & Chapman, 1967)	Micronesia: Nauru	Herring and Chapman (1967)
<i>Corallocoris satoi</i> (Miyamoto, 1963)	Japan: Ryukyu Islands, Takarajima	Miyamoto (1963)
	Japan: Ryukyu Islands, Yakushima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Amami Oshima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Tokunoshima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Okinoerabu-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Royon-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Okinawa shima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Iheya-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, aguni-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Minamidaitou-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Kitadaitou-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Miyako-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Kurima-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Irabu-jima	Hayashi <i>et al.</i> (2016)
	Japan: Ryukyu Islands, Ishigaki-jima	Hayashi <i>et al.</i> (2016)
Japan: Ryukyu Islands, Iriomote-jima	Hayashi <i>et al.</i> (2016)	
Japan: Ryukyu Islands, Yonaguni-jima	Hayashi <i>et al.</i> (2016)	
<i>Corallocoris xishaensis</i> sp. nov.	China: Xisha Islands, Lingyang Jiao	present paper
	China: Xisha Islands, Yongxing Dao	present paper

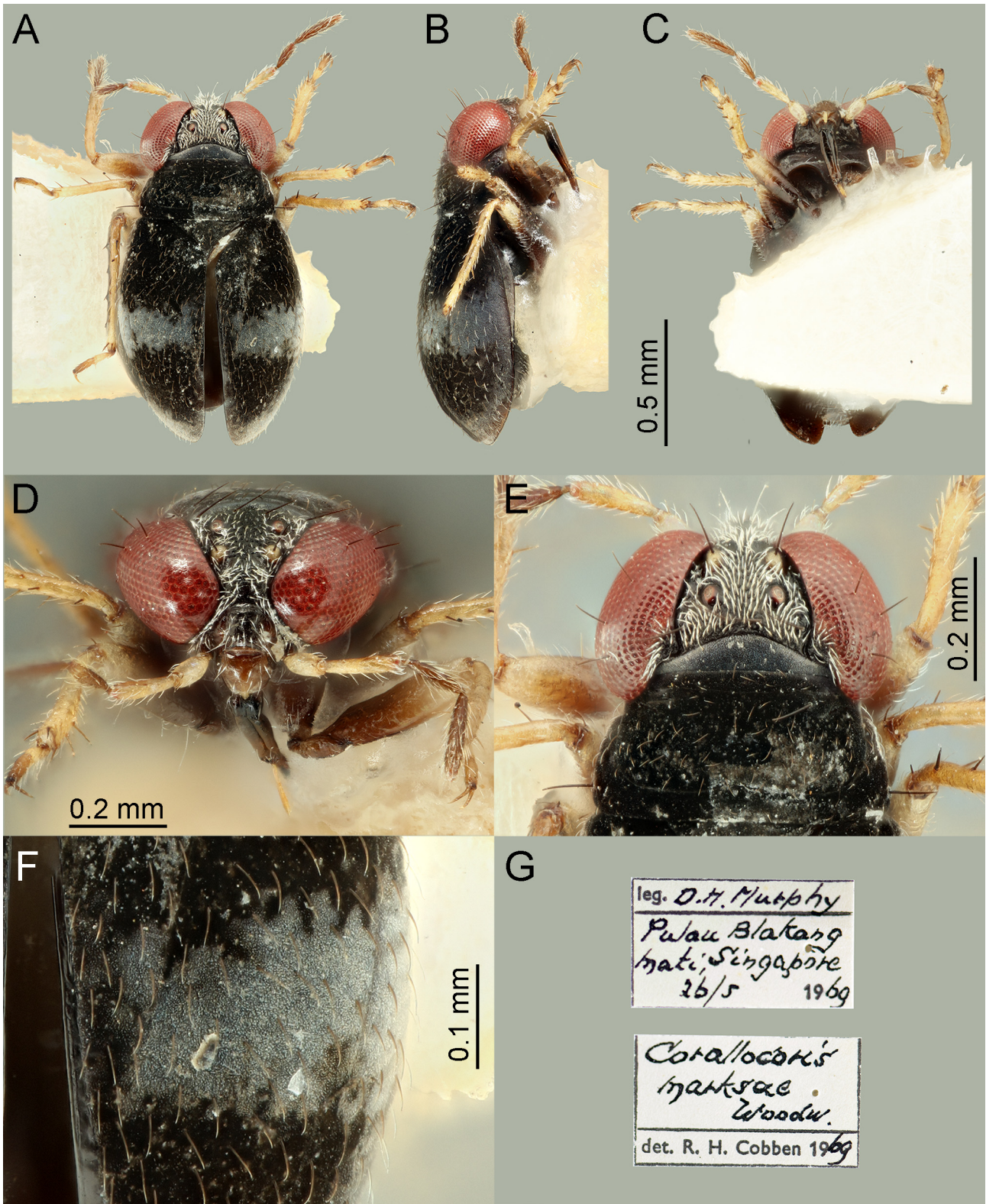


FIGURE 7. *Corallocoris marksae*, non-type specimen, female: A–C, habitus; A, dorsal view; B, lateral view; C, ventral view; D, head in frontal view; E, head and pronotum in dorsal view; F, light fascia on right forewing; G, labels.

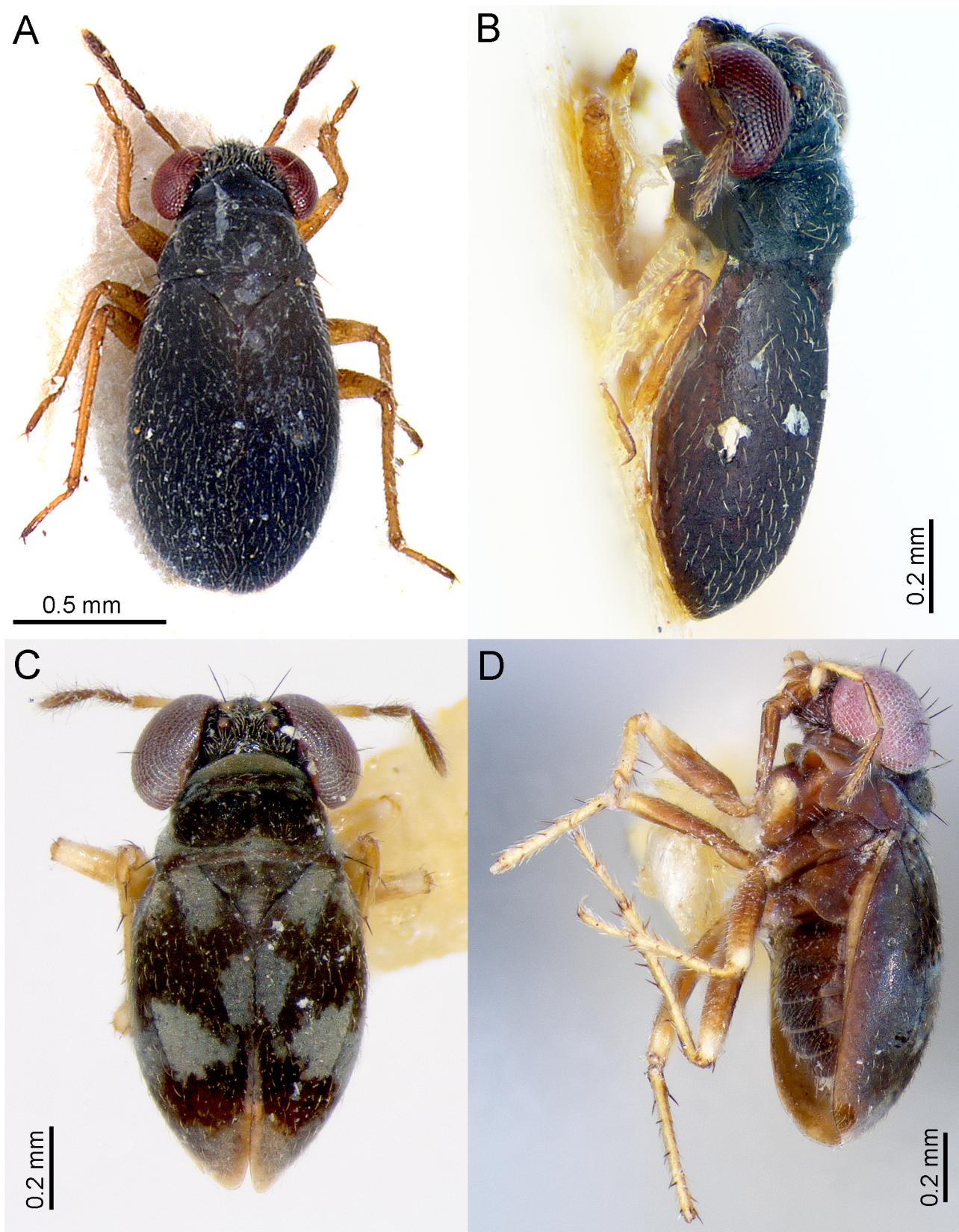


FIGURE 8. A–B, Habitus of *Omania coleoprata*, paratypes, female: A, dorsal view; B, lateral view C–D, habitus of *Corallocoris nauruensis*, paratypes, male: C, dorsal view; D, lateral view.

***Corallocoris marksae* (Woodward, 1958)**

(Figs. 5M–R, 7, 9)

Omania marksae Woodward, 1958: 104. Holotype: ♂, Australia, Heron Island; QM. Kellen (1960): 494, 495 (biology, distribution, habitat); Drake (1961): 302 (figures); Schuster (1965): 340 (distribution); Cobben (1968): 42, 43 (egg morphology), 43 (figure); Cobben (1970): 66, 68 (diagnosis, distribution, synonymy, morphology), 63, 67, 70, 72, 76, 79, 82 (figures); 69 (in key); 71, 73 (biology, habitat); Polhemus (1976): 244 (figures); Schuh *et al.* (1987): 260 (catalogue, distribution); Cobben (1987): 25 (distribution); Polhemus & Polhemus (2012): 333 (color figure, distribution).

Omania samoensis Kellen, 1960: 495. Holotype: ♂, Samoa, Tutuila Island; USNM. (synonymized by Cobben 1970: 66). Schuster (1965): 340 (distribution).

Material examined: AUSTRALIA: Queensland: Qld. Great Barrier Reef, Heron Island, 10-14. XI. 1957, leg. T.E. Woodward, paratypes 2 ♀♀ [labelled as *Omania marksae*]; Heron Island, 16-20. XII. 1967, leg. S.R. Curtis, 4 exx.; N. Qld. Great Barrier Reef, Lowe Isles, 19. VIII. 1954, leg. H. Marks, 1 ♂; “Australia Woodward” met melkz. beh. [= treated with lactic acid; no identification label]. NEW CALEDONIA: Îlot Croissant, dans empilement de madréporites mort [in a pile of dead *Madrepora* coral], 19. XI. 1980, leg. L. Bigot, 1 ♂ 1 ♀, [îlot = a small island, which actually is a small coral reef]. SAMOA: Tutuila, 10. IV. 1958, leg. W.R. Kellen, 3 exx.; “*Omania Samoa*”, 1 ex. SINGAPORE: Pulau Blakang, Mati, 26. V. 1969, leg. H.D. Murphy 34 exx.; Labrador on rock seashore, Feb. 1961, leg. Murphy, 2 exx. [Labrador is a shorthand for Labrador Park, a nature reserve in SW Singapore]; (all in RMNH).

Diagnosis: Body length of male (1.15–1.44), female (1.48–1.59). It can be distinguished from other species of *Corallocoris* by the following characteristics: the body is nearly black, the forewing has a distinct grey transverse fascia and grey apical margin (Fig. 7A–B, F).

Habitat and biology. *Corallocoris marksae* was collected by searching volcanic rocks lying in the intertidal zone of a shallow, protected lagoon, which exposed 25 feet of beach at low tide and was covered by up to 2 feet of water at high tide (Kellen 1960). The motor behaviors of this species in the field were recorded by Kellen (1960) and he reared entire generations in the laboratory. Woodward (1958) recorded finding *C. marksae* mainly on the moist undersurface of the slabs of porous coral rock and on the sand and rock beneath when these rocks were exposed, together with Collembola, mites (*Microtrombidium* sp. and *Eupodes* sp.) and small beetles.

Distribution: Australia (Great Barrier Reef); Malaysia (Malaya); New Caledonia (Îlot Croissant); Philippines (Badian, Luzon); Samoa (Tutuila Island); and Singapore (Sentosa Island) (Fig. 9A, Table 3).

***Corallocoris nauruensis* (Herring & Chapman, 1967)**

(Figs. 8C–D, 9)

Omania nauruensis Herring & Chapman 1967: 355. Holotype: ♂, Nauru Island; USNM. Cobben (1970): 68 (diagnosis), 69 (in key); Schuh (1987): 261 (catalogue, distribution); Cobben (1987): 25 (distribution); Schuh *et al.* (1987): 260 (catalogue, distribution); Schuh & Polhemus (1980): 5, 6, 7 (figures).

Material examined: NAURU: Central Pacific, Nauru Island, 16. XI. 1966, leg. H.C. Chapman, paratypes 2 ♂♂ 2 ♀♀ (RMNH).

Diagnosis: Body length of male (1.21), female (1.30–1.40). *C. nauruensis* can be distinguished from other species of *Corallocoris* by the following characteristics: the pronotum and scutellum have a light pattern (Fig. 8A); the median fovea of the pronotal dome continues as a sulcus, which almost completely divides the dome into two lobes (Fig. 8A); a large basal and preapical blue-grey band is on the clavus, an irregular blue-grey patch on the base of corium extends narrowly down the lateral margin of the forewing, widening at the middle third and extending inward almost to the commissure, and a grey band is at the apical margin (Fig. 8A–B).

Habitat. *Corallocoris nauruensis* was collected at low tide from pinnacles that were common in the reef, which completely surrounds Nauru Island (Herring & Chapman 1967).

Distribution: Nauru Island (Fig. 9A, Table 3).

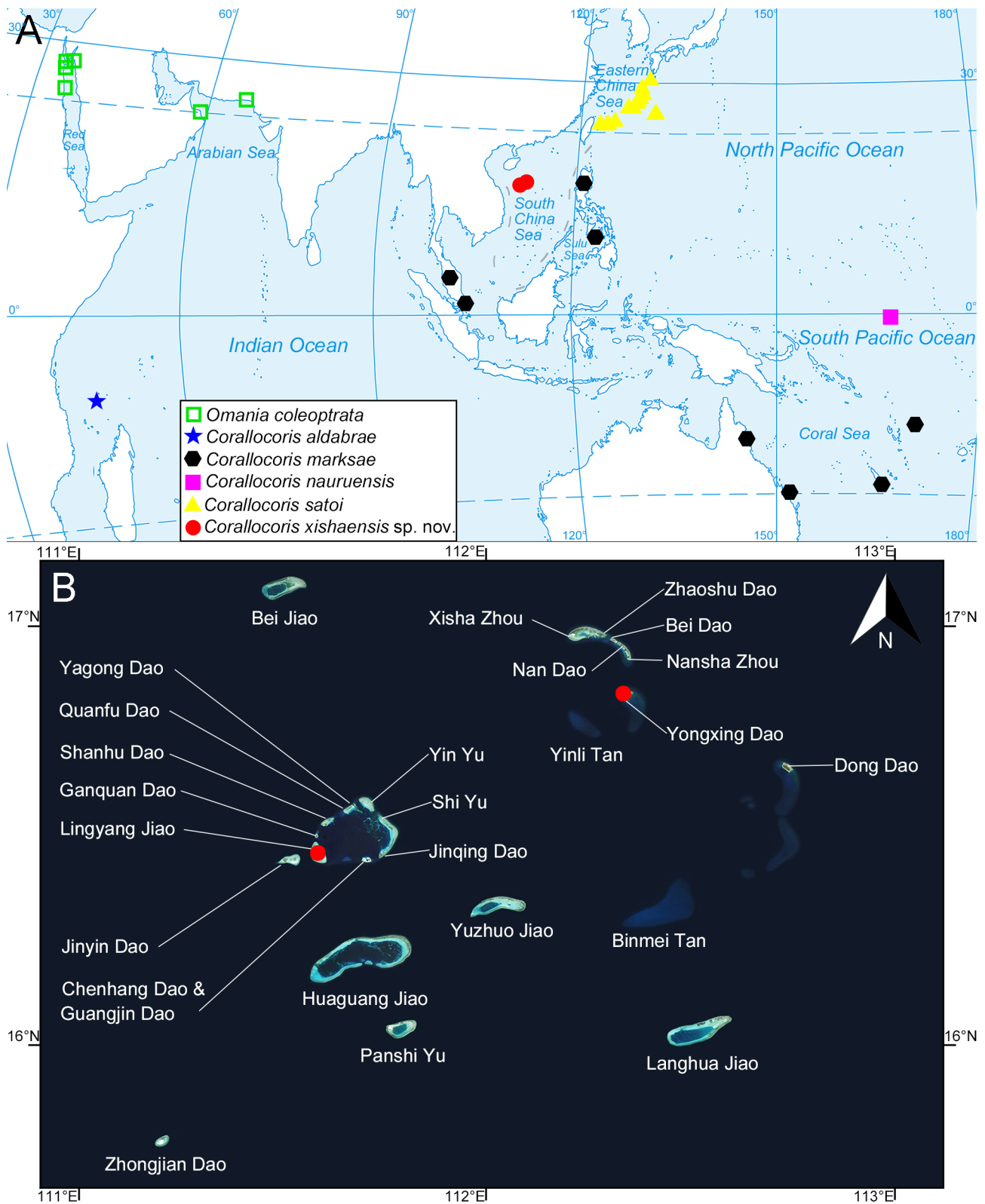


FIGURE 9. Distribution maps of species of Omaniidae: A, Distribution of all known species of Omaniidae. B, Detailed distribution records of *Corallocoris xishaensis* sp. nov. (solid red dots)

Corallocoris satoi (Miyamoto, 1963)

(Fig. 9)

Omania satoi Miyamoto, 1963: 39. Holotype: ♀, Japan, Takarajima; ELKU. Cobben (1970): 68 (diagnosis), 69 (in key); Schuh *et al.* (1987): 261 (catalogue, distribution); Cobben (1987): 25 (distribution); Lindskog (1995): 140 (catalogue, distribution); Hayashi *et al.* (2016): 376 (catalogue, distribution).

Diagnosis: Body length of female (1.45). It can be distinguished from other species of *Corallocoris* by the following characteristics: cephalic trichobothria pair 2 is in front of pair 1; cephalic trichobothria pair 3 does not arise from light spots; the fourth antennal segment is twice as long as the third segment.

Distribution: Japan (Ryukyu Islands) (Fig. 9A, Table 3).

Corallocoris xishaensis Luo, Wang & Chen, sp. nov.

<http://zoobank.org/FFEBDBCB-050D-4742-85B3-2409D5F2E9BF>

(Figs. 1–5, 6, 9)

Type material. Holotype (♂) CHINA: Hainan Province, Sansha Prefecture, Xisha, Lingyang Jiao Reef: 16°28'03"N, 111°35'58"E, 0 m.a.s.l., 2019-XI-12, leg. Jiu-Yang LUO, mounted on card (SYSBM). Paratypes: same data as holotype, mounted on cards (5♂♂, 3♀♀, SYSBM); same data as holotype, mounted on cards (1♂, 1♀, RMNH); CHINA: Hainan Province, Sansha Prefecture, Xisha, Lingyang Jiao Reef: 16°28'03"N, 111°35'58"E, 0 m.a.s.l., 2019-XI-12, leg. Yan-Hui WANG, mounted on card (4♂♂, 8♀♀, SYSBM); CHINA: Hainan Province, Sansha Prefecture, Xisha, Yongxing Dao: 2019-IV-18, leg. Qiang XIE, mounted on cards (1♂, SYSBM).

Diagnosis: *Corallocoris xishaensis* sp. nov. is similar to *C. marksae* in size and habitus, but it can be distinguished from the latter species by following characteristics: (1) body greyish-black, without distinct grey fascia on the the middle of forewing (Fig. 1A–B, D–E), (body nearly black, with a transverse grey fascia near the middle of forewing in latter species [Fig. 7A–B, F]); (2) cephalic trichobothria pairs 1 and 2 subequal in length with pair 3 (Fig. 1B, E), (distinctly shorter than pairs 3 in latter species [Fig. 7B]); (3) the coxae are yellowish-brown, entire trochanters and femora, except for subapices, are whitish-yellow (Fig. 1B–C, E–F), (coxae, entire trochanters and femora, except for apices, are dark-brown in latter species [Fig. 7B–C]); (4) the proepisternum is whitish-yellow (Fig. 1B–C, E–F), (the proepisternum is nearly black in latter species [Fig. 7B–C]); (5) the pygophore is round in caudal view (Fig. 5D), (pygophore is high in caudal view in latter species [Fig. 5M]); (6) the paramere is curved near the middle (Fig. 5H–J), (the paramere is slightly curved near the middle in latter species [Fig. 5P]).

Description: **Size:** Male, length 1.13–1.22 mm, greatest width 0.54–0.59 mm; female, length 1.24–1.38 mm, greatest width 0.63–0.70 mm. **Color and body surface:** Body and collum-like area of head greyish-black and dull (Fig. 1A–E); most of head and abdomen black; eyes red, ocelli dark red; elevated spots on head whitish-yellow; antennal segment I whitish-yellow, segment II slightly darker than segment I, and darkening from base to apex, segment III and IV blackish-brown, segment III slightly lighter than segment IV; labrum and labium light-brown to brown, apex of labial segment IV blackish-brown; pronotum, scutellum and upper surface of forewing with moderately dense, semierect brown setae (Fig. 1A, D); apical portion and hypocostal lamina of forewing yellowish-brown to dark-brown (Fig. 1B, E); proepisternum whitish-yellow; coxae yellowish-brown, entire trochanters and femora except for subapices whitish-yellow; tibiae and tarsi whitish-yellow, with blackish-brown distal end. Most of head with dense, relatively thin, silver setae (Figs. 3A–B, 4A); collar of head, surface of thorax and upper surface of forewing with dense, grey microtrichia (Fig. 4A–B), lower surface of forewing with dense, short microtrichia (Fig. 3F–H); antennae, labium, legs and abdomen with moderately dense, silver setae (Fig. 2B, E, H–J).

Brachypterous male. Structures: Body oval. Body length 2.03–2.09× greatest width. Head. Wider than long, greatest width across eyes 2.63–2.85× median length, with three pairs of black cephalic trichobothria, two pairs on vertex behind ocelli, and one pairs arising from light, elevated spots before ocelli (Figs. 2B, E, 3B, 4A), cephalic trichobothria pairs 1 and 2 subequal in length with pair 3 (Fig. 1B, E); eyes large, width of eyes 1.14× vertex width of across ocelli, with three pairs of dark-brown trichobothria (Figs. 2B, E, 4A), trichobothria on eyes shorter and thinner than cephalic trichobothria; antennal length subequal to body width; segments I and III subequal in length; segment I thickest and segment IV longest (Fig. 2B, E); ratio of antennal segments I to IV = 1 : 1.36 : 1.10 : 1.71. Apex of labium reaching to hind coxa (Fig. 1B–C, E–F); labial segment I widest, subequal to segment II in length,

segment III longest, ratio of labial segments I to IV = 1.28 : 1 : 3.59 : 2.69. Thorax. Pronotum short and trapezoid (Figs. 2B, 3A), median length about 0.5× humeral width; collar distinct, narrower than posterior lobe; anterior lobe elevated and deeply concave at fovea (Figs. 2B, 3A, D, 4A, C); with three pairs of black pronotal trichobothria (Figs. 2B, 3D); scutellum triangular, wider than long, ratio of length / width = 1 : 1.44; lateral margin of scutellum with small concavity centrally (Figs. 2A, 3A, E); middle of scutellum base ridge-like, longitudinally convex (Fig. 2A); mesosternum with two small sub-transverse ridges (Fig. 4E–F), metasternum with high middle longitudinal ridge (Fig. 4E); forewing with claval and R+M sutures, bases of sutures with deep round pit, R+M suture ends at about two-thirds of forewing, claval suture ends at about four-sevenths of forewing (Fig. 2D); legs stout, coxae and femora thick, tibiae and tarsi slender; femora and tibiae with thick spines; tarsal formula 3-3-3 (Fig. 2H–J); forefemur and middle femur longer than tibia, forefemur about 1.14× length of foretibia, middle femur about 1.16× length of middle tibia; hind coxae with setose area (Figs. 2J, 4G–H); hind femur shorter than hind tibia, tibia about 1.18× length of femur.

Pregenital abdomen. Mediotergites less sclerotized than sterna, with broad membranous area (Fig. 2G, K); mediotergites V–VII more sclerotized than I–IV; laterotergites less sclerotized than sterna, well-delimited with mediotergites and sterna (Fig. 2G, H); laterotergite III expanded, with strongly sclerotized margin (Fig. 2G); sterna strongly sclerotized; middle of basal margin of sternum I with cleft; segment VIII cylindrical shaped.

External genitalia. Pygophore cylindrical (Fig. 5A–D), posterior area of venter expanded (Fig. 5B); with parandria protruding posterior margin of genital capsule opening (Fig. 5B); parameres club-shaped, with slender and distally curved bases (Fig. 5H–J); articulatory apparatus sclerotized (Fig. 5E–G); ligamentous processes with wide base (Fig. 5E); caudal side of phallosome with swellings (Fig. 5E); more than half of endosoma with spicule (Fig. 5E–F).

Brachypterous female. Structures: Similar to male, except for the following: Body length 1.94–2.00× greatest width. Head. Greatest width across eyes 2.63–2.90× median length; width of eyes 1.22× vertex width of across ocelli; ratio of antennal segments I to IV = 1 : 1.42 : 1.10 : 1.82; ratio of labial segments I to IV = 1.06 : 1 : 2.91 : 2.29. Thorax. Pronotum short and trapezoid, median length about 0.47× humeral width; forefemur about 1.16× length of foretibia.

Pregenital abdomen. Laterotergite III normally developed.

External genitalia. Gynatrium ellipsoidal; spermatheca oval; accessory canal more sclerotized (Fig. 5K–L).

Measurements see Table 1.

Etymology: The specific epithet refers to the type locality area, the Xisha Islands in the South China Sea; adjective.

Biology: Specimens of *Corallocoris xishaensis* sp. nov. were collected in the intertidal zone. They spend periods submerged by high tides in rock crevices and then emerge at low tide, and were frequently found in crevices and holes of coral rocks (Fig. 6A–B).

Distribution: This species is so far known only from Lingyang Jiao and Yongxing Dao, Xisha Islands in the South China Sea (Figs. 9A–B; Table 3).

Discussion

The new species *Corallocoris xishaensis* sp. nov. described herein can be ascribed to *Corallocoris* based on the following morphological characteristics: collar of head delimited from vertex by a broadly arcuate line; forewing with two sutures; abdominal segment III of male with a deep laterotergal cleft; ponticulus basalis of phallus without dorsal projection. Morphologically, *C. xishaensis* sp. nov. is similar to the widely distributed species *C. marksae* (Fig. 7A–G; Table 2), but can be distinguished from the latter by genitalia characters and body color. Compared with another closely distributed species *C. satoi*, although they have similar body color, there are distinct differences in the position of the cephalic trichobothria, the presence or absence of a light, elevated spot on the head, the ratio between antennal segment III and IV, and the color of the legs and proepisternum.

The number and arrangement of trichobothria are highly conserved and important as diagnostic features of family-groups and in cladistic analyses of Heteroptera (Schaefer 1975, Schuh 1975, Andersen 1977, 1982, Henry 1997, Grazia *et al.* 2008, Tazsakowski *et al.* 2020). Cobben (1970) proposed that the presence of an extra pair of trichobothria posterior to the ocelli is one of the diagnostic characteristics of Omaniidae and Saldidae, which is

verified herein (Figs. 2B, E, 3B, 4A, 7D–E, 8A, C). In addition, according to the observation under incident light (Figs. 1A–B, D–E, 2B) and by scanning electron microscope (Figs. 3A–B, D, 4A), three pairs of trichobothria-like long setae on the pronotum have very similar appearance to cephalic trichobothria pairs 1–3, and we believe it is also a potential diagnostic characteristic of this family.

All known distribution records of Omaniidae are located in the Indo-West Pacific region, and species diversity for this family reaches its maximum in the Indo-Australian Archipelago (IAA). All six species of Omaniidae have non-overlapping geographical distributions (Fig. 9A; Table 3). The monotypic genus *Omania* is distributed in the Red Sea and Arabian Sea. The genus *Corallocoris* comprises five species and has a wider distribution than *Omania*: *C. aldabrae* is distributed in the western Indian Ocean; *C. satoi* between the North Pacific Ocean and East China Sea; *C. marksae* in the Sulu Sea, Coral Sea, South Pacific Ocean, and between the Indian Ocean and the South China Sea; *C. nauruensis* in the South Pacific Ocean; and *C. xishaensis* **sp. nov.** in the South China Sea. Considering the lack of flight ability in intertidal dwarf bugs (all known species have the entire forewing brachypterous and lack hind wings), the present distribution pattern of Omaniidae might be due to the closure of the Tethys Ocean during the Cenozoic Era, or together with the result of dispersal by ocean surface currents distribution pattern and the phylogeographic structure of this family.

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