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NEW SPECIES OF CAVERNICOLOUS CRABS OF THE GENUS *SESARMOIDES* FROM THE WESTERN PACIFIC, WITH A KEY TO THE GENUS (CRUSTACEA: DECAPODA: BRACHYURA: SESARMIDAE)

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ABSTRACT. – Five new species of cavernicolous sesarmid crabs of the genus *Sesarmoides* are described from Indonesia, Loyalty Islands, Philippines and Guam, viz., *S. balicus*, *S. loyalty*, *S. sulu*, *S. boholano* and *S. guamensis*. Diagnoses and detailed figures are provided for all species. The taxonomy of *S. emdi* Ng & Whitten, 1995, is also clarified, and a key to the 14 recognised species of *Sesarmoides* is provided.

KEY WORDS. – Taxonomy, Sesarmidae, Grapsidae, Indonesia, Loyalty Islands, Philippines, Guam, anchialine caves, new species, *Sesarmoides*.

INTRODUCTION

Over the last few years, the author has obtained numerous specimens of cavernicolous sesarmid crabs from various parts of the western Pacific, including Southeast Asia. Most of them belonged to the genus *Sesarmoides* Serène & Soh, 1970, and all appear to be undescribed. The present paper reports on the five new species from Indonesia, Philippines, Guam and Loyalty Islands. A key to the 14 recognised species is also provided.

Specimens of the new species are deposited in the Museum of the University of San Carlos (USC), Cebu, Philippines; Taiwan National University (TMCD), Taipei, Taiwan; Museum Zoologicum Bogoriense (MZB), Bogor, Indonesia; Queensland Museum (QM), Brisbane, Australia; Muséum national d'Histoire naturelle (MNHN), Paris, France; Università degli studi di Firenze, Museo Zoologico de "La Specola", Firenze (MZF), Italy; Florida Museum of Natural History (FMNH), Gainesville, Florida, U.S.A.; and the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research, National University of Singapore. Measurements, in millimetres, are of the carapace width and length respectively. The abbreviations G1 and G2 are used for the male first and second pleopods respectively. The first to fourth ambulatory legs correspond to the second to fifth pereiopods respectively. The terminology used here essentially follows Ng (1988).

FAMILY GRAPSIDAE MACLEAY, 1838

Genus *Sesarmoides* Serène & Soh, 1970

Type species. – *Sesarma kraussi* De Man, 1887, by original designation.

Remarks. – In their revision of the genera of the Indo-West Pacific Sesarminae (present Sesarmidae), Serène & Soh (1970: 403) established a new genus, *Sesarmoides*, for species with a relatively flattened carapace with strongly divergent lateral margins, a narrow frontal margin which is distinctly shorter than the posterior carapace margins, a swollen and globular basal antennal segment with a nearly longitudinal peduncle, an epistome with a distinct transverse rim and deep median notch, and slender and long ambulatory legs, with the third leg (pereiopod 4) more than twice the length of the carapace. The genus currently contains nine Indo-West Pacific species, viz. *S. borneensis* (Tweedie, 1950), *S. cerberus* (Holthuis, 1964), *S. emdi* Ng & Whitten, 1995, *S. jacksoni* (Balss, 1934), *S. jacobsoni* (Ihle, 1912), *S. kraussi* (De Man, 1887) (type species by original designation), *S. longipes* (Krauss, 1843), *S. novabritannia* Ng, 1988, and *S. ultrapes* Ng, Guinot & Iliffe, 1994 (see Serène & Soh, 1970; Ng, 1988a; Ng et al., 1994; Ng & Whitten, 1995). Two Atlantic species that Serène & Soh (1970) suggested may also be *Sesarmoides* species, *Sesarma verleyi* Rathbun, 1914, and *Sesarma jarvisi* Rathbun, 1914, are not included here as they differ from typical *Sesarmoides*

in several major aspects including at the molecular level (see also Abele, 1992; Schubart et al., 1998). They are retained in *Sesarma* Say, 1817, sensu stricto.

Ng et al. (1994) and Ng & Whitten (1995) commented that there are two species groups in *Sesarmoides*. One group includes three species usually associated with mangroves, estuarine areas and sometimes coastal caves, viz. *S. longipes*, *S. kraussi* and *S. borneensis*, and morphologically, are distinguished by their smaller adult carapace size, a relatively shallower groove between the epigastric regions (Figs. 1A, B), presence of a longitudinal row of small granules or ridge on the outer surface of the pollex (Fig. 1C), and the G1 relatively more slender. The second group contains usually relatively larger species, with swollen epigastric regions separated by a deeeper groove, often possessing a row of granules on the dorsal margin of the dactylus of the chelipeds, and there are no longitudinal row of granules or ridge on the outer surface of the pollex, and include *S. jacobsoni*, *S. cerberus*, *S. novabritannia*, *S. ultrapes*, *S. emdi* and possibly *S. jacksoni*.

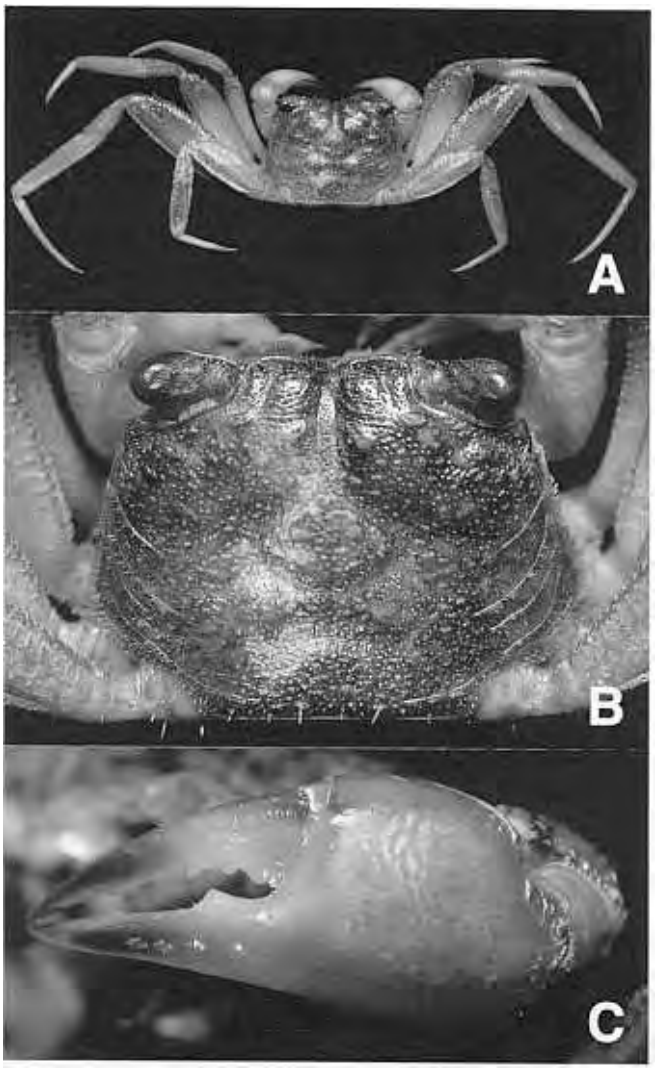

Fig. 1. *Sesarmoides borneensis*. Male (12.3 by 9.7 mm) (ZRC), Kampung Ladong, Pulau Tekong, Singapore. A, overall view; B, carapace; C, chela.

Sesarmoides emdi Ng & Whitten, 1995
(Figs. 2, 3, 9A, B, 10A)

Sesarmoides emdi Ng & Whitten, 1995: 370 (part), Figs. 1-6.

Material examined. – Holotype – male (17.8 by 15.5 mm) (MZB), 100 m from opening of Gua Paon cave, Dusun Karangsan, Desa Suana, Nusa Penida, southeast of Bali, Indonesia, coll. A. J. Whitten, 12 Dec.1993.

Paratypes – 2 males (23.7 by 20.5 mm, 18.5 by 15.5 mm), 1 female (14.6 by 11.8 mm) (ZRC 1995.278), Gua Giri Putri cave, 50 m asl, Dusun Karangsari, Desa Suana, Nusa Penida, southeast of Bali, Indonesia, coll. A. J. Whitten, 21 Mar.1994.

Diagnosis (holotype). – Carapace approximately trapezoidal in shape; anterior regions well defined, almost glabrous; lateral regions covered with oblique striae; epigastric region pronounced, separated by prominent groove; frontal margin with prominently concave median emargination; external orbital tooth with tip not extending beyond level of frontal margin; outer margin almost straight to gently convex, separated from first anterolateral tooth by small V-shaped cleft; first anterolateral tooth separated from second anterolateral tooth by fissure. Chelae relatively stout, fingers subequal to length of palm; ventral margin of pollex gently concave. Ambulatory legs very long, in males, length to width ratios of meri of second and third legs 4.3 and 4.0 respectively; dorsal and ventral margins with weak serrations, more prominent distoventrally, dorsal subdistal edge angular but not spiniform; brush-like setae present on ventral margins of propodi and dactyli of first and second legs, setae usually sparse on propodi and dactyli of third leg and completely absent on fourth leg. Prominent tufts of short setae between

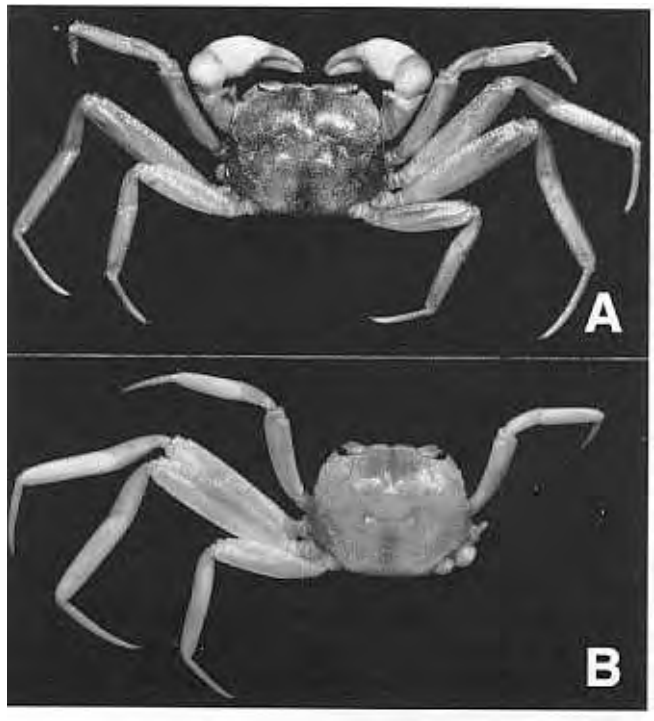

Fig. 2. *Sesarmoides emdi*. A, paratype male (18.5 by 15.5 mm) (ZRC 1995.278), Bali; B, paratype female (14.6 by 11.8 mm) (ZRC 1995.278), Bali.

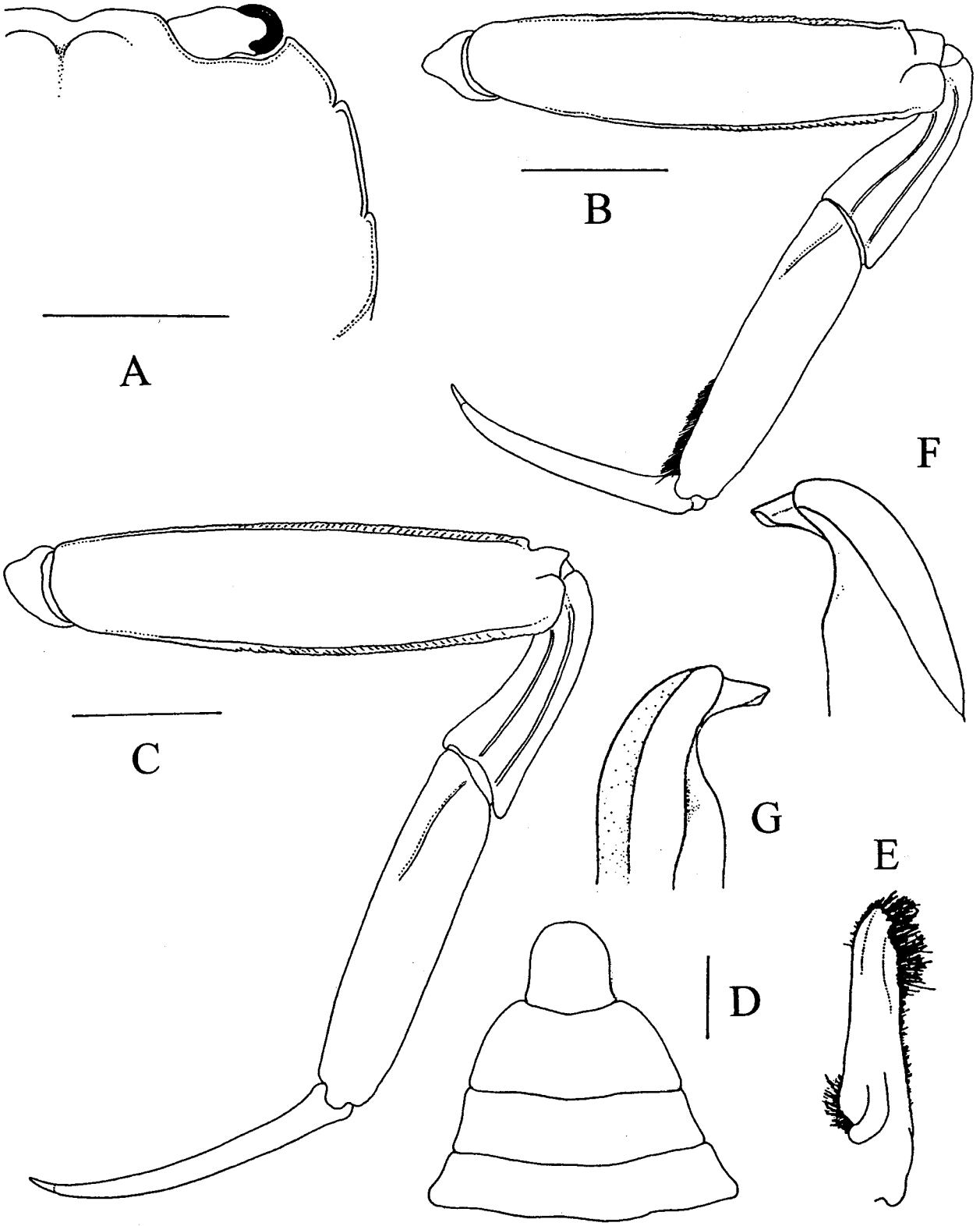

Fig. 3. *Sesarmoides emdi*. Paratype male (18.5 by 15.5 mm) (ZRC 1995.278), Bali. A, carapace; B, second ambulatory leg; C, third ambulatory leg; D, abdominal segments 4-6 and telson; E, left G1; F, G, distal part of left G1 (denuded) (after Ng & Whitten, 1995: Fig. 6C, D). Granules and setae on structures omitted. Scales: A-C = 5.0 mm, D = 2.0 mm.

coxae of first to third ambulatory legs. Male abdomen less broad, lateral margins of male telson subparallel. G1 relatively short, stout, inner margin almost straight; distal part sharply bent outwards and slightly downwards, chitinous distal part short.

Paratypes. – Only one female specimen is known, and although rather small, is almost adult size. The only significant non-sexual difference with the other types seem to be the presence of very short and widely but evenly spaced setae on the dorsal surface of the carapace, especially on the anterior part; and none of the ambulatory leg segments possess brush-like setae.

Colour. – The dorsal surface of the carapace is dark purplish-brown, ambulatory legs dark brown, carpus of the cheliped purplish with the chelae bright orange (see Ng & Whitten, 1995).

Remarks. – Recently, as part of the comparisons with smaller allied species from Philippines (*S. boholano*, new species) and Guam (*S. guamensis*, new species), the author re-examined all the type specimens of *S. emdi*. One of the smaller paratype male specimens (17.8 by 15.4 mm) appeared slightly different from the other males in having a more setose carapace, different anterolateral margin armature, proportionately shorter ambulatory legs and a telson that had the lateral margins relatively more subparallel. In describing *S. emdi*, Ng and Whitten (1995: 371), had noted that one of "... the smaller paratypes (17.8 x 15.4 mm) has very small tufts of setae scattered on its carapace ..." but they accepted this as part of the variation within the species.

A re-examination of this specimen's (17.8 by 15.4 mm) G1 and removal of the dense setae surrounding the chitinous distal part showed that it actually differs markedly from the G1s of the other type specimens of *S. emdi*, with its chitinous distal part far longer than can be accounted for by growth or variation. The G1 difference is so substantial (Figs. 5E-G vs. Figs. 3E-G) that there can be question that two species are involved. As such, the differences observed in the carapace of the 17.8 by 15.4 mm specimen (more setose anterior part of the dorsal surface [Figs. 4A, 9C], vs. glabrous [Figs. 2A, 9A]); anterolateral margin (the external orbital and anterolateral teeth separated by very shallow clefts [Figs. 5A, 9C], vs. deep [Figs. 3A, 9A]); male telson form (lateral margins gently diverging backwards [Fig. 5D], vs. subparallel [Fig. 3D]), as well as the shorter leg proportions (length to width ratios of meri of second and third ambulatory legs 3.3 and 3.6 respectively, vs. 4.1 and 4.5 respectively [Figs. 5B, C vs. Figs. 3B, C]), cannot be considered to be mere variation within *S. emdi*. While many species of cavernicolous *Sesarmoides* species previously described have been based on only a few specimens, the excellent series of *S. boholano* and *S. guamensis* studied here show that the differences discussed above cannot be attributed to just infra-specific variation.

As such, a new species, *S. balicus*, has been established for the 17.8 by 15.4 mm paratype specimen previously attributed to *S. emdi*. The other male paratypes agree with the holotype male of *S. emdi* in all the original diagnostic characters, including the structure of the G1; while the sole female paratype has the same type of anterolateral armature as the holotype of *S. emdi*. While the dorsal surface of the carapace of the paratype female is more setose (Figs. 2B, 9B) (like that of *S. balicus*), such variation between sexes is known for some *Sesarmoides* species (e.g. *S. guamensis*) and is not considered to be significant.

The presence of two closely related species in the same cave in Bali is very surprising, but the differences observed here warrant such an action. More collections will need to be made to ascertain if the niches of *S. emdi* and *S. balicus* really overlap.

Sesarmoides balicus, new species
(Figs. 4A, 5, 9C, 10B)

Sesarmoides emdi Ng & Whitten, 1995: 370 (part).

Material examined. – Holotype – male (17.8 by 15.4 mm) (ZRC), Gua Giri Putri Cave, 50 m asl, Dusun Karangsari, Desa Suana, Nusa Penida, southeast of Bali, Indonesia, coll. A. J. Whitten, 21 Mar.1994.

Diagnosis (holotype). – Carapace approximately trapezoidal in shape; anterior regions well defined, with short, widely but evenly spaced setae; lateral regions covered with oblique striae; epigastric region pronounced, separated by prominent groove; frontal margin with concave median emargination; external orbital tooth with tip not extending beyond level of

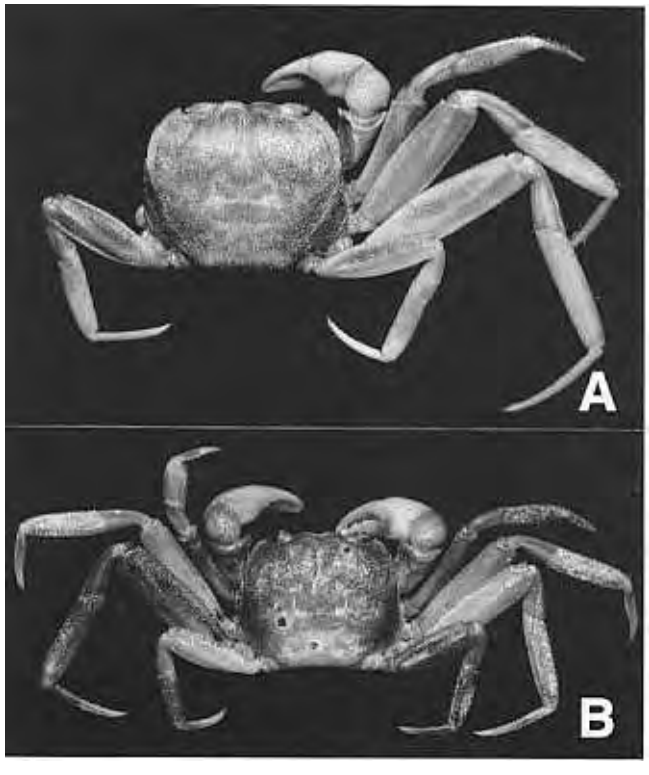

Fig. 4. A, *Sesarmoides balicus*, new species, holotype male (17.8 by 15.4 mm) (ZRC), Bali; *S. loyalty*, new species, holotype male (16.3 by 13.7 mm) (MNHN), Loyalty Island.

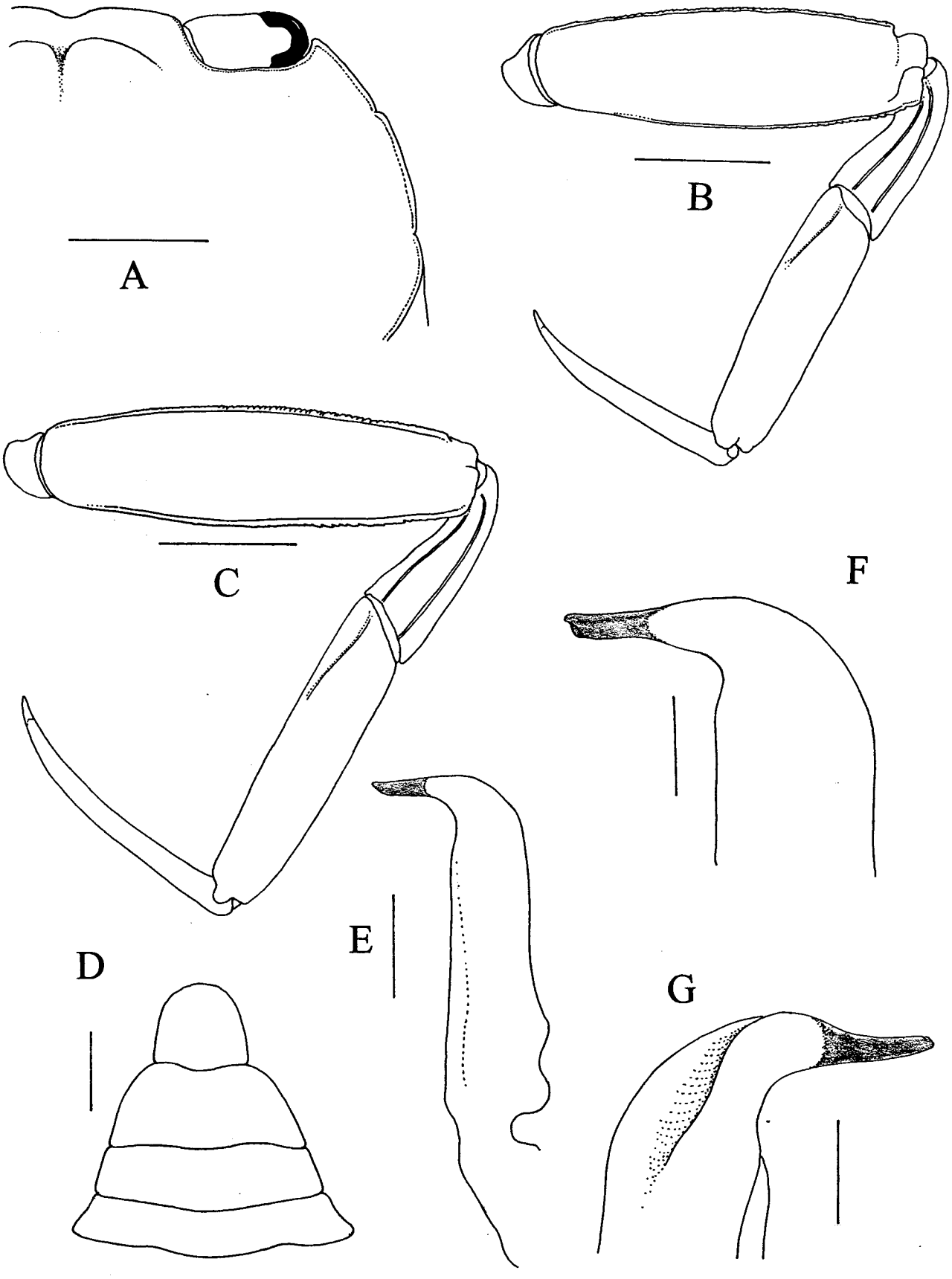

Fig. 5. *Sesarmoides balicus*, new species. Holotype male (17.8 by 15.4 mm) (ZRC), Bali. A, carapace; B, second ambulatory leg; C, third ambulatory leg; D, abdominal segments 4-6 and telson; E-G, left G1 (denuded). Granules and setae on structures omitted. Scales: A-C = 5.0 mm, D = 2.0 mm, E = 1.0 mm, F, G = 0.5 mm.

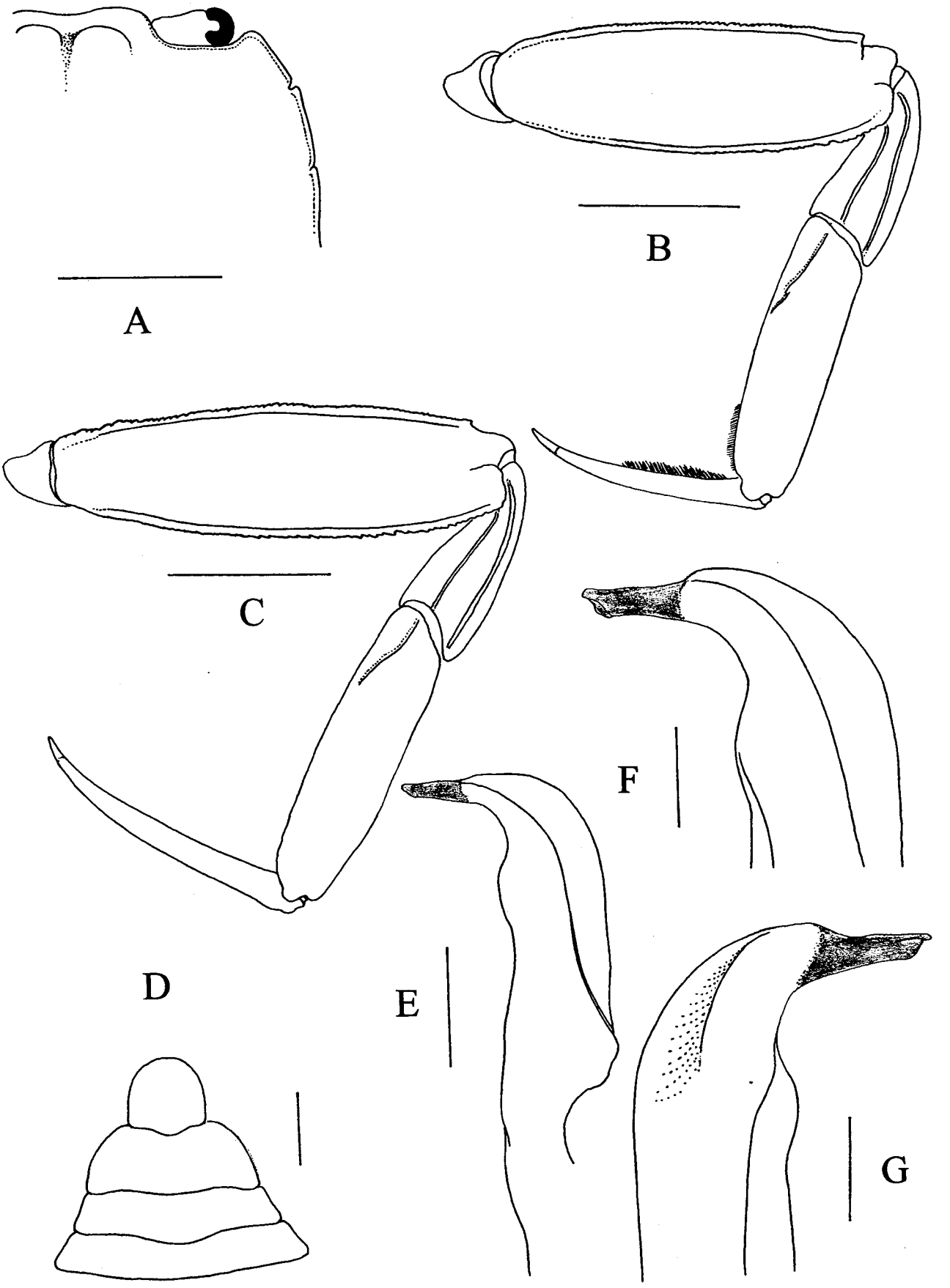

Fig. 6. *Sesarmoides loyalty*, new species. Holotype male (16.3 by 13.7 mm) (MNHN). A, carapace; B, second ambulatory leg; C, third ambulatory leg; D, abdominal segments 4-6 and telson; E-G, left G1 (denuded). Granules and setae on structures omitted. Scales: A-C = 5.0 mm, D = 2.0 mm, E = 1.0 mm, F, G = 0.5 mm.

frontal margin; outer margin almost gently convex, separated from first anterolateral tooth by very shallow notch; first anterolateral tooth separated from second anterolateral tooth by small notch. Chelae relatively stout, fingers subequal to length of palm; ventral margin of pollex almost straight. Ambulatory legs long, length to width ratios of meri of second and third legs 3.3 and 3.6 respectively; dorsal and ventral margins with weak serrations, dorsal subdistal edge angular but not spiniform; brush-like setae present on ventral margins of propodi and dactyli of first and second legs, undiscernible on third and fourth legs. Prominent tufts of short setae between coxae of first to third ambulatory legs. Male abdomen relatively broad, lateral margins of male telson gently diverging backwards. G1 relatively short, stout, inner margin almost straight; distal part sharply bent outwards at approximately right angles, chitinous distal part elongate, straight.

Etymology. – The species name is derived from the type locality, Bali. .

Colour. – Not known, presumably similar to *S. emdi*

Remarks. – See discussion for *S. emdi*.

Sesarmoides loyalty, new species
(Figs. 4B, 6, 9D, 10C)

Material examined. – Holotype – male (16.3 by 13.7 mm) (MNHN), station NC00–114, Peng Cave, Hapetra, Lifou Island, coll. L. Deharveng & A. Bedos, 26 Oct.2000.

Diagnosis (holotype). – Carapace approximately trapezoidal in shape; anterior regions well defined, with very short widely, evenly spaced setae; lateral regions covered with low oblique striae; epigastric region pronounced, separated by prominent groove; frontal margin with gently concave median emargination; external orbital tooth with tip not extending beyond level of frontal margin; outer margin almost straight, separated from first anterolateral tooth bu small V-shaped cleft; first anterolateral tooth separated from second anterolateral tooth by small fissure. Chelae relatively stout, fingers subequal to length of palm; ventral margin of pollex gently concave. Ambulatory legs long, length to width ratios of meri of second and third legs 3.1 and 3.5 respectively; dorsal and ventral margins with weak serrations, dorsal subdistal edge angular but not spiniform; brush-like setae present on ventral margins of propodi and dactyli of first and second legs, undiscernible on third and fourth legs. Prominent tufts of short setae between coxae of first to third ambulatory legs. Male abdomen relatively broad, lateral margins of male telson subparallel. G1 relatively short, stout, with submedian hump along inner margin; distal part sharply bent outwards at approximately right angles, chitinous distal part elongate, almost straight.

Etymology. – The species is named after its type locality, Loyalty Islands. The name is used as a noun in apposition.

Colour. – In the freshly preserved specimen, the dorsal surface of the carapace is purplish-brown, with the legs slightly lighter in colour. The chelae are light orange.

Remarks. – The G1 of *S. loyalty* most closely resembles that of *S. balicus*, but it is proportionately shorter and stouter (Fig. 6E vs. Fig. 5E), the inner submedian margin possessing a distinct hump (Fig. 6E vs. Fig. 5E). Externally, the external orbital and anterolateral teeth of *S. loyalty* are also separated by distinct clefts (Figs. 6A, 9D) (vs. shallow, Figs. 5A, 9C), and the lateral margins of the male telson are subparallel (Fig. 6D) (vs. gently diverging, Fig. 5D).

Sesarmoides sulu, new species
(Figs. 7, 8, 9E, F, 16A)

Material examined. – Holotype – male (18.9 by 15.1 mm) (MZF), lateral branch, St. Paul N. P. Cave, Palawan Island, Philippines, coll. Borri & C. Volpi, 25 Feb.1991.

Paratype – 1 female (23.0 by 18.1 mm) (MZF), between entrance and rocky parts, St. Paul N. P. Cave, Palawan Island, Philippines, coll. R. Berti & G. Ferret, 23 Feb.1991.

Diagnosis (holotype). – Carapace approximately trapezoidal in shape; anterior regions well defined, with widely but evenly spaced short setae; lateral regions covered with oblique striae; epigastric region pronounced, separated by prominent groove; frontal margin with distinct concave median emargination; external orbital tooth with tip almost reaching level of frontal margin; outer margin gently convex, separated from first anterolateral tooth by deep V-shaped cleft; first anterolateral tooth separated from second anterolateral tooth by small cleft. Chelae relatively stout, fingers subequal to length of palm; ventral margin of pollex

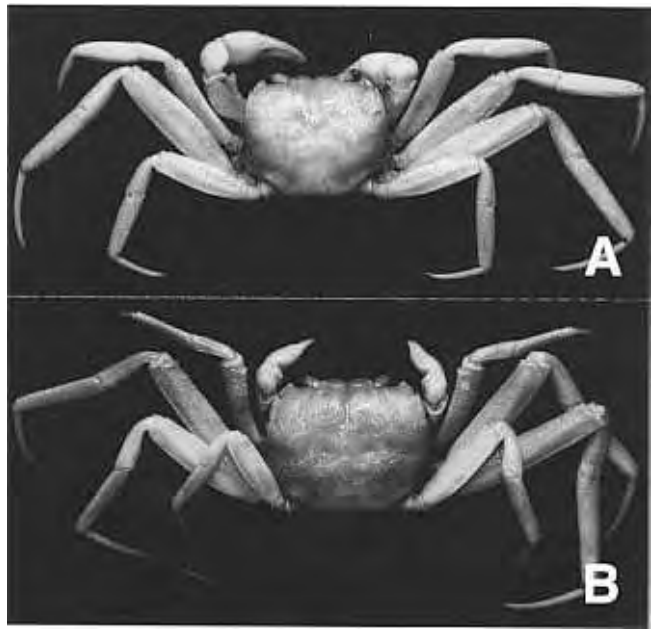

Fig. 7. *Sesarmoides sulu*, new species. A, holotype male (18.9 by 15.1 mm) (MZF), Palawan Island; B, paratype female (23.0 by 18.1 mm) (MZF), Palawan Island.

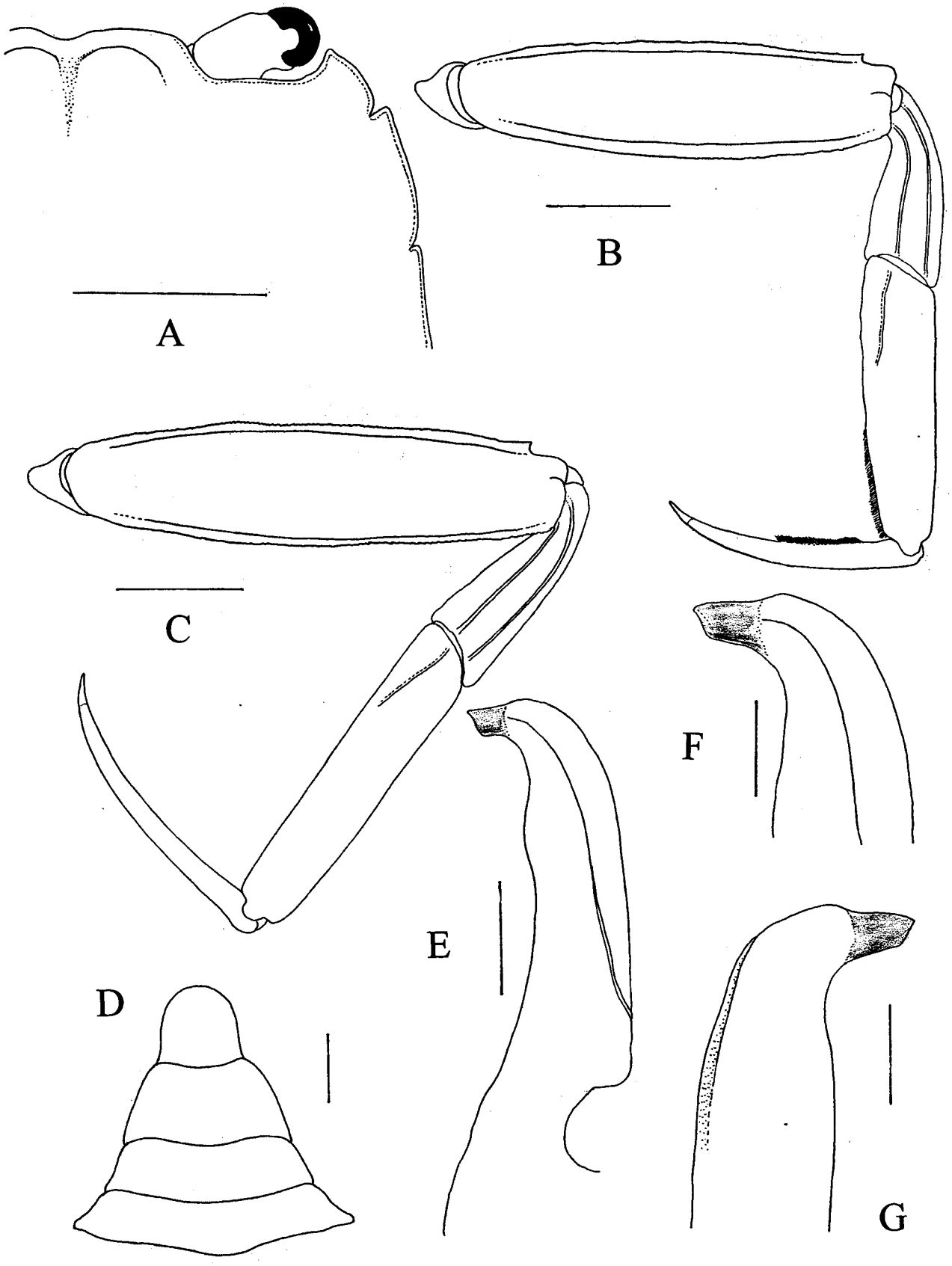

Fig. 8. *Sesarmoides sulu*, new species. Holotype male (18.9 by 15.1 mm) (MZF). A, carapace; B, second ambulatory leg; C, third ambulatory leg; D, abdominal segments 4-6 and telson; E-G, left G1 (denuded). Granules and setae on structures omitted. Scales: A-C = 5.0 mm, D = 2.0 mm, E = 1.0 mm, F, G = 0.5 mm.

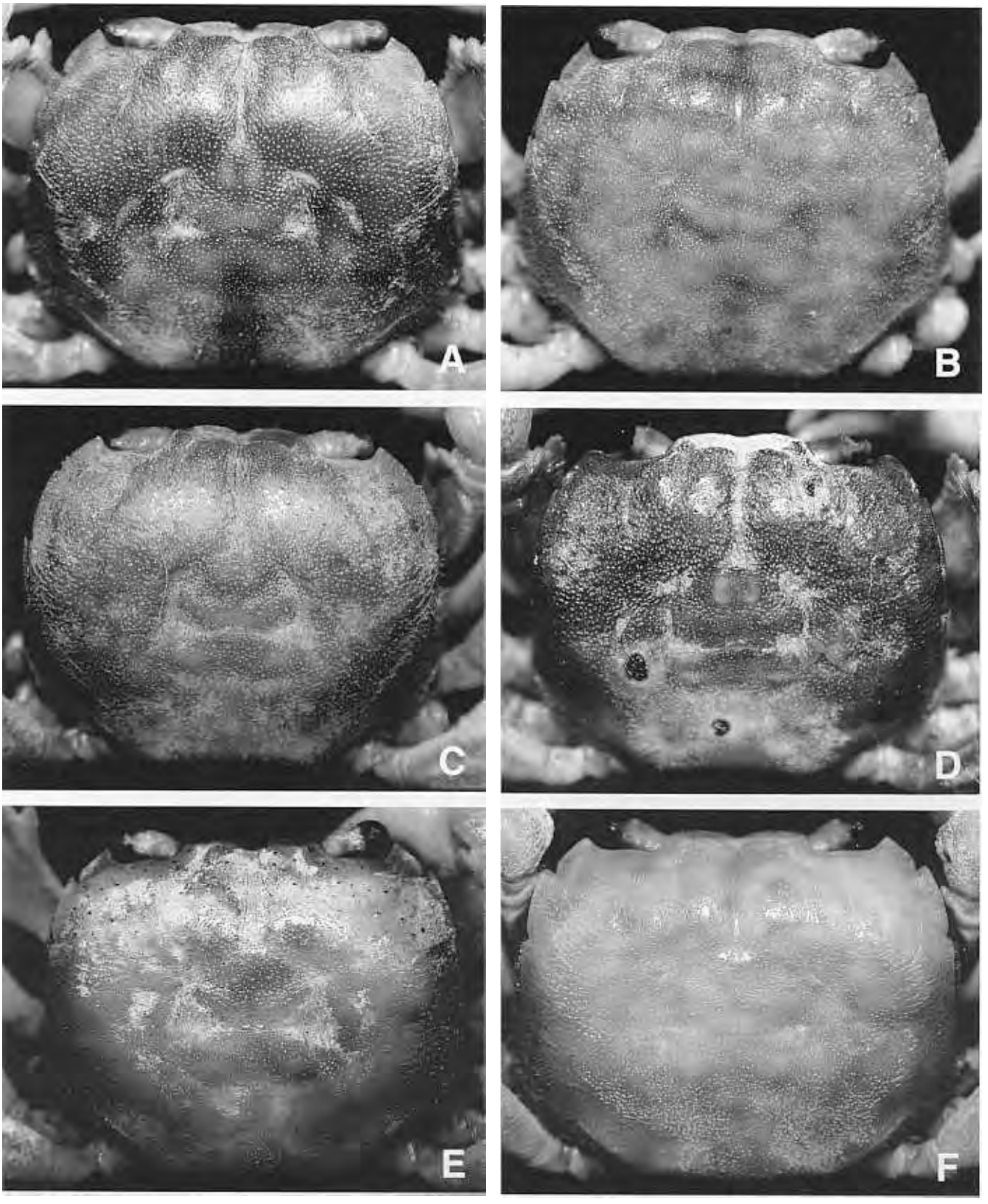

Fig. 9. Carapaces of *Sesarmoides*. A, *S. emdi*, paratype male (18.5 by 15.5 mm) (ZRC 1995.278), Bali; B, *S. emdi*, paratype female (14.6 by 11.8 mm) (ZRC 1995.278) Bali; C, *S. balicus*, new species, holotype male (17.8 by 15.4 mm) (ZRC), Bali; D, *S. loyalty*, new species, holotype male (16.3 by 13.7 mm) (MNHN), Loyalty Island; E, *S. sulu*, new species, holotype male (18.9 by 15.1 mm) (MZF), Palawan Island; F, *S. sulu*, new species, paratype female (23.0 by 18.1 mm) (MZF), Palawan Island.

gently concave. Ambulatory legs very long, length to width ratios of meri of second and third legs 3.8 and 4.1 respectively; dorsal and ventral margins with very weak serrations to almost smooth, dorsal subdistal edge with small but distinct spine; brush-like setae present on ventral margins of propodi and dactyli of first and second legs, undiscernible on third and fourth. Prominent tufts of short setae between coxae of first and second ambulatory legs, not discernible on third leg. Male abdomen relatively broad, lateral margins of male telson gently diverging backwards. G1 relatively stout, inner margin with very gentle submedian hump; distal part sharply bent outwards at approximately right angles, chitinous distal part short, subtruncate.

Paratype. – Only one paratype female is known. In addition to the sexual characters, the adult female has a proportionately broader carapace and relatively longer ambulatory legs, especially the second and third legs. The clefts separating the lateral carapace teeth are also relatively deeper, and the setae on the dorso-anterior part of the carapace are also shorter. None of the legs have brush-like setae on any of the segments.

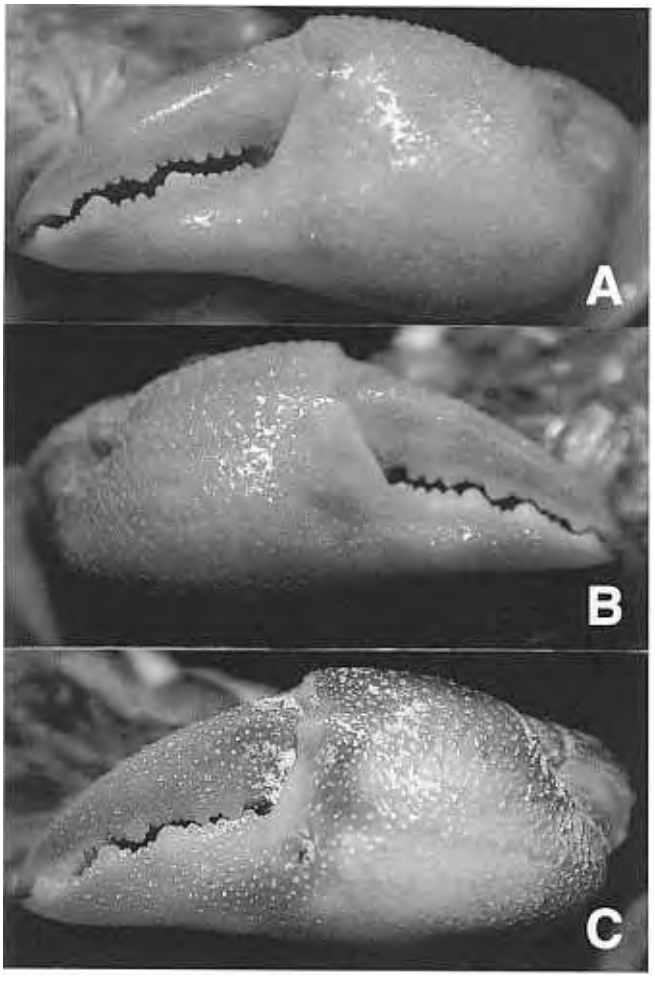

Fig. 10. Male chelae of *Sesarmoides*. A, *S. emdi*, paratype (18.5 by 15.5 mm) (ZRC), Bali; B, *S. balicus*, new species, holotype (17.8 by 15.4 mm) (ZRC), Bali; C, *S. loyalty*, new species, holotype (16.3 by 13.7 mm) (MNHN), Loyalty Islands.

Etymology. – The species is named after the Sulu Sea, where Palawan Island is located. The name is used as a noun in apposition.

Colour. – Not known. Preserved specimens decolorised.

Remarks. – In the form of the G1, *S. sulu* is perhaps closest to *S. emdi*, but its inner margin has a gentle submedian hump (Fig. 8E) (vs. absent, Fig. 3E) and the chitinous distal part is relatively stouter and more truncate (Figs. 8E-G vs. Figs. 3F, G). The second ambulatory leg of *S. sulu* is also relatively shorter (length to width ratio of merus 3.8 vs. 4.3) (Fig. 8B vs. Fig. 3B), and the sixth male abdominal segment is proportonately less wide (Fig. 8D vs. Fig. 3D).

Two specimens of *S. borneensis* (1 male, MZF, lateral branch, St. Paul N. P. Cave, Palawan Island, Philippines, coll. Borri & C. Volpi, 25 Feb.1991; 1 female, MZF, Palawan Island, Philippines, coll. G. Messana, 25 Jan.1991) were also collected from Palawan, one with the holotype male of *S. sulu*. *Sesarmoides borneensis* is a new record for the Philippines.

Sesarmoides boholano, new species
(Figs. 11, 12, 15A, B, 16B, 17b)

Material examined. – Holotype - male (15.6 by 13.1 mm) (USC), Tawala Cave, Tawala, Panglao Island, Bohol, Philippines, coll. P. K. L. Ng et al., 27 Nov.2001.

Paratypes – 1 male (15.1 by 12.3 mm), 1 female (17.5 by 14.3 mm) (ZRC), same data as holotype; 4 males (9.9-16.0 by 8.1-13.6 mm), 1 female (13.4 by 11.0 mm) (ZRC), Tawala Cave, Tawala, Panglao, Panglao Island, Bohol, Philippines, coll. P. K. L. Ng et

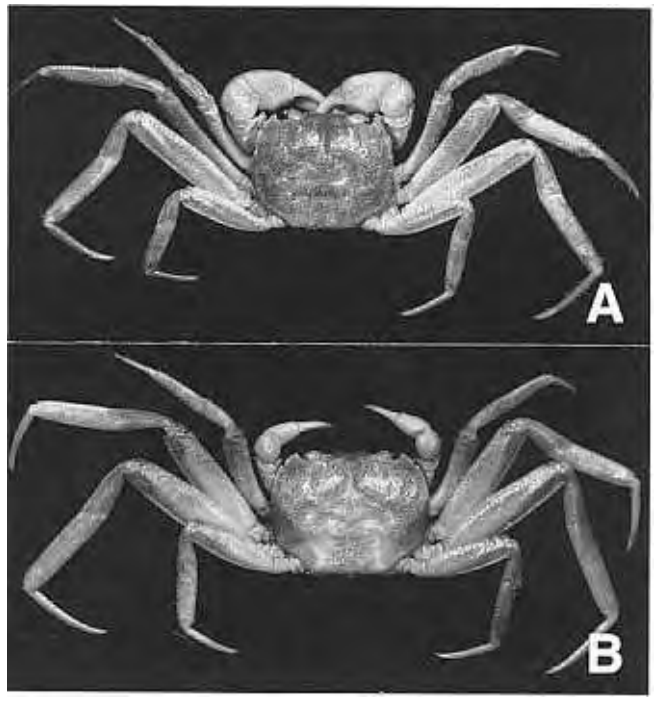

Fig. 11. *Sesarmoides boholano*, new species. A, paratype male (15.1 by 12.3 mm) (ZRC), Panglao Island; B, paratype female (17.5 by 14.3 mm) (ZRC), Panglao Island.

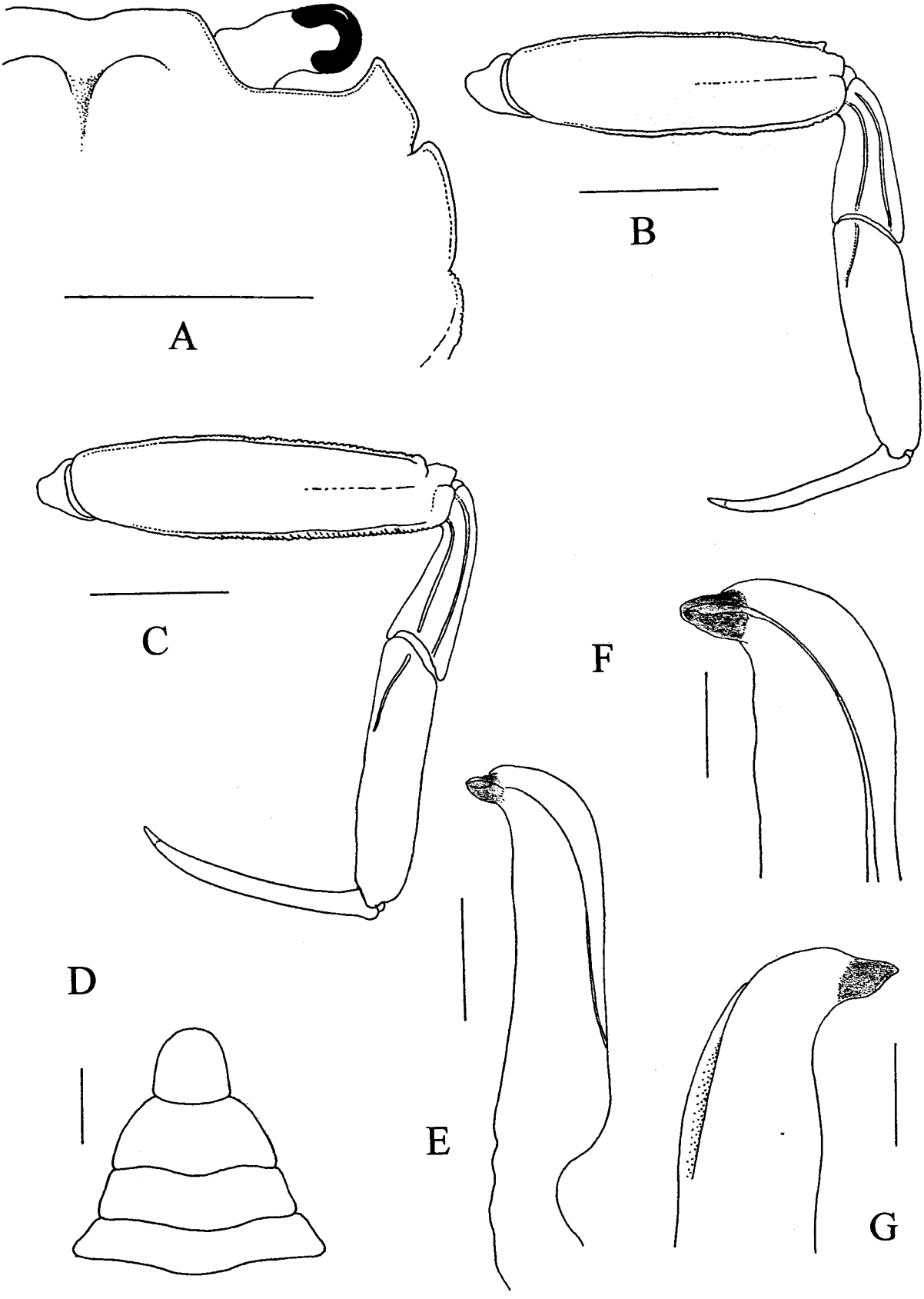

Fig. 12. *Sesarmoides boholano*, new species. Paratype male (15.1 by 12.3 mm) (ZRC). A, carapace; B, second ambulatory leg; C, third ambulatory leg; D, abdominal segments 4-6 and telson; E-G, left G1 (denuded). Granules and setae on structures omitted. Scales: A-C = 5.0 mm, D = 2.0 mm, E = 1.0 mm, F, G = 0.5 mm.

al., 17 Dec.2000; 2 males (13.9 by 11.8 mm, 15.4 by 13.3 mm) (ZRC), Tawala Cave, Tawala, Panglao, Panglao Island, Bohol, Philippines, coll. P. K. L. Ng, 17 Dec.2000; 1 male (11.7 by 9.8 mm) (ZRC), Virata Cave, Libaong, Panglao, Panglao Island, Bohol, Philippines, coll. Y. Cai, 18 Dec.2000; 1 male (ZRC), Virata Cave, Libaong, Panglao, Panglao Island, Bohol, Philippines, coll. P. K. L. Ng, 18 Dec.2000; 1 male (16.8 by 15.1 mm), 1 female (16.6 by 15.0 mm) (USC), Virata Cave, Libaong, Panglao, Panglao Island, Bohol, Philippines, coll. A. Porpetcho et al., 17 Apr.-10 May.2001; 2 males (12.9 by 10.1 mm, 12.4 by 10.0 mm), 2 females (14.1 by 11.8 mm, 15.5 by 13.0 mm) (ZRC), Virata Cave, Libaong, Panglao, Panglao Island, Bohol, Philippines, coll. H.-C. Liu & P. K. L. Ng, 27 Nov.2001; 2 males (14.0 by 12.0 mm, 11.3 by 9.8 mm), 2 females (10.5 by 8.8 mm, 10.4 by 9.2 mm) (TMCD), Tawala Cave, Tawala, Panglao, Panglao Island, Bohol, Philippines, coll. H.-C. Liu, 26 Nov.2001; 4 males (12.0-13.9 by 10.1-11.0 mm) (ZRC), Hinagdanan Cave, northern part of Panglao Island, Bohol, Philippines, coll. P. K. L. Ng, 30 Nov.2001; 1 female (14.1 by 11.9 m) (ZRC 2001.2313), Hinagdanan Cave, northern part of Panglao Island, Bohol, Philippines, coll. P. K. L. Ng, 30 Nov.2001; 2 males (12.2 by 10.2 mm, 14.9 by 12.1 mm) (ZRC), caves near Hinagdanan Cave, northern part of Panglao Island, Bohol, Philippines, coll. P. K. L. Ng, 29 Nov.2001.

Diagnosis (holotype). – Carapace approximately trapezoidal in shape; anterior regions well defined, with very short, widely but evenly spaced setae; lateral regions covered with oblique striae; epigastric region pronounced, separated by prominent groove; frontal margin with distinct concave median emargination; external orbital tooth with tip just reaching level of frontal margin;, outer margin almost straight, separated from first anterolateral tooth by deep V-shaped cleft; first anterolateral tooth separated from second anterolateral tooth by small notch. Chelae relatively stout, fingers subequal to length of palm; ventral margin of pollex gently concave. Ambulatory legs long, length to width ratios of meri of second and third legs 3.4 and 3.7 respectively; dorsal and ventral margins with weak serrations, dorsal subdistal edge angular but not spiniform; brush-like setae present on ventral margins of propodus and dactylus of first leg, usually present on second leg, sparse to undiscernible on third leg, absent on fourth leg. Prominent tufts of short setae between coxae of first to third ambulatory legs. Male abdomen relatively broad, lateral margins of male telson gently diverging backwards. G1 relatively short, stout, inner margin almost straight; distal part sharply bent outwards at approximately right angles, chitinous distal part short.

Paratypes. – Other than in the sexual characters, adult females differ from males in having proportionately broader carapaces and relatively longer ambulatory legs, especially the second and third pairs. The notches/clefts separating the lateral carapace teeth are also usually deeper and more prominent. None of the legs have brush-like setae on any of the segments.

Etymology. – The species name is derived from local name used for residents of Bohol. It is used as a noun in apposition.

Colour. – The dorsal surface of the carapace is brown to orangish-brown, with the ventral surfaces dirty to yellowish white. The male chelipeds are bright orange, with those of the female paler orange. The ambulatory legs are light orangish-brown (Fig. 17a).

Remarks. – In general body form and approximate leg proportions, *S. boholano* resembles *S. guamensis* and *S. loyalty*. It can easily be distinguished from *S. loyalty* by its G1 possessing an almost straight inner margin (Fig. 12E) (vs. with a submedian hump, Fig. 6E) and having a relatively short chitinous distal part of the G1 (Figs. 12E-G) (vs. long, Figs. 6E-G). Compared to *S. guamensis*, the external orbital tooth of *S. boholano* is also more prominently separated from the first anterolateral tooth by a deeper and more distinct V-shaped cleft (Figs. 12A, 15A, B vs. Figs. 14A, 15C, D), the ambulatory legs are relatively slightly shorter (Figs. 12B, C vs. Figs. 14B, C), and the lateral margins of the male telson are gently diverging backwards (Fig. 12D) (vs. subparallel, Fig. 14D). The G1s of *S. boholano* and *S. guamensis* are very similar, but that of *S. boholano* is slightly shorter and more truncate in shape (Figs. 12F, G vs. Figs. 14F, G).

Sesarmoides boholano is especially common on the moister parts of the cave roof, hiding in the crevices during the day. Many specimens were observed to have excavated burrows in the soft earth between the crevices, and are often seen with only their long second and/or third ambulatory legs partially protruding. They have been observed to scrape the lichens and/or algae from the rocks.

Sesarmoides guamensis, new species
(Figs. 13, 14, 15C, D, 16C, 17b)

Material examined. – Holotype – male (14.2 by 11.8 mm) (FMNH), in limestone cave and adjacent limestone cliffs and beach, Faifai Beach, near Gun Beach, Tumon Bay, Guam, coll. P. K. L. Ng et al., 28 Jul.–1 Aug.2001.

Paratypes – 8 males (11.7-15.1 by 9.5-12.4 mm), 6 females (15.3-18.5 by 12.2-14.2 mm) (ZRC), 1 female (FMNH), 1 male, 1 female (QM), same data as holotype.

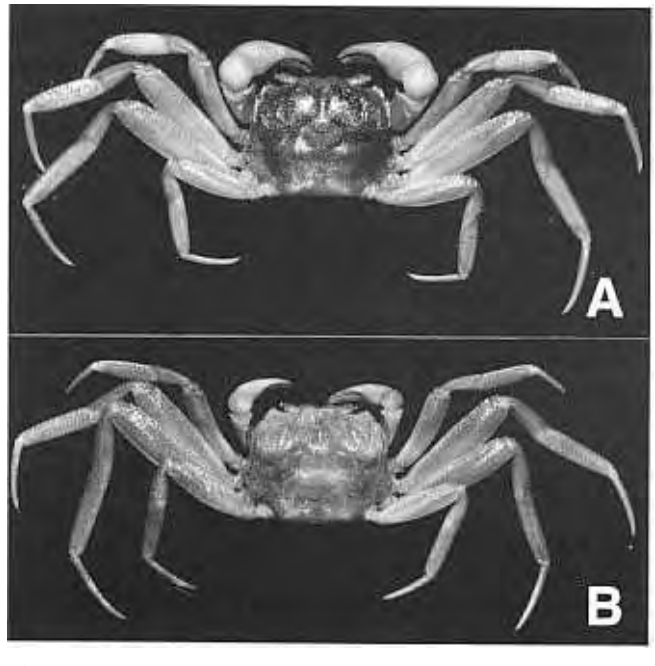

Fig. 13. *Sesarmoides guamensis*, new species. A, paratype male (15.1 by 12.4 mm) (ZRC), Guam; B, paratype female (18.5 by 14.2 mm) (ZRC), Guam.

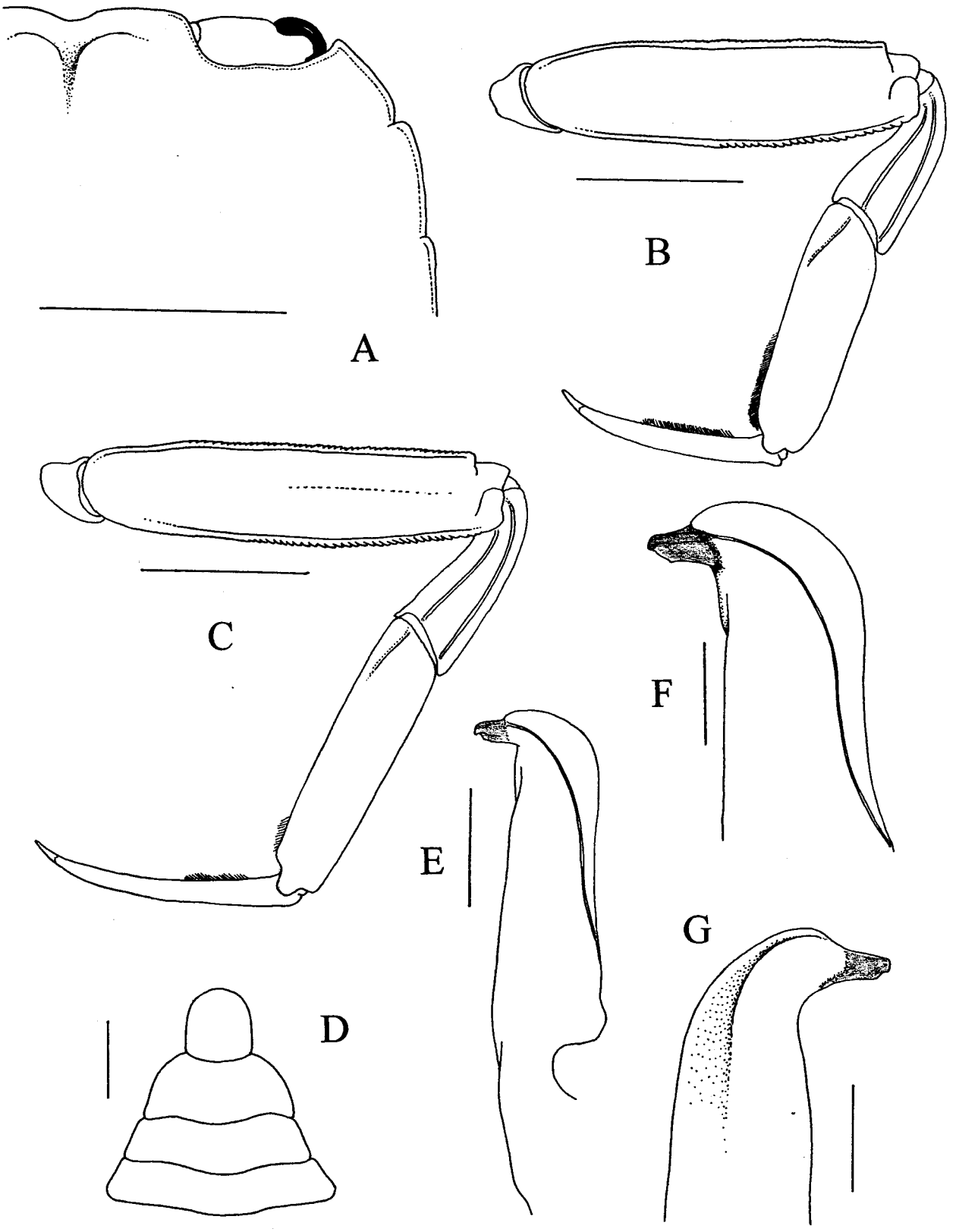

Fig. 14. *Sesarmoides guamensis*, new species. Paratype male (15.1 by 12.4 mm) (ZRC). A, carapace; B, second ambulatory leg; C, third ambulatory leg; D, abdominal segments 4-5 and telson; E-G, left G1 (denuded). Granules and setae on structures omitted. Scales: A-C = 5.0 mm, D = 2.0 mm, E = 1.0 mm, F, G = 0.5 mm.

Diagnosis (holotype). – Carapace approximately trapezoidal in shape; anterior regions well defined, with very short, widely but evenly spaced setae; lateral regions covered with oblique striae; epigastric region pronounced, separated by prominent groove; frontal margin with distinct concave median emargination; external orbital tooth with tip not reaching level of frontal margin; outer margin almost straight, separated from first anterolateral tooth by small V-shaped cleft; first anterolateral tooth separated from second anterolateral tooth by small fissure. Chelae relatively stout, fingers subequal to length of palm; ventral margin of pollex gently concave. Ambulatory legs long, length to width ratios of meri of second and third legs 3.7 and 4.1 respectively; dorsal and ventral margins with weak serrations, especially ventrally, dorsal subdistal edge angular but not spiniform; brush-like setae present on ventral margins of propodus and dactylus of first leg, usually present on second leg, sparse to occasionally absent on third leg, undiscernible on fourth leg. Prominent tufts of short setae between coxae of first to third ambulatory legs. Male abdomen relatively broad, lateral margins of male telson subparallel. G1 relatively short, stout, inner margin almost straight; distal part sharply bent outwards at approximately right angles, chitinous distal part short.

Paratypes. – In addition to the sexual characters, adult females have proportionately broader carapaces and relatively longer ambulatory legs, especially the second and third legs. None of the legs have brush-like setae on any of the segments. The anterior dorsal half of the carapace also has evenly spread out short setae that are usually relatively longer and more prominent than those in males.

Etymology. – The species is named after its type locality, Guam.

Colour. – The dorsal surface of the carapace is light purplish-brown, with the ventral surfaces dirty white. The male chelipeds are bright orange, those of the female being paler orange. The ambulatory legs are purplish-brown (Fig. 17b).

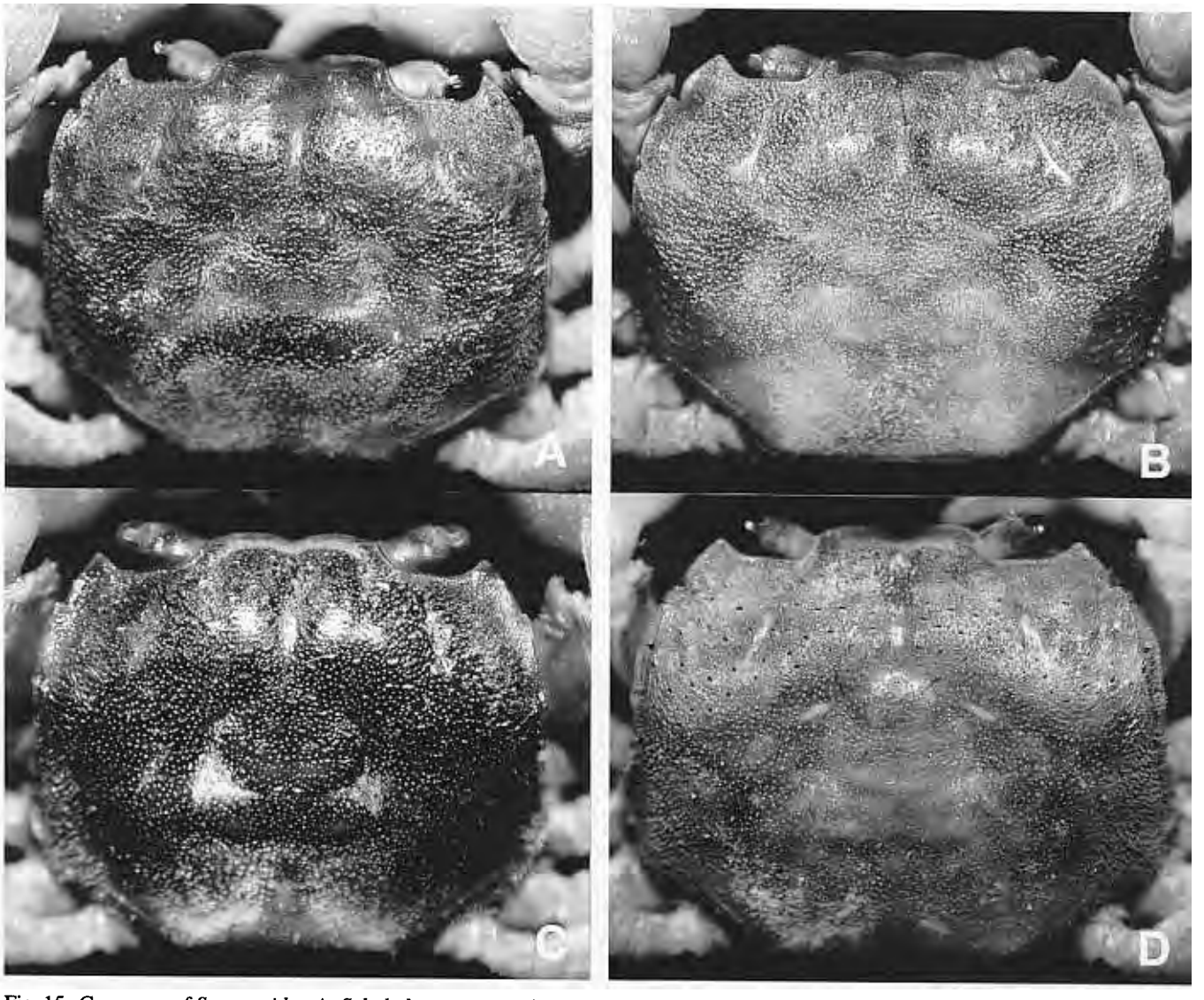

Fig. 15. Carapaces of *Sesarmoides*. A, *S. boholano*, new species, paratype male (15.1 by 12.3 mm) (ZRC), Pamglao Island; B, *S. boholano*, new species, paratype female (17.5 by 14.3 mm) (ZRC), Panglao Island; C, *S. guamensis*, new species, paratype male (15.1 by 12.4 mm) (ZRC), Guam; D, *S. guamensis*, new species, paratype female (18.5 by 14.2 mm) (ZRC), Guam.

Remarks. – *Sesarmoides guamensis* is perhaps closest to *S. boholano*, including the form of its G1, but can easily be separated by several carapace and ambulatory leg characters (see discussion for *S. boholano*).

Most of the specimens of *S. guamensis* were obtained from the moister parts of the cave roof. Some were observed to scrape the blue-green algae from the rocks. Several ovigerous specimens were obtained but the first zoeae could not be hatched. These females invariably pulled off the eggs from the abdomen after a few days in captivity. The eggs are very small and the zoeae almost certainly planktonic.

DISCUSSION

In male *S. boholano*, only the ventral margins of the propodi and dactyli of the first ambulatory leg are lined with a dense row of short, stiff setae, resembling a brush; being sparse to absent in the second and third third ambulatory legs, and are always absent on the fifth leg. In male *S. guamensis*, the ventral margins of the propodus and dactylus of the first ambulatory leg always have the brush-like setae; on the second third ambulatory leg, the brush-like setae are usually present on the ventral margins of the propodus and dactylus, but is often less dense, and barely discernible in a few specimens, and on the third ambulatory leg, the brush-like setae on these articles are usually sparse, sometimes absent. In *S. loyalty*, known only from one male specimen, such brush-like setae are only present on the first and second ambulatory legs, being undiscernible on the third and fourth. In *S. balicus* and *S. sulu*, both known only from one male, the brush-like setae are present on the propodi and dactyli of the first and second ambulatory legs but not discernible on the third. These brush-like setae are always absent on the fourth male ambulatory legs of all the species discussed above. They are also absent on all the female ambulatory legs.

In addition to the presence of the brush-like setae on the ambulatory legs, adult female specimens of *S. boholano*, *S. guamensis* and *S. sulu* also have distinctly broader carapaces proportionately and relatively longer ambulatory legs (Figs. 7, 9E, F, 11, 13, 15). In the good series of specimens of *S. boholano* and *S. guamensis* examined, females also usually have slightly longer setae on the anterior part of the dorsal surface of the carapace and thus appear somewhat more setose (Fig. 15). In *S. sulu* on the other hand (but known from only one heterosexual pair), the carapace setae of the male are more prominent (Figs. 7, 9E, F).

Sesarmoides jacksoni is not well known, although the species is very distinctive with its very long ambulatory legs (cf. Balss, 1934; Ng, 1988a). The carapace shape and the presence of setae between the bases of the first to third ambulatory legs allies *S. jacksoni* with most of the taxa treated here, but its more elongate legs (length to width ratio

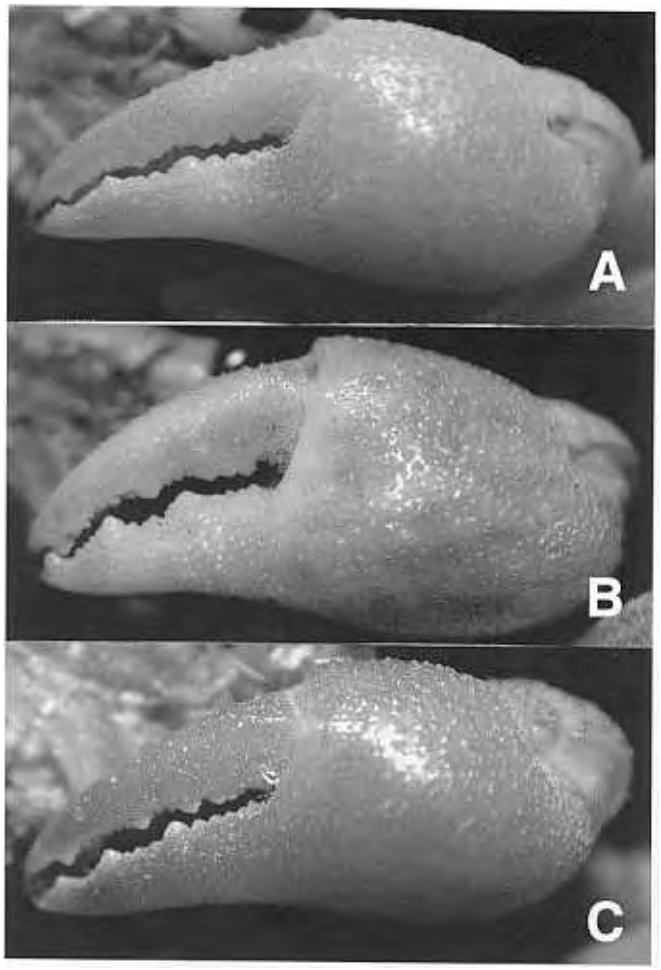

Fig. 16. Male chelae of *Sesarmoides*. A, *Sesarmoides sulu*, new species, holotype (18.9 by 15.1 mm) (MZF); B, *S. boholano*, new species, paratype (15.1 by 12.3 mm) (ZRC), Panglao Island; C, *S. guamensis*, new species, paratype (15.1 by 12.4 mm) (ZRC), Guam.

Fig. 17. Life colours. a, *Sesarmoides boholano*, new species, Virata Cave, Panglao, Panglao Island, Bohol, Philippines (photograph: author); b, *S. guamensis*, new species, Faifai Beach, Guam (photograph: H.-C. Liu). (Specimens not collected).

of third ambulatory leg 5.1) easily distinguishes it from these. It is known only from Christmas Island in the Indian Ocean thus far, primarily from caves, although it is known to wander outside this habitat (see Ng, 1988a: 186).

None of the species of cavernicolous *Sesarmoides* species discussed here have the reduced eyes or loss in pigmentation associated with true troglobites (sensu Guinot, 1988), although all have long ambulatory legs. The only species of *Sesarmoides* with reduced eyes is *S. jacobsoni* from Java. Ovigerous *S. guamensis* were collected, but no larvae were obtained; the specimens having very small eggs. Thus far, larvae are not known for any *Sesarmoides* species but no species is expected to have completely or even partially abbreviated development like in *Geosesarma* species (see Ng, 1988b). How the species of anchialine or coastal cave-dwelling *Sesarmoides* species release their eggs is still not known. It is seems likely that some of the species may have to migrate to the open sea, perhaps like the cavernicolous gecarcinid *Discoplax longipes* (see Ng & Guinot, 2001). *Sesarmoides boholano* for example, was obtained in caves where there were no obvious connections to the sea (e.g. Virata) as well as in caves with permanent pools (e.g. Tawala and Hinagdanan) with clear underground connections to the open sea.

KEY TO SPECIES OF *SESARMOIDES*

1 a. Ocular peduncle short, cornea small, eyes occupying only part of orbit [Java: Indonesia] ..... *S. jacobsoni*

b. Ocular peduncle and cornea of normal size and occupying entirely the orbital cavity 2

2 a. Outer surface of pollex of chela with a distinct longitudinal row of small conical tubercles, more prominent in males (Fig. 1C) 3

b. Outer surface of pollex of chela may be rugose or granulated, but without longitudinal row of small conical tubercles 5

3 a. Carapace with only 1 epibranchial tooth; length of third ambulatory leg less than 3 times extraorbital width, propodus about 2-3 times as long as broad; anterior frontal margin nearly straight; male abdomen with telson slightly shorter than broad at base; length of segment 6 slightly less than twice width [East Africa] ..... *S. longipes*

b. Carapace with 2 epibranchial teeth; length of third ambulatory leg more than 3 times extraorbital width, propodus about 4 times as long as broad; anterior frontal margin gently sinuous; length of segment 6 not as above 4

4 a. Outer surface of pollex with a longitudinal row of 8-13 small conical tubercles; adult male abdomen with segment 6 a little shorter than half its proximal breadth [Indian Ocean and Southeast Asia] ..... *S. kraussi*

b. Outer surface of pollex with a longitudinal row of 3-5 more elongated tubercles; adult male abdomen with segment 6 slightly longer than half proximal breadth [Southeast Asia] ..... *S. borneensis*

5 a. No tufts of setae between coxae of first to third ambulatory legs 6

b. Distinct tufts of setae between coxae of first to third ambulatory legs 8

6 a. Ambulatory legs extremely long, third ambulatory leg (merus to dactylus length) about 4.9 times carapace length [Solomon Islands] ..... *S. ultrapes*

b. Ambulatory legs long, but third ambulatory leg (merus to dactylus) distinctly less than 4.5 times carapace length 7

7 a. Tip of external orbital tooth reaching just beyond level of frontal margin; male telson equal in length to segment 6 [Ambon: Indonesia] ..... *S. cerberus*

b. Tip of external orbital tooth not reaching level of frontal margin; male telson shorter than segment 6 [New Britain] ..... *S. novabritannia*

8 a. Surface of carapace without obvious oblique striae on posterior branchial region; meri of second to third ambulatory legs 4.7 and 5.1 times carapace length respectively [Christmas Island: Indian Ocean] ..... *S. jacksoni*

b. Surface of carapace with clear oblique striae on posterior branchial region; meri of second to third ambulatory legs less than 4.5 and less than 5.0 times carapace length respectively 9

9 a. Meri of first to third ambulatory legs with sharp distal dorsal spine (Figs. 8B, C) [Palawan: Philippines] ..... *S. sulu*

b.Meri of first to third ambulatory legs without distal dorsal spine, may be angular but never spiniform 10

10 a. External orbital tooth truncate, outer margin straight to gently concave, separated from first anterolateral tooth by prominent, deep V-shaped notch (Fig. 12A) [Bohol: Philippines] ..... *S. boholano*

b. External orbital tooth not truncate, outer margin almost straight to gently convex, separated from first anterolateral tooth by narrow cleft or relatively shallower notch (e.g. Figs. 5A, 14A) 11

11 a. G1 with elongate, slender chitinous distal part (e.g. Figs. 5F, G) 12

b. G1 with relatively short, truncate chitinous distal part (e.g. Figs. 3F, G) 13

12 a. External orbital tooth separated from first anterolateral tooth by very shallow notch (Fig. 6A); length to width ratios of meri of second and third ambulatory legs 3.1 and 3.5 respectively (Figs. 6B, C); inner margin of G1 with gentle submedian hump (Fig. 6E) [Loyalty Islands] ..... *S. loyalty*

b. External orbital tooth separated from first anterolateral tooth by very shallow notch (Fig. 5A); length to width ratios of meri of second and third ambulatory legs 3.3 and 3.6 respectively (Figs. 5B, C); inner margin of G1 almost straight (Fig. 5E) [Bali: Indonesia] ..... *S. balicus*

13 a. Length to width ratios of merus of second and third ambulatory legs 4.3 and 4.0 respectively (Figs. 3B, C); length to width ratios of propodi of second and third ambulatory legs 4.1 and 4.5 respectively; G1 with chitinous distal part slightly bent downwards (Figs. 3F, G) [Bali: Indonesia] ..... *S. emdi*

b. Length to width ratios of meri of second and third ambulatory legs 3.7 and 4.1 respectively (Figs. 14B, C); length to width ratios of propodi of second and third ambulatory legs 3.4 and 4.2 respectively; G1 with chitinous distal part bent at right angles (Figs. 14F, G) [Guam] ..... *S. guamensis*

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