

Rare mud shrimp genus *Naushonia* Kingsley (Decapoda: Thalassinidea: Laomediidae) from Japan: description of a new species and new record of *N. lactoalbida* Berggren

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Abstract.— Two species of the rare mud shrimp genus *Naushonia* Kingsley, 1897 (Thalassinidea: Laomediidae) are reported from Japanese waters. *Naushonia japonica*, new species, described based on a single male specimen from Shimonoseki, southwestern Honshu, is similar to *N. perrieri* (Nobili, 1904) known only from the Red Sea. They are differentiated by the armature of the rostrum and anterolateral margin of the carapace, development of the second lateral carina on the gastric region of the carapace, armature of the antennal scale and shape of the dactylus of the first pereopod. *Naushonia lactoalbida* Berggren, 1992, originally described from Mozambique, East Africa, is recorded from Iriomote Island, southern Ryukyu Islands. The record of species of *Naushonia* in the western Pacific region has been represented only by planktonic zoeas of an unidentified species taken at Gokasho Bay, central Japan (Konishi, 2001). The occurrence of species of *Naushonia* in the region is now fully confirmed by the discovery of the adult specimens.

Introduction

The laomediid mud shrimp genus *Naushonia* Kingsley, 1897 is rare, and very few findings of specimens belonging to species of the genus have been reported in spite of their habitats in shallow waters. The genus was first described by Kingsley (1897) with a new species of shrimp *Naushonia crangonoides* described from off

the coast of Massachusetts, U.S.A. Kingsley (1897) suggested certain similarities in the subchelate structure of the first pereopod between *Naushonia* and the caridean family Crangonidae, but he noted differences, which might justify the establishment of a new family. Later Thompson (1903) remarked on the similarities of zoeas of *N. crangonoides* to those of *Jaxea nocturna* Nardo, 1847 (as *Calliaxis adriatica*), and suggested the assignment of *Naushonia* to the thalassinidean family Laomediidae. Chace (1939) was the first who thoroughly revised *Naushonia*, synonymizing *Homoriscus* Rathbun, 1901 and *Coralliocrangon* Nobili, 1904 under *Naushonia*. Although the genus is known from both Atlantic and Pacific coast of America, the Red Sea, and east coast of Africa (Goy & Provenzano, 1979; Martin & Abele, 1982; Berggren, 1992; Alvarez *et al.*, 2000), no species of *Naushonia* was known from the western Pacific localities until recently Konishi (2001) reported first stage zoeas of an undetermined species taken in the plankton from Gokasho Bay, Mie Prefecture, Japan. Seven named species are known in the genus: *N. crangonoides* Kingsley, 1897 from the east coast of U.S.A.; *N. portoricensis* (Rathbun, 1901) from the Gulf of Mexico and the Caribbean; *N. perrieri* (Nobili, 1904) from Somalia, Red Sea; *N. macginitie* (Glassel, 1938) from southern California and Mexico, U.S.A.; *N. panamensis* Martin and Abele, 1982 from the Pacific coast of Panama; *N. lactoalbida* Berggren, 1992 from Mozambique; and *N. manningi* Alvarez, Villalobos and Iliffe, 2000 from Bahamas. Available information suggests that the genus is most

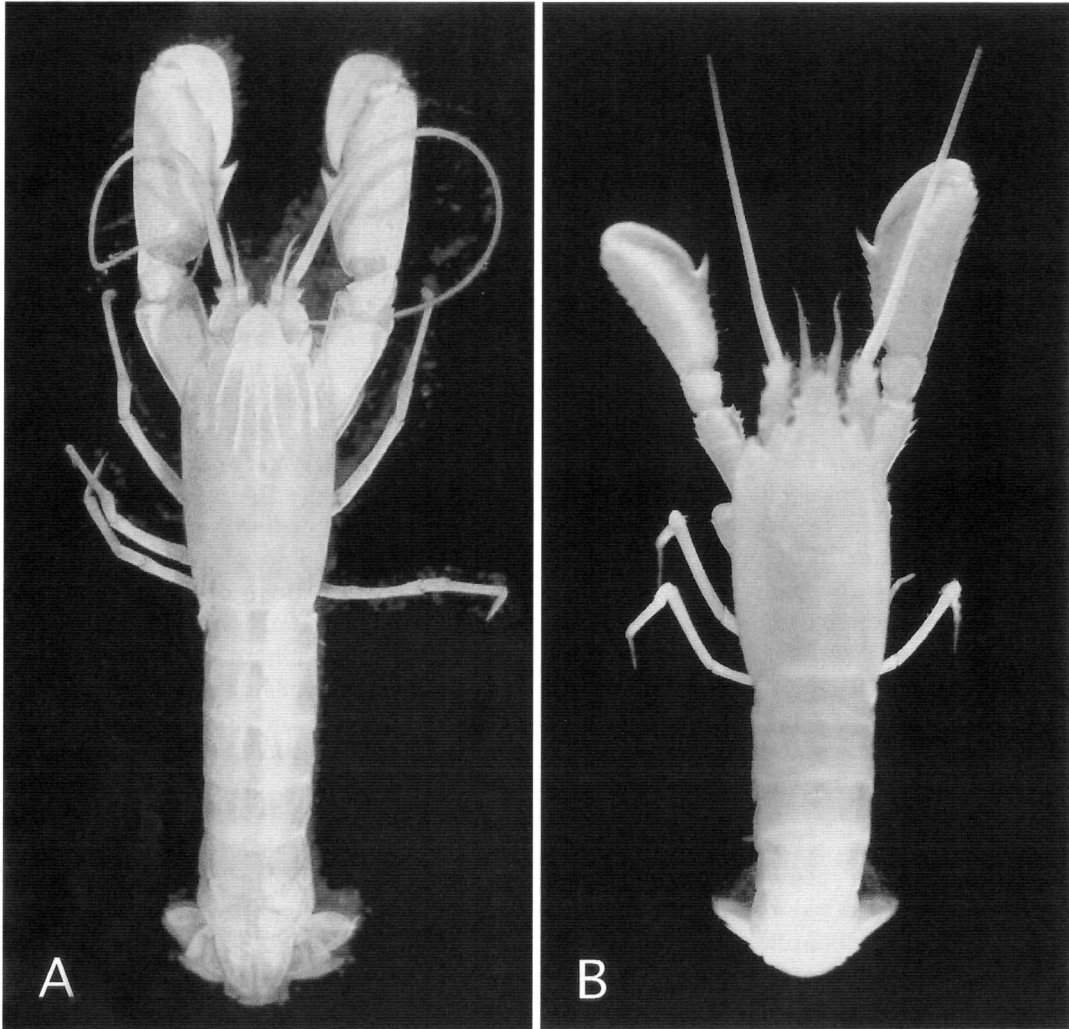


Fig. 1. A, *Naushonia japonica*, new species, holotype male from Shimonoseki (CL 6.0 mm; CBM-ZC 7544), entire animal in dorsal view; B, *Naushonia lactoalbida* Berggren, 1992, female from Iriomote Island (CL 4.3 mm; CBM-ZC 7545), entire animal in dorsal view.

diverse in America with five of the seven known species.

In this study, a new species, *N. japonica*, is described and illustrated on the basis of a single male specimen from Shimonoseki, Yamaguchi Prefecture, Japan, representing the eighth species in the genus. A significant range extension of *N. lactoalbida* is also recorded based on a single male specimen from Iriomote Island, southern Ryukyu Islands. The occurrence of the genus in the western Pacific region, first indicated by

Konishi (2001), is now fully confirmed, although the specific identity of the larvae reported by Konishi remains still indeterminate.

Material and Methods

Specimens used in this study are deposited in the Natural History Museum and Institute, Chiba (CBM, with a code of ZC) and Nationaal Natuurhistorisch Museum, Leiden (RMNH, with a code of D). The

abbreviation CL is used for postorbital carapace length. The drawings were made with the aid of a drawing tube mounted on a Leica MZ8 stereomicroscope. For detailed observation of the surface structure, the specimens (including removed appendages) were stained with methylene blue.

Taxonomic account

Infraorder Thalassinidea

Family Laomediidae

Genus *Naushonia* Kingsley, 1897

Naushonia japonica, new species
(Figs 1A, 2–4)

Material examined.— Holotype: male CL 6.0 mm, Yoshimi beach (in front of National Fisheries University), Shimonoseki, Yamaguchi Prefecture, 7 m deep, under stone, 6 November 1997, SCUBA diving, coll. K. Nomura (CBM-ZC 7544).

Description.— Body (Fig. 1A) moderately robust. Rostrum (Fig. 2A–D) strongly flattened dorsoventrally, rounded in dorsal view, reaching distal margin of second segment of antennular peduncle; margins with row of numerous small spines increasing in size anteriorly; dorsal surface with shallow median depression extending posteriorly to just anterior to anterior end of median carina on carapace, and with granules.

Carapace (Fig. 2A–D) subcylindrical, with pronounced linea thalassinica. Postorbital spine small, simple. Postantennal notch deep. Anterolateral margin spinulose, deeply notched just ventral to small branchiostegal spine. Branchiostegal spine supported by short ridge. Gastric region of carapace slightly convex, with five longitudinal carinae, including median carina interrupted by cervical groove, all carinae low, minutely tuberculate; anterior section of median carina beginning from slightly posterior to level of postantennal notch; first carinae slightly diverging posteriorly, each beginning from just level of postantennal notch, but not extending to cervical groove;

second carinae subparallel to first carinae, not confluent with lateral rostral margins, each extending to level of midlength between orbital margin and cervical groove, followed by short, longitudinal patch of granules separated by short interval. Cervical groove conspicuous, but short, not extending onto lateral face, bordered posteriorly by unarmed transverse ridge. Posterior section of median carina extending nearly to posterodorsal margin of carapace. Posterior part of dorsal surface with scattered minute granules laterally. Lateral surface ventral to linea thalassinica with scattered granules (granules more numerous in anterior part), but without spines or spinules.

First abdominal somite (Fig. 2E) unarmed on anterodorsal border; dorsal surface with faint transverse ridge. Second to fifth abdominal somites devoid of median carina or row of tubercles on dorsal midline, but with faint longitudinal ridge on lateral face on third and fourth somites; pleura rounded ventrally. Sixth somite (Fig. 2E, F) with trace of median carina and low, somewhat squamiform tubercles on either side of midline; pleuron smooth marginally; posterolateral process blunt. Telson (Fig. 2F) subrectangular with slightly convex posterior margin, 1.3 times longer than wide; lateral margin unarmed; dorsal surface with scattered small, low tubercles, midline faintly sulcate; posterior margin and posterior half of lateral margins fringed with long plumose setae.

Ocular peduncle (Fig. 2C, D) short, stout, armed with small spine at distomesial angle; cornea unpigmented in preservative, not broader than ocular peduncle, partially visible in dorsal view.

Antennular peduncle (Fig. 2C, D, G) short, reaching distal margin of fifth segment of antennal peduncle. Basal segment not visible in dorsal view, with somewhat raised anterodorsal margin, with 1 conspicuous spine on ventrodistal margin; stylocerite rudimentary. Penultimate segment armed with 1 distolateral and 1 distomesial spines, and further with 2 spinules on mesial mar-

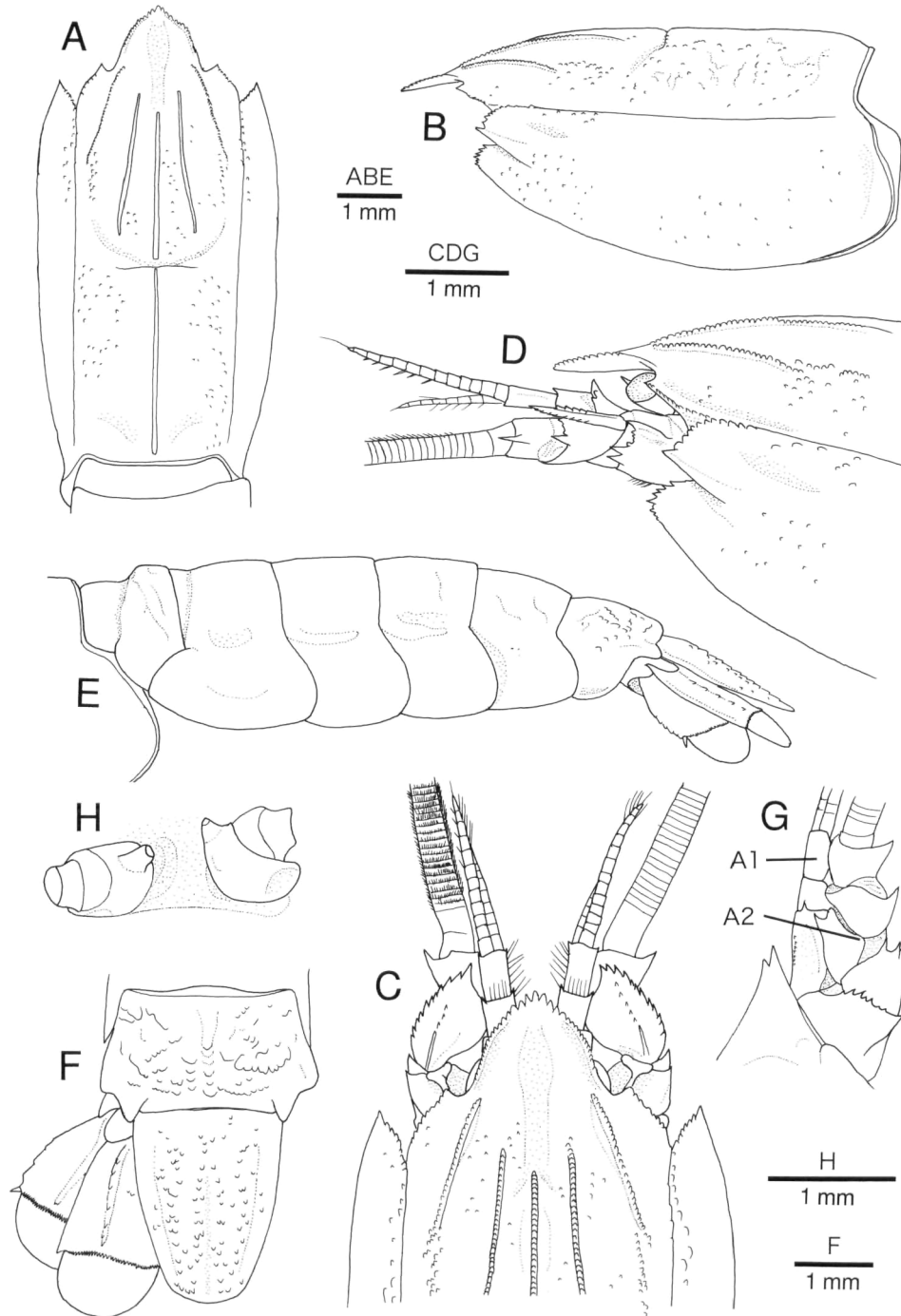


Fig. 2. *Naushonia japonica*, new species. Holotype male from Shimonoseki (CL 6.0 mm; CBM-ZC 7544). A, carapace, dorsal view; B, same, lateral view; C, anterior part of carapace and cephalic appendages, dorsal view; D, same, lateral view; E, abdomen, lateral view (setae omitted); F, sixth abdominal somite, telson and left uropod, dorsal view (setae omitted); G, left antennule (A1) and antenna (A2), ventral view (setae omitted); H, coxae of fifth pereopod, ventral view.

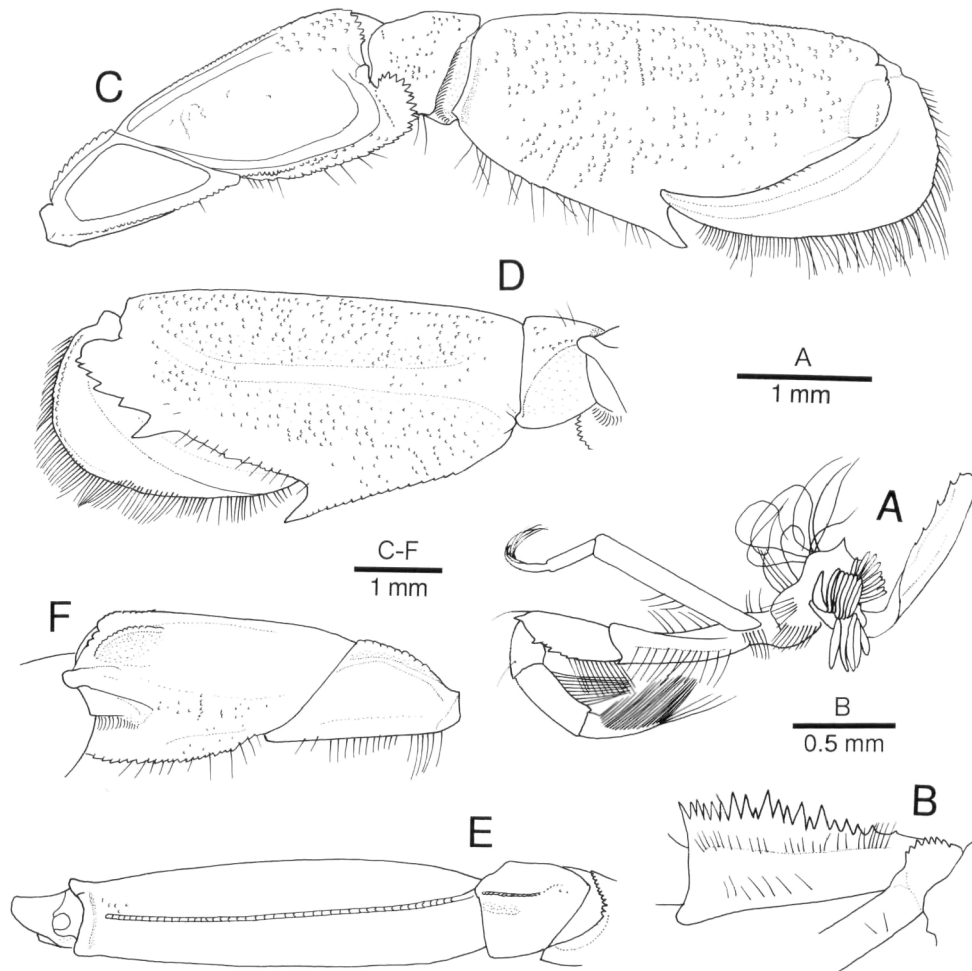


Fig. 3. *Naushonia japonica*, new species. Holotype male from Shimonoseki (CL 6.0 mm; CBM-ZC 7544). A, left third maxilliped, lateral view; B, same, ischium and basis, dorsal view; C, left first pereopod, dorsal view; D, chela and carpus of left first pereopod, ventral view; E, same, lateral view; F, merus of left first pereopod, ventral view.

gin. Ultimate segment with distolateral angle unarmed, but with tiny spinule at distomesial angle. Lateral flagellum longer than peduncle, composed of 13 articles; mesial flagellum about 0.6 length of lateral flagellum, composed of 8 articles.

Antennal peduncle (Fig. 2C, D, G) stout. First segment with row of spinules on ventrodistal margin. Second segment armed with row of minute tubercles on dorsodistal margin and 4 strong spines ventrodistal lateral margin. Third segment with 1 small

ventromesial spine. Fourth and fifth segments each with 1 strong distolateral spine. Flagellum somewhat shorter than body, stout, with dense annulation. Antennal scale broad with strongly convex mesial margin, terminating distally in small spine; lateral margin weakly convex, with 10 or 11 spines increasing slightly in size over almost entire length; dorsal surface with row of spinules on dorsal midline.

Mouthparts not dissected, but generally similar to those described for other con-

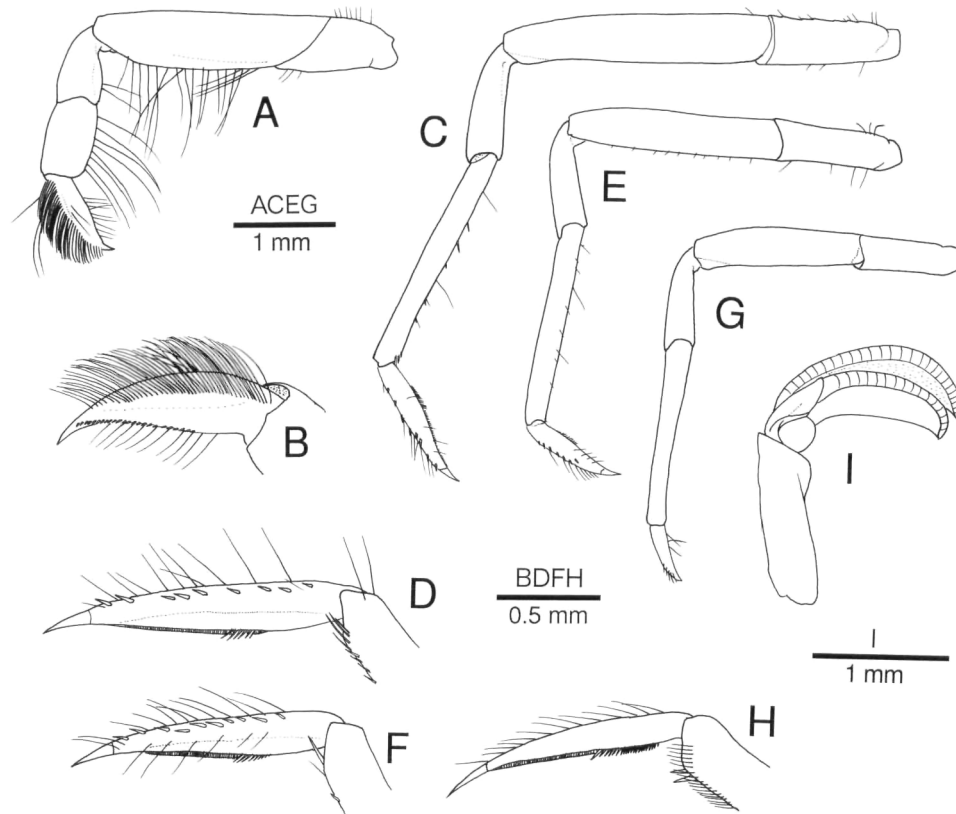


Fig. 4. *Naushonia japonica*, new species. Holotype male from Shimonoseki (CL 6.0 mm; CBM-ZC 7544). Left appendages. A, second pereopod, lateral view; B, same, dactylus, lateral view; C, third pereopod, lateral view; D, same, dactylus, lateral view; E, fourth pereopod, lateral view; F, same, dactylus, lateral view; G, fifth pereopod, lateral view; H, same, dactylus, lateral view; I, second pleopod, mesial view.

generic species (Berggren, 1992; Alvarez *et al.*, 2000). Mandible with row of acute teeth (middle tooth strongest) on mesial margin of incisor process. Third maxilliped (Fig. 3A) with endopod composed of 7 segments; coxa with setobranch composed of several long setae; basis (Fig. 3B) with row of spinules on ventromesial margin; ischium (Fig. 3B) broadened distally, with row of acute, unequal teeth on dorsomesial margin, ventral surface elevated in midline; merus with dorsodistal spinule and with few spinules on ventral margin distally; carpus short, with somewhat produced dorsodistal margin; propodus subequal in length to dactylus; dactylus with thick cluster of long setae extending to lateral face; exopod two-seg-

mented, proximal segment slightly overreaching ischium, distal segment very short, distinctly flexed against proximal segment; flagellum short, but well-developed; epipod very large, with denticulate dorsal margin; podobranch well developed.

First pereopods (Fig. 1A, 3C–F) strong, subchelate, subequal, flattened dorsoventrally. Coxa with conspicuous spine at ventrodistal angle. Basis with minute spinule at ventrolateral distal angle. Ischium broadened distally, with row of small tubercles on lateral margin and dorsomesial margin, but ventromesial margin entire. Merus broadened distally, section nearly triangular; dorsal surface with granules distolaterally, dorsodistal margin with row of spinules lateral-

ly; distomesial angle produced in rounded lobe, bearing spinules marginally; lateral margin sharply carinate, minutely tuberculate; mesial face narrow, granular, dorsomesial margin delimited by row of minute granules extending onto dorsal surface distally, ventromesial margin delimited with row of minute spinules, continuing to distomesial lobe; ventral surface bluntly elevated in midline, ventromesial face granular, ventrolateral face with short ridge distolaterally. Carpus short, surfaces granular except for ventral surface; dorsolateral, ventrolateral and ventromesial margins distinctly delimited, all margins without conspicuous spines. Propodus approximately rhomboidal in section, 1.9 times as long as wide (including fixed finger), about same length as ischium, merus and carpus together; dorsal and ventral surface granular, slightly elevated in midline; lateral margin sharply carinate, inconspicuously tuberculate; mesial margin also sharply carinate, minutely tuberculate, with row of sparse setae; ventromesial distal margin with row of sharp teeth increasing in size proximally in distal half, proximal half minutely denticulate; fixed finger relatively small for genus, directed distomesially. Dactylus relatively broad with noticeably expanded proximo-outer margin, closing completely against distomesial margin of propodus; dorsal and ventral surfaces both with low, blunt longitudinal ridge; mesial margin sharply carinate, mesial part just dorsal to sharp carina bearing double or triple row of short setae.

Second pereopod (Fig. 4A) shortest, stout, not chelate or subchelate. Merus with row of long setae on ventral margin. Carpus about 0.3 times as long as merus. Propodus slightly longer than carpus, with long setae on ventral surface. Dactylus (Fig. 4B) lanceolate, terminating in slender unguis; dorsal surface with dense, short to long setae; ventral margin with row of minute corneous spinules and sparse setae.

Third to fifth pereopods (Fig. 4C, E, G) generally similar, but decreasing in length toward posterior, moderately stout for

genus. Third pereopod with some granules on dorsal margin of ischium; merus slightly narrowed distally, 5.3 times as long as greatest width, unarmed; carpus about half length of merus, unarmed; propodus with row of slender spinules on ventral margin; dactylus (Fig. 4D) 0.6 times as long as propodus, 6.5 times as long as greatest width, terminating in slender corneous unguis, armed with 10 movable spines on lateral face adjacent to dorsal margin; dorsal margin of dactylus with row of setae; ventral margin of dactylus finely pectinate in distal 0.7 (except for unguis), proximal 6 or 7 spinules distinctly longer than others. Fourth pereopod with dactylus (Fig. 4F) 0.5 times as long as propodus, armed also with 10 spinules on lateral face adjacent to dorsal margin. Fifth pereopod with 2 distal spines at ventrodistal angle of somewhat flattened propodus; dactylus (Fig. 4H) 0.6 times as long as propodus, unarmed on lateral face, ventral margin finely pectinate with spinules on proximal 0.4 longer than others on distal 0.6; coxa with well calcified genital papilla (Fig. 2H).

First pleopod absent. Second to fifth pleopods each lacking appendix interna; appendix masculina absent on second pleopod (Fig. 4I). Uropod (Fig. 2F) with stout protopod deeply notched on dorsolateral margin; endopod and exopod each with complete, finely serrate, transverse suture; endopod overreaching posterior margin of telson, unarmed on lateral margin, but with row of low tubercles on low dorsal ridge on surface; exopod not reaching posterior margin of telson, with faintly denticulate lateral margin and 1 movable posterolateral spine, but unarmed on low dorsal ridge.

Color in life.— Entirely light yellowish brown.

Distribution.— Known only from the type locality, Yoshimi beach, Shimonoseki, Yamaguchi Prefecture, at a depth of 7 m. Found in burrow under stone on sandy substrate.

Remarks.— This new species is most similar to *Naushonia perrieri*, which was recently redescribed by Ngoc-Ho (1996)

based on the type material. These two species are differentiated from the other congeneric species by a suit of characters, the rounded rostrum, simple antennal spine, presence of two carinae on the gastric region either side of the midline and non-spinose lateral margin of the subchela. Although the rostrum of *N. perrieri* was described and/or illustrated as "truncate" by some authors (Nobili, 1904; Goy & Provenzano, 1979; Berggren, 1992; Alvarez *et al.*, 2000), it is actually rounded subtriangular like in the new species (Ngoc-Ho, 1996). The new species is easily distinguished from *N. perrieri* by the armature of the rostrum and anterolateral margin of the carapace, development of the second lateral carina on the gastric region of the carapace, armature of the antennal scale and shape of the dactylus of the first pereopod. In *N. japonica*, the posterior half of the lateral margin of the rostrum and anterolateral margin of the carapace are denticulate, whereas in *N. perrieri*, the margins are smooth. The second carina on the gastric region of the carapace is much longer in *N. japonica* than in *N. perrieri*. It extends from just posteromesial of the orbital margin to the midway between the level of the orbital margin and the cervical groove in *N. japonica*, rather than extending from the level of the postantennal notch to somewhat anterior to the level of the midway between the orbital margin and the cervical groove in *N. perrieri*. The antennal scale of *N. japonica* is armed with 10 or 11 spines (excluding the terminal spine) on the lateral margin over the entire length and with a row of spinules on the dorsal median ridge. In contrast, the antennal scale of *N. perrieri* is armed only with three spines (excluding terminal spine) on the distal half of the lateral margin and the dorsal median ridge of the antennal scale is unarmed. The dactylus of the first pereopod is noticeably expanded at the distomesial part in *N. japonica*, and thus the dactylus is much broader than that of *N. perrieri*.

Concerning the geographical proximity,

it is possible that the zoeas reported by Konishi (2001) might represent this new species. It is hoped that adult shrimp will be collected from the same or adjacent locality for certain identification.

***Naushonia lactoalbida* Berggren, 1992**
(Figs. 1B, 5, 6)

Naushonia lactoalbida Berggren, 1992: 514, 522 (key), figs. 1–6; Alvarez *et al.*, 2000: 198 (key).

Material examined.— One female CL 4.3 mm, Kanokawa Bay, Iriomote Island, Yaeyama Islands, 8 m deep, 17 August 1998, SCUBA diving, coll. K. Nomura (CBM-ZC 7545).

Allotype female CL 3.25 mm, western side of the midpart of Inhaca Island, Mozambique, low tide level (about 10 cm at low spring), 5 March 1988, Yabby pump (RMNH-D 41355).

Differential diagnosis.— Rostrum (Fig. 5A–C) broadly triangular in dorsal view, terminating acutely. Carapace (Fig. 5A–C) with 2 rows of small spines or spinules on gastric region on either side of midline; post-orbital spine simple. Pleura of third to sixth abdominal somites unarmed ventrally (Fig. 5D). Telson (Fig. 5E) with 3 or 4 lateral spines. Eye-stalk (Fig. 5B, C) with small anteromesial tubercle. Antennal scale (Fig. 5B) terminating in strong spine slightly curved mesially; lateral margin with 5 or 6 spines. Uropodal exopod and endopod (Fig. 5E) each with complete suture; exopod with 7 lateral spines (including terminal one).

Supplemental description.— Rostrum (Fig. 5A–C) flattened dorsoventrally, armed with 6 or 7 spines on each lateral margin. Carapace (Fig. 5A–C) with minutely denticulate median carina beginning from level of antennal notch of carapace; gastric region with 2 rows of small spines or spinules on either side of midline, lateral row not continuous with lateral margin of rostrum; anterolateral margin spinose, with conspicuous

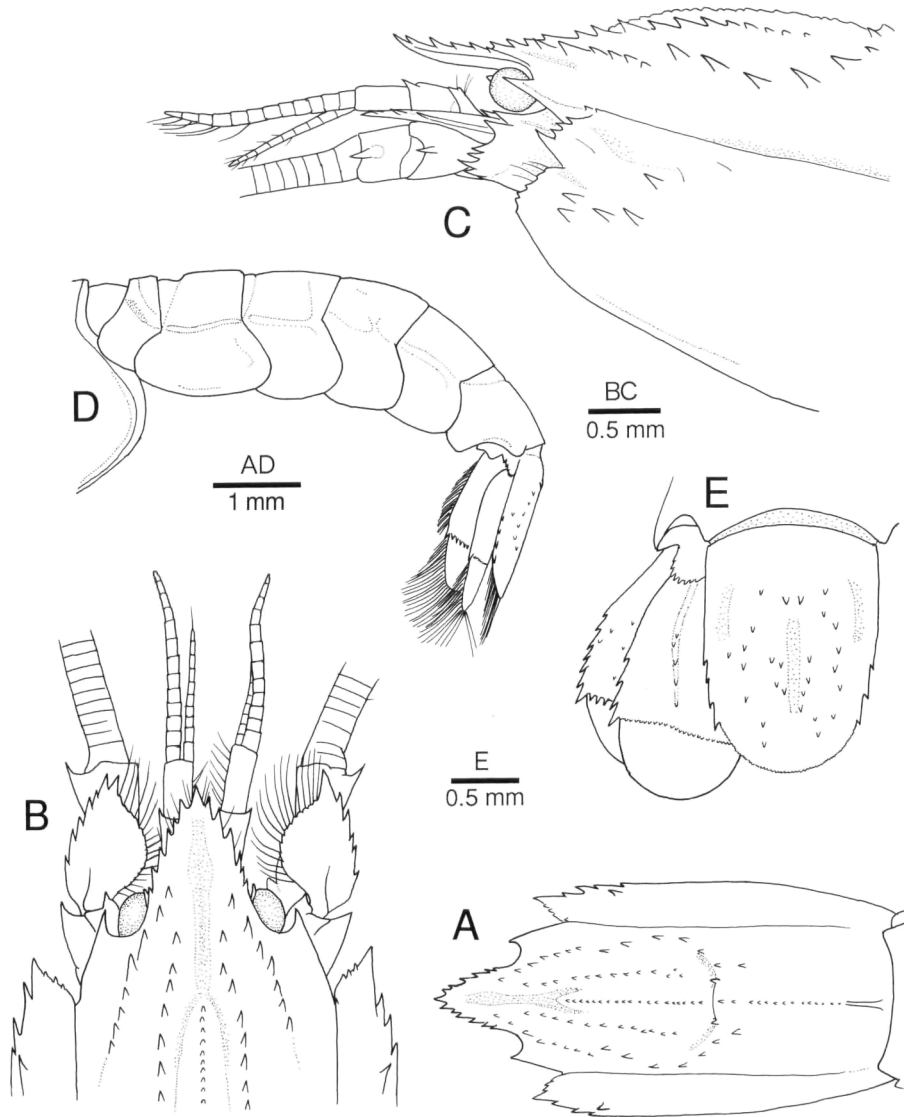


Fig. 5. *Naushonia lactoalbida* Berggren, 1992. Female from Iriomote Island (CL 4.3 mm; CBM-ZC 7545). A, carapace, dorsal view; B, anterior part of carapace and cephalic appendages, dorsal view; C, same, lateral view; D, abdomen, lateral view; E, telson and left uropod, dorsal view.

notch just inferior to slender branchiostegal spine; anterior part of branchiostegal region with 5–7 small spines.

First to fifth abdominal somites (Fig. 5D) each with trace of lateral carina. Telson (Fig. 5E) armed with 3 or 4 lateral spines; dorsal surface with small spinules scattered or arranged in irregular rows.

First pereopod (Fig. 6A, B) large, flat-

tened dorsoventrally. Ischium with row of small spines on dorsolateral, dorsomesial, ventrolateral and ventromesial margins, sometimes with 1 prominent spine on dorsolateral margin proximally. Merus with row of 7 spines on distal half of dorsolateral margin, sometimes with 2 additional spinules on proximal half; dorsomesial margin with 5 small spines, ventromesial margin with 3–11

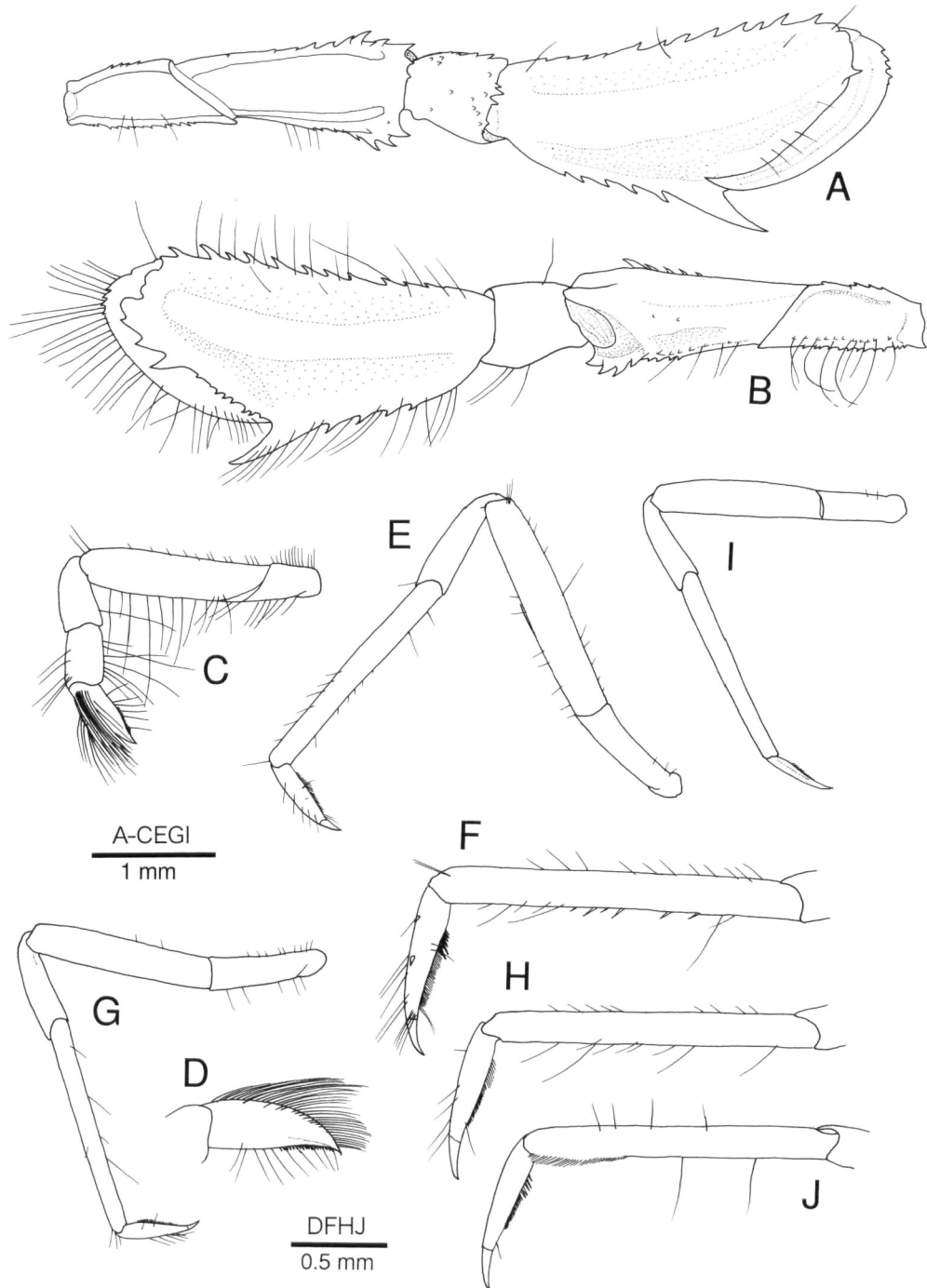


Fig. 6. *Naushonia lactoalbida* Berggren, 1992. Female from Iriomote Island (CL 4.3 mm; CBM-ZC 7545). Left pereopods. A, left cheliped, dorsal view; B, same, ventral view; C, second pereopod, lateral view; D, same, dactylus, mesial view; E, third pereopod, lateral view; F, same, propodus and dactylus, lateral view; G, fourth pereopod, lateral view; H, same, propodus and dactylus, lateral view; I, fifth pereopod, lateral view; J, same, propodus and dactylus, lateral view.

spines, distal 3 or 4 spines strong. Carpus with some spinules on lateral face. Palm with row of spines increasing in size distally on lateral and mesial margins; midline of dorsal and ventral surfaces bluntly carinate; cutting edge with row of spines, of them distal 3 or 4 strong. Dactylus rather slender, with short row of spinules proximally.

Third to fifth pereopods decreasing in length successively (Fig. 6E, G, I). Third pereopod with 1 or 2 movable spinules on lateral face of dactylus (Fig. 6F). Dactyli of fourth and fifth pereopods (Fig. 6H, J) unarmed or armed with 1 movable spinule on lateral face dorsally.

Color in life.— Body and appendages generally yellowish brown; eye darkly pigmented.

Distribution.— Known only from Inhaca Island, Mozambique and Iriomote Island, Ryukyu Islands; intertidal to 8 m.

Remarks.— Berggren' (1992) original description of *N. lactoalbida* is fully detailed for species recognition. Here some minor but possibly important details not mentioned by Berggren and characters showing variations are supplemented. The present specimen from Iriomote Island agrees very well with the original description and the allotype in all diagnostic aspects enumerated above. It greatly extends the known geographical range of *N. lactoalbida* to east, suggesting a wide Indo-West Pacific distribution of this species.

Discussion

Species of *Naushonia* is characteristic in having large, dorsoventrally flattened, subchelate first pereopod. This feature is unique among the Thalassinidea, as well as in the family Laomediidae, currently represented by five genera, *Axianassa* Schmitt, 1924, *Jaxea* Nardo, 1847, *Laomedia* De Haan, 1844, *Laurentiella* Le Loeuff & Intes, 1974, and *Naushonia*. Function of this remarkable first pereopod remains unknown, although it may be related to burrowing behavior of the animal. Similar homoplastic subchelate first

pereopod is found in the caridean family Crangonidae, although relative size of that appendage is much smaller in the Crangonidae than in *Naushonia* (personal observation). In crangonid shrimps, the subchelate first pereopod is used for feeding and grooming of the antennal flagellum (personal observation).

Most species of *Naushonia* occur in shallow water from intertidal to subtidal zones with a muddy substrate, where they burrow. Only *N. manningi*, a cave dwelling species, was observed walking across rock and mud substrates (Alvarez *et al.*, 2000). The holotype of *N. japonica* was found in a burrow under rock on the sandy mud substrate; the specimen of *N. lactoalbida* was observed in a burrow under coral rock on the coral sand substrate (K. Nomura, personal communication). Considering the habitats in shallow water environments, the rare occurrence of species of *Naushonia* is rather enigmatic. For example, no adult specimens have been collected from Gokasho Bay, Japan, where Konishi (2001) reported zoeas of unidentified species of the genus. Konishi (2001) suggested two possible explanations for the rare occurrence of *Naushonia* species in Japan and adjacent East Asian waters, the first, natural rarity, and the second, recent introduction. The present discovery of the new species so far not reported from the localities outside Japan may reject the second hypothesis. The answer may be related to the highly cryptic habitats of adults, as well as natural rarity.

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