A new calocaridid shrimp of the genus *Calaxiopsis* Sakai & de Saint Laurent, 1989 (Crustacea, Decapoda, Thalassinidea) from deep waters off Taiwan

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KEY WORDS
Crustacea,
Decapoda,
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Calocaridae,
Calaxiopsis,
deep sea,
Taiwan,
new species.

ABSTRACT
An undescribed species of the rare thalassinidean genus *Calaxiopsis* Sakai & de Saint Laurent, 1989 was found in samples obtained during a recent deep-sea survey off Taiwan. The new species, *Calaxiopsis mclaughlinae* n. sp., is unique within the genus in that the rostrum and telson each bear only one pair of spines, and in that the carapace bears a distinct median carina extending from the base of the rostrum to the cervical groove.

MOTS CLÉS
Crustacea,
Decapoda,
Thalassinidea,
Calocaridae,
Calaxiopsis,
eaux profondes,
Taiwan,
espèce nouvelle.

RÉSUMÉ
Une nouvelle crevette Calocarididae du genre Calaxiopsis *Sakai & de Saint Laurent, 1989 (Crustacea, Decapoda, Thalassinidea) des eaux profondes du large de Taiwan.*
Une espèce de Thalassinidea non encore décrite, appartenant au rare genre *Calaxiopsis* Sakai & de Saint Laurent, 1989, a été trouvée dans les récoltes faites récemment lors d'une campagne en mer profonde au large de Taiwan. L'espèce récoltée, *Calaxiopsis mclaughlinae* n. sp., se distingue dans le genre par le rostre et le telson armés chacun d'une seule paire d'épines et la carapace présentant une carène médiane nette s'étendant de la base du rostre au sillon cervical.

INTRODUCTION

Sakai & de Saint Laurent (1989) established a new genus, *Calaxiopsis*, under the family Axiidae Huxley, 1879. Kensley (1989), however, argued that taxa previously assigned to the Axiidae and characterized by hermaphroditism, eye reduction and second pleopod having an enlarged appendix masculina along with loss of the distal endopod, should be assigned to the Calocarididae Ortmann, 1891. Poore's (1994) cladistic analysis of the Thalassinidea showed *Calaxiopsis* to be in the Calocarididae.

Calaxiopsis is a small and rare genus containing only three species, each of which is represented only by the type material. They are found in the different oceans of the world, with *C. serrata* Sakai & de Saint Laurent, 1989 from the Gulf of Guinea, eastern Atlantic (type species of the genus), *C. felix* (Alcock & Anderson, 1899) from the Arabian Sea, Indian Ocean, and *C. manningi* Komai, 2000 from Japan, northwestern Pacific.

During recent Taiwanese/French deep water exploratory trawling off Taiwan, several specimens belonging to *Calaxiosis* were collected. Careful examination revealed that the specimens represent a new species. This new species, the fourth in *Calaxiopsis*, is described herein. The type specimens are deposited at the National Taiwan Ocean University (NTOU) and Muséum national d'Histoire naturelle, Paris (MNHN). Carapace length (cl) is measured dorsally from the orbital margin to the posterior margin of the carapace. The abbreviation CP refers to French beam trawl.

SYSTEMATICS

Family CALOCARIDIDAE Ortmann, 1891
Genus *Calaxiopsis*
Sakai & de Saint Laurent, 1989

Calaxiopsis mclaughlinae n. sp.
(Figs 1-4)

TYPE MATERIAL. — Holotype: TAIWAN 2002, R/V *Ocean Researcher I*, stn CP 195, 24°52.02'N, 122°03.11'E, 572-605 m, 11.IX.2002, holotype hermaphrodite cl 10.78 mm (NTOUA00096). — Paratypes: TAIWAN 2001, commercial trawler, stn CP 106, 24°51.17'N, 122°04.97'E, 650-800 m, 20.V.2001, 2 hermaphrodites cl 10.00 mm, 10.70 mm (NTOUA00082, transferred to MNHN-Th 1487); TAIWAN 2002, R/V *Ocean Researcher I*, stn CP 195, 24°52.02'N, 122°03.11'E, 572-605 m, 11.IX.2002, 1 hermaphrodite cl 11.15 mm (with bopyrid parasite in right branchial chamber), 2 ovig. hermaphrodites cl 10.33 and 11.00 mm (NTOUA00081).

ETYMOLOGY. — This species is named for Dr Patsy A. McLaughlin, in recognition of her extraordinary contribution to knowledge of the Anomura.

DISTRIBUTION. — So far known only from off the northeastern coast of Taiwan, at 572-800 m.

DESCRIPTION

Rostrum (Figs 1; 2A; 3A) narrow, about 0.2-0.3 times as long as carapace, slightly overreaching distal margin of first segment of antennular peduncle, slightly upturned, terminating in acute point; dorsolateral margins extending to anterior part of gastric region as weak ridges, armed with one pair of strong spines just above eyes; ventral margin unarmed. Carapace with gastric region convex; sharp median carina extending from base of rostrum to cervical groove, with small tubercle on anterior 0.15 of carapace length; submedian carina extending to 0.25 of carapace length, armed with two or three strong spines; intercarinal space between median and submedian carina roughly pitted; anterolateral margin with low, obtusely triangular suborbital lobe; pterygostomial angle weakly produced anteriorly, broadly rounded; cervical groove clearly delineated on dorsal part.

Abdomen (Fig. 1) rounded dorsally, with sparse long setae on dorsal surface. Pleuron of first somite acutely triangular; pleura of second to sixth somite unarmed. Sixth somite with rounded posterolateral lobe. Telson subrectangular, about 1.8 times longer than wide; dorsal surface with shallow median sulcus extending from anterior 0.2 to nearly posterior margin; dorsolateral ridges low, unarmed; lateral margin unarmed; posterior margin convex, with one pair of movable spines at lateral angles.

Ocular peduncles (Fig. 3A, C) greatly reduced, narrowly separated from each other at bases, partially fused with cephalothorax; cornea (Fig. 3C, D) rather large, subovate, faintly faceted, opaque in preservative.

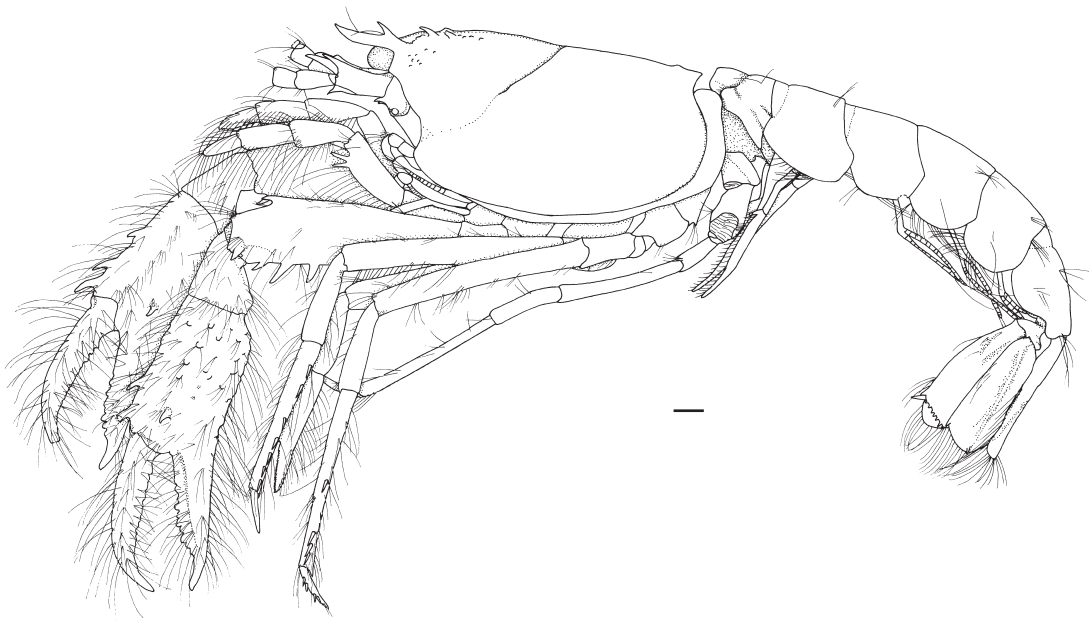

FIG. 1. — *Calaxiopsis mclaughlinae* n. sp., holotype, hermaphrodite, cl 10.78 mm, Taiwan (NTOUA00096), habitus, lateral view. Scale bar: 1 mm.

Antennular peduncle (Figs 1; 2A; 3A, B) reaching nearly to mid-length of fifth segment of antennal peduncle. First segment subequal in length to distal two segments combined, with small spine on lateral surface of statocyst lobe. Second segment unarmed. Third segment subequal in length to second segment, unarmed. Both antennular flagella longer than carapace, bearing short to long setae on distal margin of each article; ventral flagellum slightly longer than dorsal flagellum.

Antennal peduncle moderately stout. First segment with one or two small spines on ventrodistal margin; antennal gland opening situated ventrolaterally. Second segment with dorsolateral distal angle produced in strong spine, reaching midlength of fourth segment. Third segment with distinct spine at ventromesial distal angle. Fourth segment slightly narrowed basally. Fifth segment about 0.6 length of fourth segment. Antennal acicle slender, terminating in acute tip, reaching distal margin of fourth segment. Antennal flagellum much longer than antennular flagella, slightly longer than body, with several short to long setae on each article.

Mandible (Fig. 3E, F) with incisor process rounded anteriorly, bearing one small tooth on cutting edge medially; palp with three articles, third article longer than first and second articles combined, weakly curved, bearing short stiff setae distally. Maxillule (Fig. 3G) with coxal endite tapering distally, bearing numerous stiff setae mesiodistally; basal endite armed with spiniform setae on truncate mesiodistal margin; endopod consisting of two articles, distal article strongly sinuous, with one long apical bristle. Maxilla (Fig. 3H) with basal and coxal endites densely setose on mesial margins; coxal endite unequally bilobed, proximal lobe broader than distal lobe; basal endite also unequally bilobed, distal lobe broader than proximal lobe; endopod elongate, distinctly overreaching distal margin of basal endite, slightly sinuous, tapering, bearing four long apical setae; scaphognathite with elongate, setulose seta on posterior apex of subtriangular posterior lobe. First maxilliped (Fig. 3I) with elongate suboval basal endite; coxal endite short; endopod weakly arched, tapering distally, reaching distal 0.4 of exopod, not visible in outer view; exopod very slightly curved mesially, flagel-

lum rudimentary, articulated at distomesial angle of exopod; epipod bearing numerous teeth, weakly bilobed with distal lobe smaller than proximal lobe. Second maxilliped (Fig. 3J) with elongate merus of endopod, 4.4 times longer than wide; carpus short; propodus 1.2 times longer than wide; dactylus subovoid with nine spiniform setae; exopod slender, almost reaching distal margin of carpus of endopod; epipod armed with spinulose tubercles on margins and lateral surface. Third maxilliped (Fig. 3K) with exopod overreaching distal margin of carpus of endopod; ischium of endopod with two small spines on proximal half of ventral margin, crista dentata (Fig. 3L) composed of a row of small, unequal teeth (proximal teeth very small, showing as tubercles); merus with two strong subdistal spines on ventral margin; carpus unarmed, slender, propodus slender, slightly shorter than carpus; dactylus digitiform, shorter than propodus.

First pereiopod strong, chelate, slightly unequal. Major first pereiopod (left) (Fig. 2D) with ischium bearing two or three ventral spines; merus about 3.5 times longer than high, armed with one submarginal spine at ventrodistal angle of lateral surface, one subdistal spine on dorsal margin, and six to eight spines on ventral margin; carpus short, about 0.3 length of merus, unarmed; chela about 4.0 length of carpus, about 2.8 times longer than high; palm about 1.3 times longer than high, armed with two or three spines on distal 0.4-0.6 of dorsal margin, mesial surfaces with one (rarely three) subdistal spine and lateral surfaces each with one subdistal spine medially; both fingers terminating in curved claw, crossing for each other; cutting edge of fixed finger with 10 strong subacute teeth becoming weaker distally, lateral surface with blunt median carina; dactylus about 1.2 length of palm, lateral surface with median carina; cutting edge irregularly denticulated. Minor first pereiopod (right) (Fig. 2E) with ischium bearing two to five ventral spines; merus about 3.6 times longer than high, armed with one submarginal spine at ventrodistal angle of lateral surface, one subdistal spine on dorsal margin, and four to eight spines on ventral margin; carpus short, about 0.3 length of merus; chela about 4.0 length of carpus, 2.9 times longer than high; palm about 1.4 times longer than high, with three or four spines on distal 0.5-0.6 of dorsal margin, mesial and lateral surfaces each with one subdistal spine medially; both fingers terminating in curved claw crossing for each other; fixed finger with blunt median carina on lateral surface, cutting edge with nine or 10 subacute teeth becoming weaker distally; dactylus about 1.1 length of palm, with distinct median carina on lateral surface, cutting edge with row of blunt and irregular denticles.

Second pereiopod (Fig. 2F) chelate; ischium, merus, and carpus unarmed; cutting edges of fingers each with row of small, closely set corneous spinules; carpus about 0.4 length of merus; chela 1.5 times longer than carpus; both fingers terminating in slender corneous claw.

Third pereiopod (Fig. 2G) relatively long, overreaching distal margin of antennal peduncle by length of dactylus and propodus; ischium, merus, and carpus all unarmed; carpus 0.4-0.5 of meral length; propodus about 1.6 times longer than carpus, lateral surface with two oblique rows of setae and a row of seven or eight small corneous spines on lateral surface ventrally; dactylus with two small corneous spines on lateral surface.

Fourth pereiopod (Fig. 2H, J) relatively long, overreaching distal margin of antennal peduncle by length of dactylus and two-thirds of propodus; ischium, merus, and carpus unarmed; carpus about 0.4 times as long as merus; propodus about 1.9 times longer than carpus, with row of five to nine small corneous spines on lateral surface ventrally; dactylus with four small corneous spines on lateral surface dorsally, terminating in slender corneous claw.

Fifth pereiopod (Fig. 2I, K) relatively long, slightly shorter than third pereiopod, almost reaching distal margin of antennal peduncle; ischium, merus, and carpus unarmed; carpus about 0.6 of meral length; propodus about 2.2 times longer than carpus, ventrodistal margin with grooming apparatus consisting of row of short bristles, and one corneous spine; dactylus somewhat twisted, ventrolateral margin expanded with row of minute corneous spinules, terminating in slender corneous claw.

Branchial formula summarized in Table 1. Sixth thoracic sternite (Fig. 3M) with one pair of spines

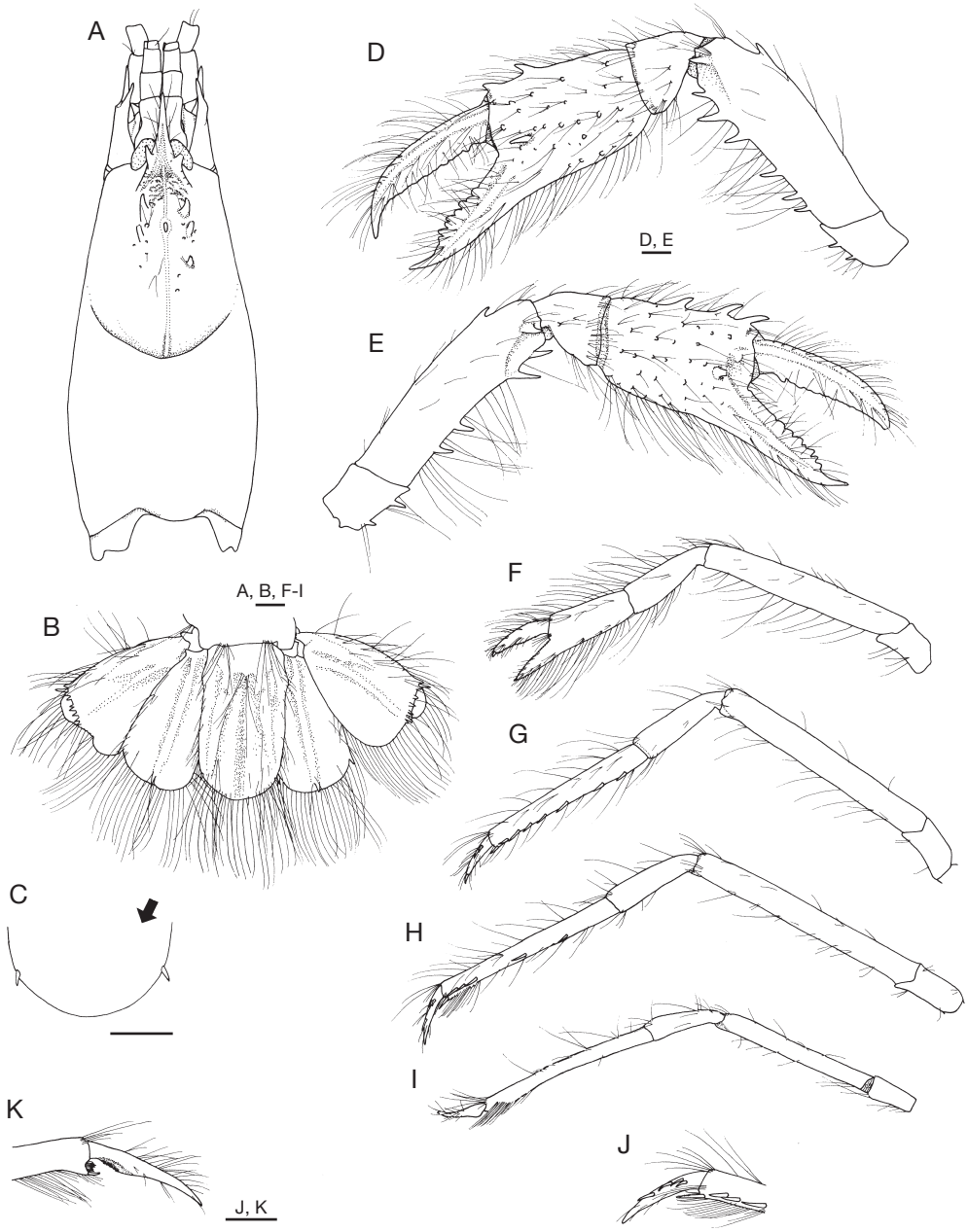

FIG. 2. — *Calaxiopsis mclaughlinae* n. sp., holotype, hermaphrodite, cl 10.78 mm, Taiwan (NTOUA00096): **A**, carapace, dorsal view; **B**, telson, dorsal view; **C**, telson, posterior margin, dorsal view (setae omitted); **D**, left major first pereiopod, lateral view; **E**, right minor first pereiopod, lateral view; **F**, second pereiopod, lateral view; **G**, third pereiopod, lateral view; **H**, fourth pereiopod, lateral view; **I**, fifth pereiopod, lateral view; **J**, dactylus and distal part of propodus of fourth pereiopod, lateral view; **K**, dactylus and distal part of propodus of fifth pereiopod, mesial view. Scale bars: 1 mm.

TABLE 1. — Branchial formula of *Calaxiopsis mclaughlinae* n. sp. Abbreviation: **r**, rudimentary.

	Maxillipeds			Pereiopods				
	1	2	3	1	2	3	4	5
Pleurobranch	-	-	-	-	-	-	-	-
Arthrobranchs	-	-	2	2	2	2	2	-
Podobranchs	-	r	1	1	1	1	-	-
Epipods	1	1	1	1	1	1	1	-

arising posterior to coxae of third pereiopods. Seventh thoracic sternite (Fig. 3M) divided into two sections by distinct transverse carina; carina produced anteromedially; anterior section narrowed anteriorly, partially fused with sixth sternite; posterior section with strongly raised lateral margins, bearing one pair of strong teeth anterolaterally; ventral surface depressed, with deep median pit followed by deep median groove extending to posterior surface. Eighth thoracic sternite (Fig. 3M) depressed medially on ventral surface.

First pleopod (Fig. 3M) contiguous, modified, uniramous; basal segment narrowed distally; distal segment shorter than basal segment, subtriangular with rounded apex, distal portion bilobed; proximomesial lobe prominent, bearing minute adhesive hooks on mesial margin. Second pleopod (Fig. 3N) with exopod reaching distal two-thirds of appendix masculina; appendix masculina elongate, mesial margin with double rows of numerous spiniform setae or bristles in distal half and transverse rows of spiniform setae or bristles in proximal half; appendix interna fused to proximal portion of appendix masculina, with minute adhesive hooks. Third to fifth pleopod biramous, each with well developed, slender appendix interna.

Uropod with endopod longer than wide, with one to three spines on lateral margin distally; submedian carina on dorsal surface terminating in spine posteriorly. Exopod longer than wide, lateral margin terminating in a small spine posteriorly, with one movable spine arising from just mesial to distolateral spine; lateral and submedian carinae on dorsal surface unarmed, transverse suture bearing several small spines.

Eggs few and large, oval, about 1.3-1.8 × 1.4-2.0 mm.

Size

Six specimens ranging from cl 10.00 to 11.15 mm.

Coloration

Body (Fig. 4) ivory (non-ovigerous) to pale yellowish (ovigerous) overall. Eyes and setae light brown. Eggs pale yellow.

REMARKS

The holotype of this new species is in good condition except for the posterior margin of the left uropodal exopod being irregular, which may be due to a regeneration after injury. The three paratypes all have a deformed telson, probably also due to regeneration after injury. Only the holotype has both first pereiopods attached to the body, of which the left is the major. One detached right first pereiopod was found in a jar containing two paratypic specimens from the station CP 106. We determined that the detached first pereiopod is a minor cheliped, because those paratypes both bear left major chelipeds. Nevertheless, it was not possible to determine to which specimen this detached cheliped belongs. All the specimens are morphologically similar in general.

The present new species generally fits the generic diagnosis of *Calaxiopsis*, particularly in the following respects: dorsolateral margins of rostrum extending to gastric region, armed with paired spines; anterolateral margin of carapace devoid of acuminate spine; gastric region convex, provided with five carinae including two continuous with dorsolateral rostral margin; cervical groove limited to dorsal part of carapace; eyes rounded and fused with carapace; pleurobranchs absent. *Calaxiopsis mclaughlinae* n. sp. is immediately distinguished from *C. serrata* and *C. manningi* by the armature of the rostrum and telson and the development of the gastric median carina on the carapace. In *C. mclaughlinae* n. sp., the rostrum is armed with only one pair of lateral spines, instead of three pairs in *C. manningi*, or four pairs in *C. serrata*. The telson is unarmed on the lateral margin in *C. mclaughlinae* n. sp., rather than having a row of three spines (in *C. serrata*) or six to eight (in *C. manningi*). Reexamination of the holotype of *C. manningi* disclosed that the fifth and posteriormost two spines on the left margin, and

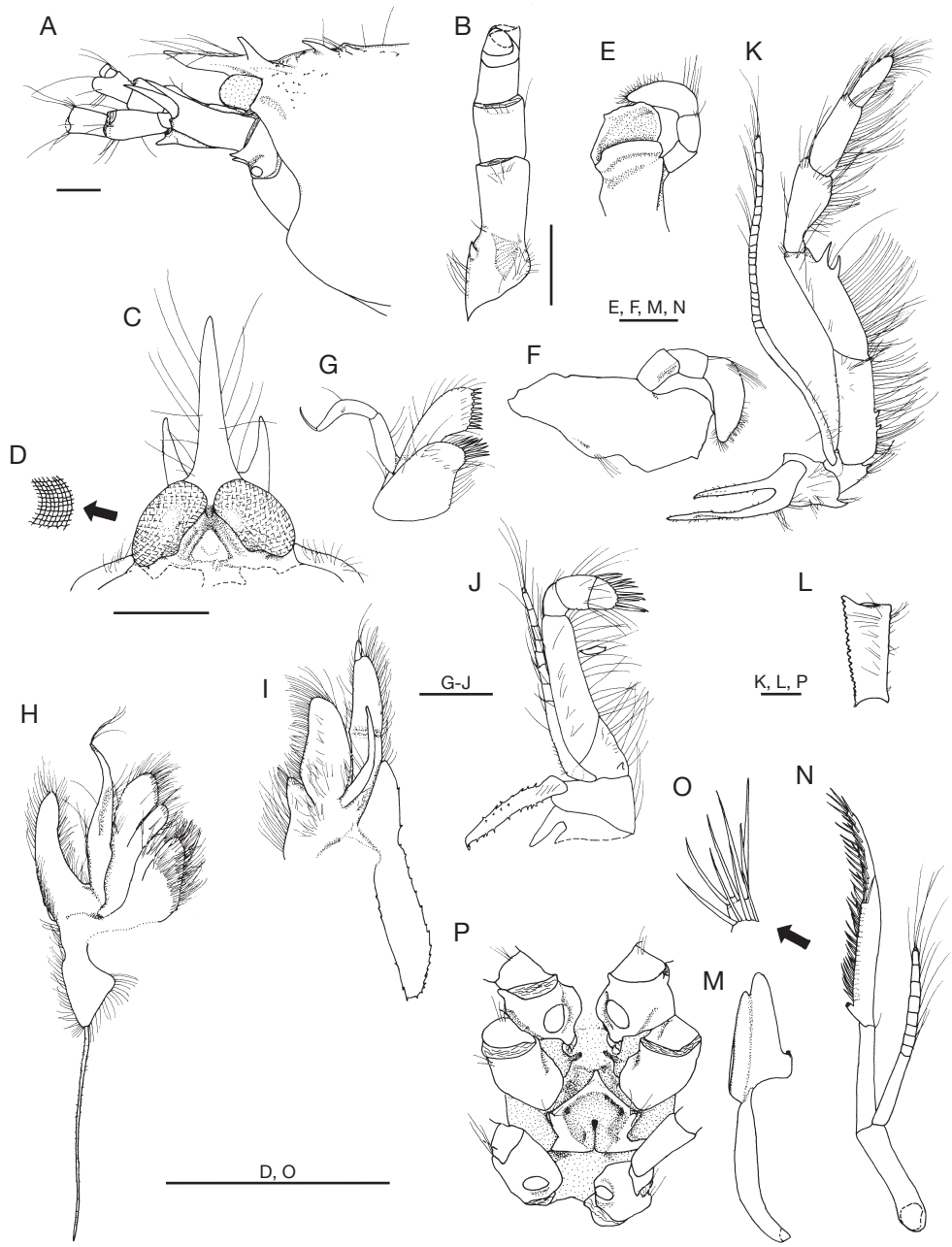

FIG. 3. — *Calaxiopsis mclaughlinae* n. sp. Taiwan: **A**, **P**, holotype, hermaphrodite, cl 10.78 m (NTOUA00096); **B**-**D**, paratype, hermaphrodite, cl 11.15 mm (NTOUA00081); **E**-**O**, paratype, ovigerous hermaphrodite, cl 11.00 mm (NTOUA00081); **A**, anterior part of carapace and cephalic appendages, lateral view (flagellum of antennule and antenna missing); **B**, antenular peduncle, dorsal view; **C**, eyes and anterior cephalic region, ventral view; **D**, faceted structure on right cornea region; **E**, mandible, inner view; **F**, mandible, outer view; **G**, right maxillule, outer view; **H**, right maxilla, outer view; **I**, right first maxilliped, inner view; **J**, right second maxilliped, outer view; **K**, right third maxilliped, lateral view; **L**, ischium of right third maxilliped, dorsal view; **M**, right first pleopod, posterior view; **N**, right second pleopod, anterior view (setae at proximal half of appendix masculine simplified, see O); **O**, transverse setae rows at proximal half of appendix masculina of second pleopod; **P**, thoracic sternum and coxae of third to fifth pereiopods, ventral view. Scale bars: 1 mm.

Fig. 4. — *Calaxiopsis mclaughlinae* n. sp. Taiwan: **A**, holotype, hermaphrodite, cl 10.78 mm (NTOUA00096); **B**, paratype, ovigerous hermaphrodite, cl 11.00 mm (NTOUA00081), right first pereiopod found detached, and may not belong to this specimen.

the fourth and posteriormost one spines on the right margin, are basally articulated, rather than fixed as described in the original description. The median gastric carina extends to the cervical groove in *C. mclaughlinae* n. sp. In contrast, the carina does not extend beyond the level of the mid-length between the rostral base and the cervical groove in *C. serrata* and *C. manningi*. Furthermore, *Calaxiopsis serrata* differs from *C. mclaughlinae* n. sp. in the armament of the abdominal pleura. In *C. serrata*, the second abdominal pleuron forms an obtuse triangular tooth at the posteroventral angle, and each third to fifth abdominal pleura is armed with two ventral teeth, whereas in *C. mclaughlinae* n. sp., these pleura are rounded and unarmed. *Calaxiopsis manningi* differs from *C. mclaughlinae* n. sp. in the unarmed submedian carinae on the gastric region and the unarmed suture of the uropodal exopod. In the new species, the submedian carina is provided with two or three strong spines; the suture of the uropodal exopod bears a row of small spines. Differences are found in the morphology of the second pleopods between *C. mclaughlinae* n. sp. and *C. manningi*. The appendix masculina is slightly curved mesially in *C. mclaughlinae* n. sp., rather than slightly recurved in *C. manningi*; setae on the mesial margin of the appendix masculina are more numerous in *C. mclaughlinae* n. sp. than in *C. manningi*; the appendix interna is less developed in *C. mclaughlinae* n. sp. than in *C. manningi*. Little is known about the detailed morphology of the second pleopod of *C. serrata*, and it was not possible to fully assess the differences in the morphology of the second pleopods between *C. mclauglinae* n. sp. and *C. serrata*.

Calaxiopsis felix is very poorly known (Komai 2000), and its diagnostic features are difficult to fully assess. Sakai & de Saint Laurent (1989) transferred this species from *Calastacus* to *Calaxiopsis* based only on the superficial similarity in the setation of the body and chelipeds as well as the shape of the telson to the type species of *Calaxiopsis*, *C. serrata*. The generic assignment of *C. felix* still needs to be verified. The thickly setose palm of the first pereiopod and the middorsal carina on the carapace extending to the posterior margin, clearly mentioned or illustrated in the literature (Alcock & Anderson 1899; Alcock 1899, 1901) distinguish *C. felix* from all the other *Calaxiopsis* species.

The new species appears to be hermaphroditic like other species of the Calocarididae (Kensley 1989, 1996a, b; Kensley & Chan 1998; Kensley *et al*. 2000; Ngoc-Ho 2003; Sakai & Ohta 2005). The ovigerous specimens have gonopores on coxae of both the third and fifth pereiopods, as well as modified first and second pleopods with the second bearing an appendix masculina. The other four non-ovigerous specimens also have two pairs of gonopores and two pairs of modified pleopods.

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