

JUVENILE MORPHOLOGY OF THE RARE BURROWING  
MUD SHRIMP *NAUSHONIA CRANGONOIDES*  
KINGSLEY, WITH A REVIEW OF THE  
GENUS *NAUSHONIA* (DECAPODA:  
THALASSINIDEA: LAOMEDIIDAE)

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*Abstract.*—The status and history of the genus *Naushonia* is reviewed. Early juvenile stages of *N. crangonoides* reared in the laboratory from larvae captured in the plankton afforded an opportunity to evaluate changes in morphology with size. The fifth juvenile stage is described in detail and compared with adults. Some taxonomic characters used previously to discriminate species within this genus are invalid but others allow separation of the species. Comparisons of *N. crangonoides* with the two other American species and with description of the Red Sea species permitted the construction of a key for the identification of the known species of the genus.

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Introduction

The genus *Naushonia* was erected by Kingsley (1897) for a small male shrimp found by Professor Hermon C. Bumpus in the sand of the channels of the Island of Naushon off the coast of Massachusetts. Kingsley named this shrimp *Naushonia crangonoides* because of certain morphological similarities to the Crangonidae, but noted differences which might subsequently justify the establishment of a new family. A short note was published by Gray (1901) on a second specimen of this species, an ovigerous female, collected by himself in the sand of the shore of Ram Island, near Woods Hole, Massachusetts. Thompson (1903) redescribed these two specimens and also described some unusual late larval stages taken in the plankton off Woods Hole. Some of them metamorphosed in the laboratory allowing him to attribute these planktonic larvae to *N. crangonoides*. Thompson remarked on the similarity of his zoeae to those of *Calliaxis adriatica* (= *Jaxea nocturna*) from the Mediterranean, and suggested placing *Naushonia* in the Family Laomediidae of the Thalassinidea.

Chace (1939) synonymized with *Naushonia* the genus *Homoriscus* Rathbun, containing two species, *H. portoricensis* (Rathbun, 1901) and *H. macginitei* (Glassell, 1938) and included *Coralliocrangon perrieri* (Nobili, 1904) in *Naushonia* as well. Chace devised a tentative key to separate the four

species and stated the need for a re-examination of the Massachusetts (*N. crangonoides*) and Red Sea (*N. perrieri*) species. From the descriptions and illustrations of *N. crangonoides* by Kingsley (1897) and Thompson (1903), it is difficult to differentiate this type-species of the genus from the other three known species.

In a previous paper (Goy and Provenzano, 1978), we redescribed the early larval development of *N. crangonoides*. During that study, we reared the fifth juvenile stage of *N. crangonoides* from captured planktonic first stage zoeae. We take this opportunity to present a description and illustrations of the juvenile morphology of *N. crangonoides*, to compare it with adult specimens and to summarize the differences between the four known species of the genus.

### Acknowledgments

We are grateful to Dr. Raymond B. Manning, Curator, Department of Invertebrate Zoology, Smithsonian Institution, who made it possible for us to examine specimens of *Naushonia crangonoides*, *N. macginitiei*, *N. portoricensis*, the paratype of *Homoriscus* (= *Naushonia*) *macginitiei* and the type of *Homoriscus* (= *Naushonia*) *portoricensis*. Dr. Austin Williams provided us with a juvenile *N. crangonoides* collected from Bogue Sound, North Carolina. This work was supported by National Science Foundation Grant number DEB-76-11716.

### Methods and Material

In our earlier paper, we mentioned that some individuals lived beyond the postlarval stage. Of these, two individuals survived to the fourth juvenile stage and one molted to the fifth juvenile stage. These animals provided basic material for the study of the very early juvenile morphology described herein. USNM refers to catalog numbers of the National Museum of Natural History, Smithsonian Institution, and UNC-IMS to catalog numbers of the University of North Carolina Institute of Marine Science. The description of the *Naushonia crangonoides* postlarva has been presented earlier (Goy and Provenzano, 1978).

Juveniles and exuviae of known history were preserved in 70% ethyl alcohol. Dead animals were heated slowly in 5% KOH for approximately ten minutes to remove tissue from the exoskeleton. These specimens and all casts from molted animals were stained in either Mallory's Acid Fuchsin Red or Chlorazol Black E (1% in 70% Alcohol). Appendages were dissected in lactic acid and mounted in glycerin jelly. Drawings were made with the aid of a camera lucida; measurements were made with the aid of a stage micrometer. Carapace length (CL) was measured from tip of rostrum to the posterolateral margin of the carapace. Total length (TL) was measured from

the tip of the rostrum to the most posterior margin of the telson, and excluded all telson processes and setae.

### Juvenile Stages of *Naushonia crangonoides*

In the first few molts after the postlarval stage, the morphology of *Naushonia crangonoides* does not change drastically from that of the postlarva. There is a gradual development of adult characteristics. The following are the major morphological changes that occur from the first juvenile stage through the fifth juvenile stage.

The telson and uropods are unchanged until the fifth juvenile stage is reached.

In the first juvenile stage, the antennule is similar to that of the postlarva, but the 6 aesthetascs are now located on the 3 middle segments of the external flagellum, 2 per segment. This appendage does not change further until the fifth juvenile stage.

The antenna of the first juvenile stage is unchanged from the postlarval stage, except that there are 20 plumose setae on the inner margin of the scale. This appendage also does not change appreciably until the fifth juvenile stage.

The mandibles show the most significant changes with each succeeding molt. The postlarval stage has symmetrical mandibles (Fig. 1A) with the cutting edge provided with 4 small teeth. The palp is developed but unsegmented, bearing a minute seta terminally. In the first juvenile stage, the cutting edge of the mandible (Fig. 1B) has the 4 teeth of the postlarva plus a small medial tooth, and the palp is still unsegmented but now bears 2 terminal rows of 5 spines. In the second juvenile stage, the mandible (Fig. 1C) has a cutting edge with 8 terminal and 2 subterminal teeth. The palp is now 2-segmented, with the first segment bearing an outer long plumose seta and the second segment having 13 terminal stout spines. The third juvenile stage has the mandible (Fig. 1D) basically unchanged from the preceding stage, except the cutting edge has only 10 small terminal teeth and the second segment of the palp bears 14 terminal spines. In the fourth juvenile stage, the mandible (Fig. 1E) has 4 large and 9 smaller teeth on the cutting edge. The palp shows signs of a third segment but is still 2-segmented, with 2 long plumose setae on the outer margin of the first segment and 15 terminal spines on the second segment.

The maxillule of the juvenile stages is unchanged from the postlarval stage, except more spines and plumose setae develop on the coxal and basal endites with each succeeding molt.

The maxilla of the juvenile stages is also similar to that of the postlarva. The number of setae increases on the 4 inner lobes, the endopodite and the scaphognathite. The endopodite remains unsegmented and by the second

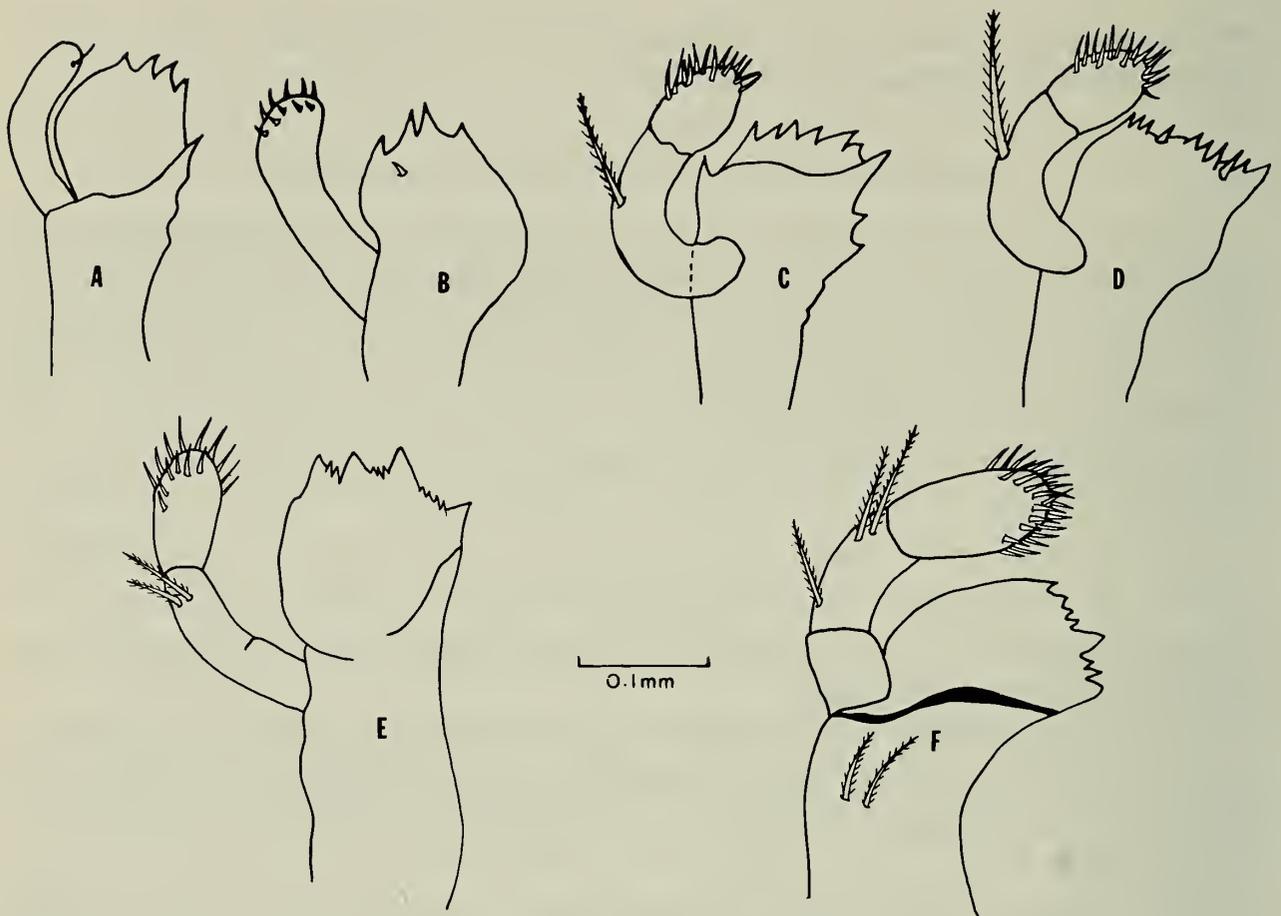


Fig. 1. *Naushonia crangonoides*: Mandibles of postlarva (A); First juvenile (B); Second juvenile (C); Third juvenile (D); Fourth juvenile (E); and Fifth Juvenile (F).

juvenile stage the long tapering proximal lobe of the scaphognathite has developed 5 long whip-like plumose setae.

The first maxilliped shows some significant changes with each successive molt past the postlarva. In the first juvenile stage, the basipodite and endopodite remain unchanged from the postlarva. The exopodite is still 3-segmented with the proximal segment now bearing 12 plumose setae and the terminal segment having 3 long plumose setae. The epipodite is large, serrate and triangular. In the second juvenile stage, the endites of the basipodite increase their numbers of setae and the endopodite is now 2-segmented with the distal segment enlarged, rounded and bearing 5 plumose setae. The exopodite is now 5-segmented with the terminal segment bearing only 2 long plumose setae. The first maxilliped does not show further change until the fifth juvenile stage.

The second maxilliped shows a more gradual change to the adult appendage after the postlarval stage. In the first juvenile stage, the endopodite becomes 5-segmented but the rest of the appendage is unchanged from the preceding stage. By the second juvenile stage, the endopodite has the penultimate segment expanded and the exopodite bears 5 long plumose setae

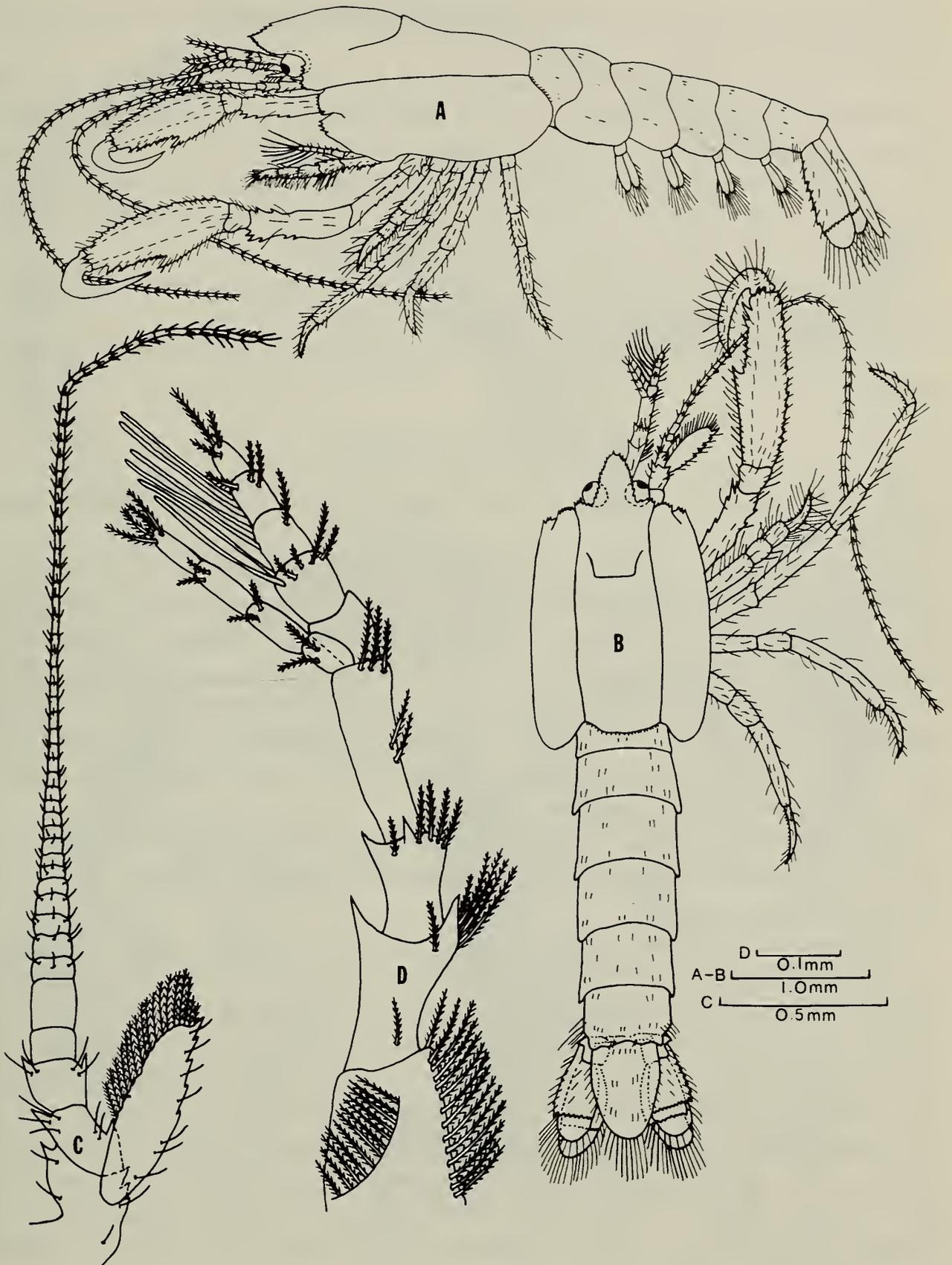


Fig. 2. *Naushonia crangonoides*: Fifth juvenile stage: Lateral view (A); Dorsal view (B); Antenna (C); and Antennule (D).

on the terminal segment. This maxilliped does not change considerably until the fifth juvenile stage.

The third maxilliped is unchanged from the postlarval stage in the first juvenile stage, except there are now 2 long plumose whip-like setae on the basipodite and the ischium distally bears 5 teeth. There is also an increase in setae on the segments of the endopodite. In the second juvenile stage, the teeth of the serrate ischium increase to 10 but the remainder of the appendage is the same until the fifth juvenile stage.

None of the pereopods changes significantly after the postlarval stage, but all gradually become larger and more setose.

The pleopods remain unchanged from the postlarva until the fifth juvenile stage.

### Fifth Juvenile Stage

The one animal that molted to this stage (TL 6.0 mm, CL 2.3 mm) died after 15 days.

Carapace (Figs. 2A, 2B) cylindrical, depressed in front with rostrum slightly down curved. Rostrum triangular, flat, extending beyond eyes with finely serrate recurved borders. Anterior borders of carapace serrate with supraorbital and antennal spines. Dorsal and branchial areas distinguished by straight, prominent, longitudinal groove (*linea thalassinica*) and cervical groove also well marked in middle. Carapace smooth except along grooves and ridges, with posterior margin bearing 20 fine hairs. Eyes still visible from above with minute pigment spot.

Abdomen about a third longer than carapace, smooth without spines or carinae. Borders of pleura of first and sixth segments truncate, those of other segments rounded.

Peduncle of antennule (Fig. 2D) composed of 4 segments extending beyond front of eyes. Proximal segment with 14 long plumose setae on outer margin and ring of 12 setae subterminally on inner edge. Second segment ends in 2 spines and bears 5 feathered setae on outer margin, 1 medially and 1 terminally. Third segment ends in spine on inner border with medial spine and bears 5 plumose terminal setae. Fourth segment with 2 medial and 3 terminal plumose setae. External flagellum of 5 segments, with first segment lacking setae or aesthetascs. Next 3 segments each bear 2 aesthetascs on outer margin and 4, 1 and 3 setae respectively. Terminal segment with 3 plumose setae at apex. Inner flagellum 4-segmented with 2 setae on each segment, but terminal segment bearing 4 setae.

Peduncle of antenna (Fig. 2C) with 5 segments. First segment with 2 spines on outer margin, 1 spine on inner margin, and bearing antennal scale. Next 2 segments with spine on each margin while penultimate and ultimate segments lack spines or setae. Antennal scale ovate with 5 outer teeth, 7

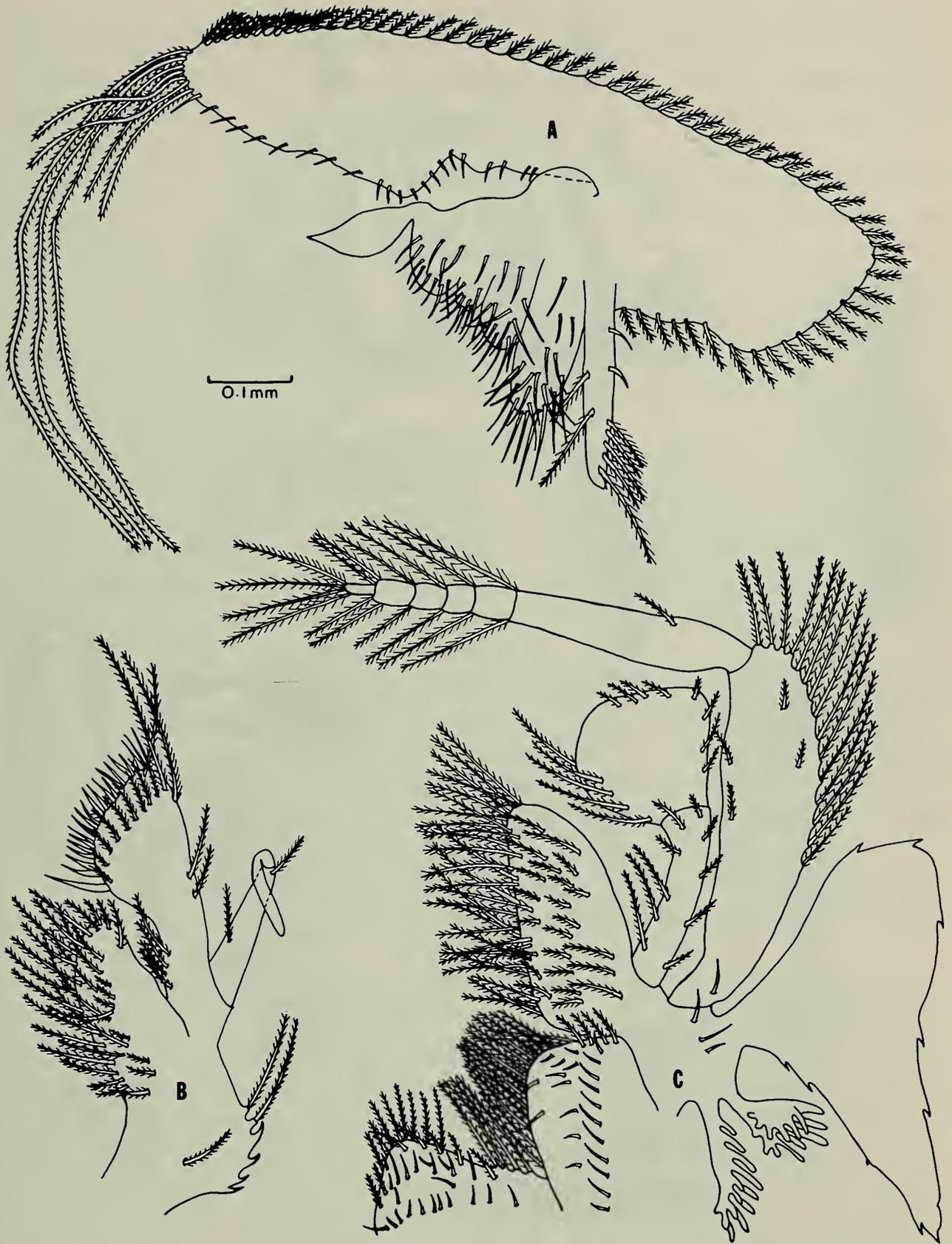


Fig. 3. *Naushonia crangonoides*: Fifth juvenile stage appendages: Maxilla (A); Maxillule (B); and First maxilliped (C).

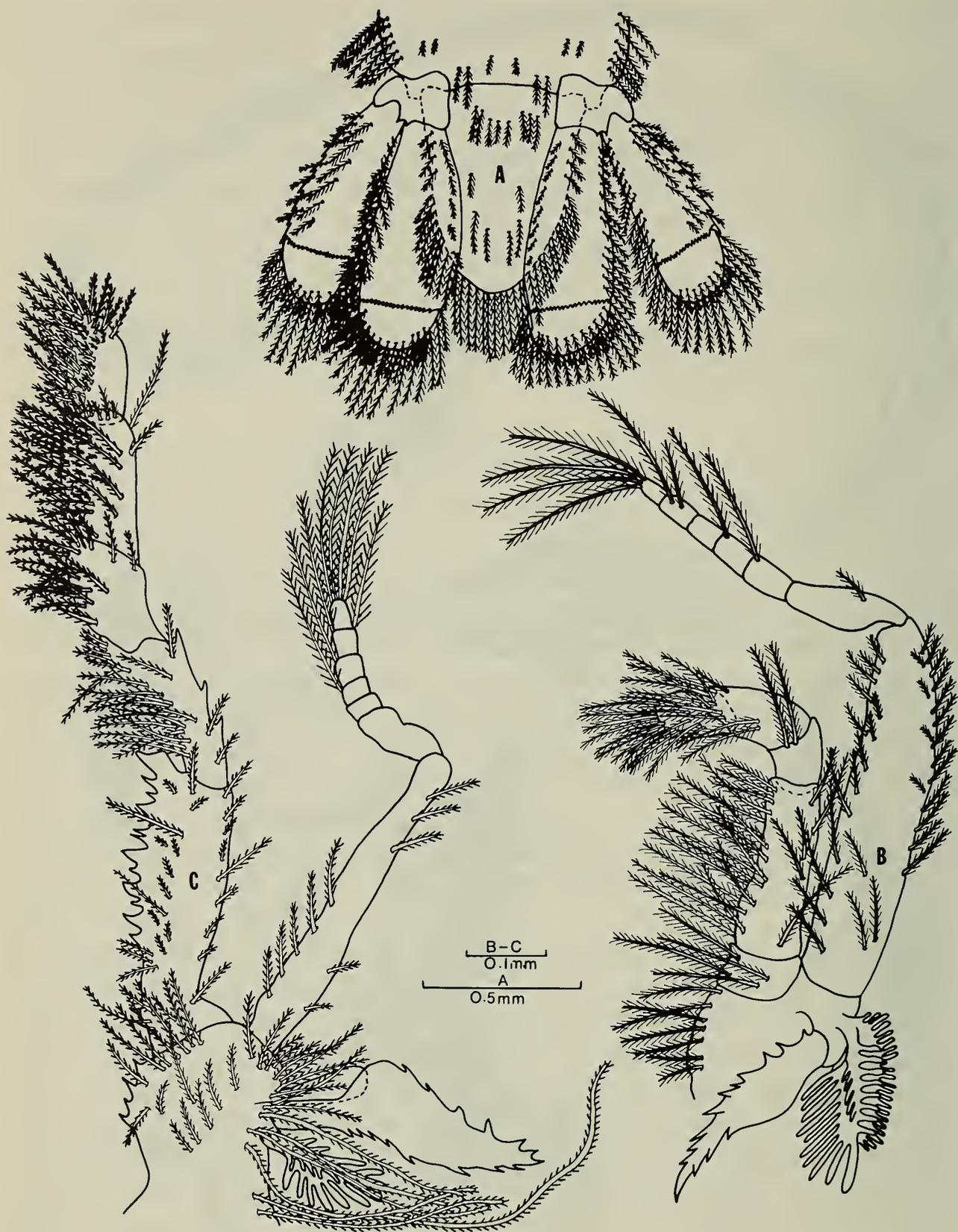


Fig. 4. *Naushonia crangonoides*: Fifth juvenile stage appendages: Telson (A); Second maxilliped (B); and Third maxilliped (C).

outer setae and 17 plumose setae on inner margin. Flagellum long and tapering consisting of 51 segments, most having circlet of setae at distal ends.

Mandible (Fig. 1F) with only 2 large and 6 smaller teeth on cutting edge. Palp 3-segmented, with second segment having 3 long plumose setae and terminal segment bearing 24 spines.

Maxillule (Fig. 3B) with 2-segmented endopodite with flexed terminal segment and with first segment bearing plumose seta terminally and one on inner margin. Basipodite bearing 4 teeth and 2 plumose setae on border. Coxal endite with 30 feathered setae marginally and submarginally. Basal endite with 30 feathered setae marginally and submarginally. Basal endite rounded with 2 and 4 plumose setae on outer and inner margins, respectively; terminally 19 stout teeth and 3 long plumose setae, and subterminally 9 shorter plumose setae.

Maxilla (Fig. 3A) with following setation on 4 inner lobes: 11 on proximal lobe of coxal endite; 8 on distal lobe; 15 on proximal lobe of basal endite; 21 on distal lobe. Unsegmented endopodite bearing 4 plumose setae distally and 2 proximally on outer margin, and 2 plumose setae on inner margin. Scaphognathite broad with 60 plumose setae on outer margin; also 22 minute setae on inner margin. Long tapering proximal lobe bearing 4 long plumose setae and 3 longer, whip-like plumose setae.

First maxilliped (Fig. 3C) with 2-lobed basipodite; proximal lobe with 20 plumose setae and 21 shorter non-plumose setae; distal lobe bearing 52 plumose setae. Endopodite 2-segmented with distal segment expanded and triangular, bearing 5 long plumose setae and 8 shorter plumose setae. Exopodite 7-segmented with proximal segment widened and bearing 15 long feathered setae on outer margin. Last 5 segments each with long plumose seta on both sides near base, except terminal segment also with 4 long plumose setae at apex. Epipodite large, serrate and triangular with arthrobranch and mastigobranche.

Second maxilliped (Fig. 4B) with 5-segmented endopodite with penultimate segment slightly expanded. These segments bearing long plumose setae proximally to distally as follows: 4; 24; 2; 10 and 16. Exopodite 7-segmented with first segment having numerous short plumose setae and last 5 segments bearing long plumose setae; terminal segment having 4 setae at apex. Epipodite heavily serrate, with 2 arthrobranches and podobranche.

Third maxilliped (Fig. 4C) having endopodite of 5 segments with ischium bearing 13 prominent teeth on inner border and numerous plumose setae. Second segment with 3 prominent teeth on outer border besides numerous plumose setae; other 3 segments heavily setose. Exopodite consisting of 7 segments with last 4 segments bearing long plumose setae. Epipodite complex consisting of small anterior lobe and bunch of long, plumose whip-like setae, serrate-margined mastigobranche and podobranche. Also 2 arthrobranches on third maxilliped.

Telson (Fig. 4A) with rounded end, no longer possessing spine at each external angle as in postlarval and preceding juvenile stages. Outer margin bearing 40 plumose setae with numerous submarginal and medial shorter setae. Uropods with serrate transverse sutures on both rami that end with external spine. Endopodite and exopodite both with 40 plumose setae on outer borders. Exopodite also with six plumose setae submarginally and five external spines ending in a stout movable spine.

Chelipeds (Fig. 5A) large, slender, subchelate. Ischium slightly smaller than merus with 5 small teeth on inner border. Merus with 2 small outer teeth and 4 small inner teeth plus large spine near apex. Carpus triangular in outline, articulating with propodus by 2 tubercles. Propodus setose, elongate, bearing 3 prominent teeth and 6 smaller teeth on distal inner margin, 2 small teeth terminally, and 13 small teeth along entire length of outer border. Dactylus bent at base almost at right angle, very slender and falcate, and with sharp margins, outer of which fringed with long setae. Two arthrobranchs, small podobranch, and slender mastigobranch present.

Second pereopods (Fig. 5B) short, flattened and setose on ventral margin. Dactylus robust, bearing 10 small teeth on inner margin and numerous long setae on outer margin.

Third pereopods (Fig. 5C) longer than fourth and fifth legs (Figs. 5D, 5E) but all 3 pairs slender with long propodi and arcuate dactyli; those of third pair bearing 18 small teeth on inner margins. Two arthrobranchs on second, third and fourth pairs of pereopods, small podobranch on second and third pairs, and slender mastigobranch on all 3 pairs. No gills on fifth pereopods.

Pleopods (Figs. 5F, 5G, 5H, 5I) absent on first abdominal somite but present on second to fifth somites. Pleopods biramous, lanceolate and without stylambys. Endopodites and exopodites with 12 and 14 long plumose setae respectively.

### Museum Specimens

#### *Naushonia crangonoides*

1.—CL 7.5 mm; TL 21.0 mm. (USNM 34143). Male. Eyes barely visible from above. No spines on telson. Uropods with complete transverse sutures, exopod with 5 spines on lateral margin ending in a strong movable spine. Antennal scale margin with 11 teeth. Mandibular palp 2-segmented. Third pereopod has 12 and fourth pereopod has 7–10 movable spines on outer margins of dactyli.

2.—CL 6.5 mm; TL 17.5 mm. (USNM 102277). Female. Eyes visible from above. Telson, uropods, antennal scale and mandibular palp same as above. Third pereopod has 20 and fourth pereopod has 12 movable spines on dactyli.

3.—CL 10.0 mm; TL 25.0 mm. (USNM 102279). Female. Eyes not visible

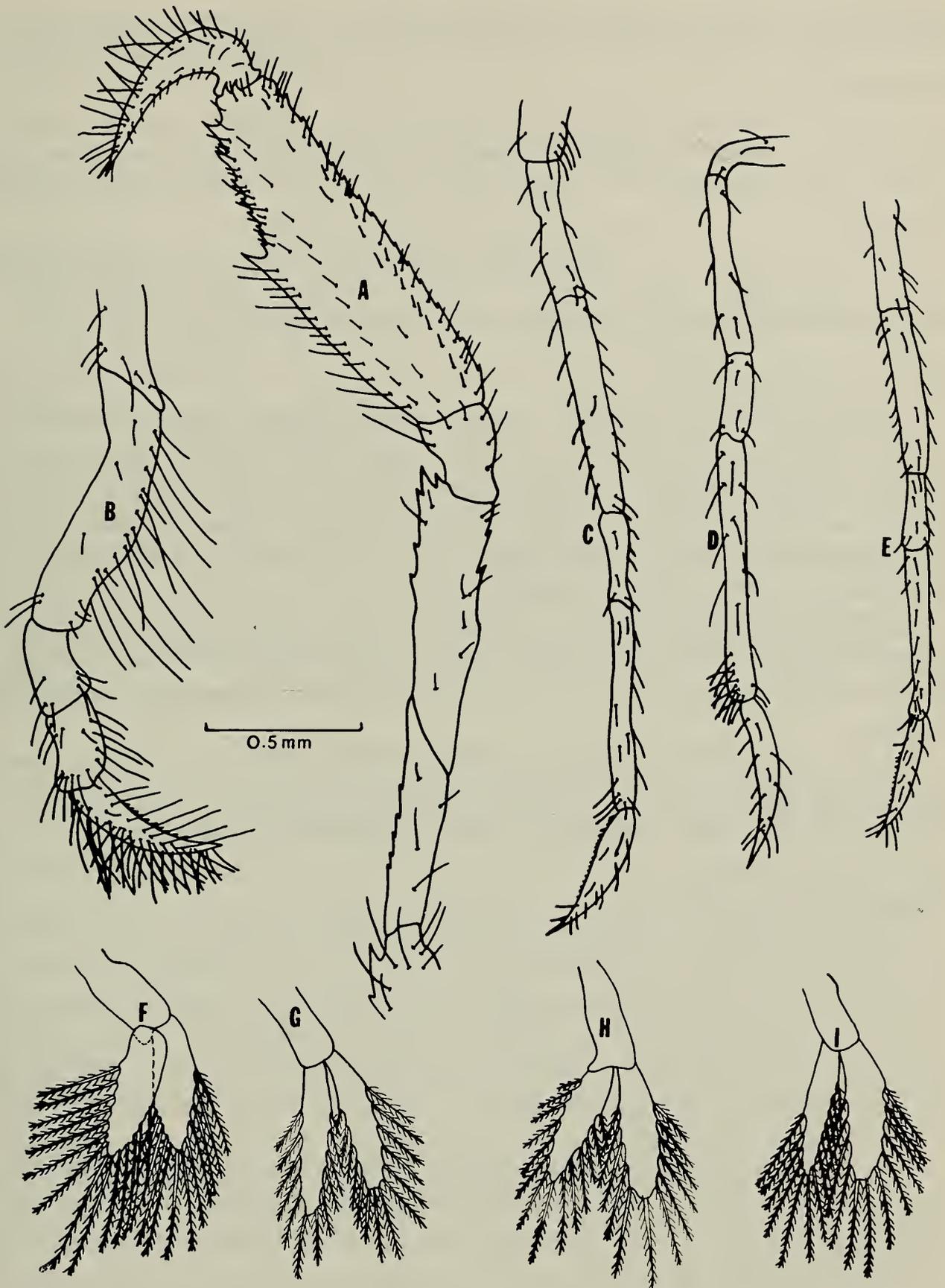


Fig. 5. *Naushonia crangonoides*: Fifth juvenile stage appendages: Cheliped (A); Second pereiopod (B); Third pereiopod (C); Fourth pereiopod (D); Fifth pereiopod (E); Second pleopod (F); Third pleopod (G); Fourth pleopod (H); and Fifth pleopod (I).

from above. Telson, uropods, antennal scale and mandibular palp same as above. Third pereopod has 24 and fourth pereopod has 15 movable spines on dactyli.

4.—CL 11.0 mm; TL 27.0 mm. (USNM 102280). Female. Eyes not visible from above. Telson, uropods, antennal scale and mandibular palp same as above. Third pereopod has 20 and fourth pereopod has 14 movable spines on dactyli.

5.—CL 4.5 mm; TL 11.0 mm. (UNC-IMS 254). Female. Eyes visible from above. Telson and uropods same as above. Antennal scale margin with 7 teeth. Mandibular palp 3-segmented. All pereopods missing.

#### *Naushonia portoricensis*

1.—CL 6.3 mm; TL 14.5 mm. (USNM 23782). Female. Type of *Homoriscus* (= *Naushonia*) *portoricensis*. Eyes visible from above. Telson with spine on lateral margin. Uropods with complete sutures, exopod with 2 spines on lateral margin ending in a strong movable spine. Antennal scale margin with 6 teeth, distal tooth largest and curved inward. Mandibular palp 3-segmented. All pereopods missing.

2.—CL 4.2 mm; TL 12.0 mm. (USNM 155101). Male. Eyes visible from above. Telson, uropods, antennal scale and mandibular palp same as above. Third pereopod has none and fourth pereopod has 20 movable spines on dactyli.

3.—CL 2.0 mm; TL 5.6 mm. (USNM 155101). Male. Eyes visible from above. No spines on telson. Uropods and mandibular palp same as above. Antennal scale margin with only 4 teeth. All pereopods missing.

#### *Naushonia macginitiei*

1.—CL 7.6 mm; TL 19.0 mm. (USNM 171605). Ovigerous female. Paratype of *Homoriscus* (= *Naushonia*) *macginitiei*. Eyes visible from above. Telson with 3 spines on lateral margin. Uropods with incomplete transverse sutures, exopod with 2 spines on lateral margin, ending with 2 small spines and a large movable spine. Antennal scale margin with 7 teeth. Mandibular palp 3-segmented. Third pereopod has 20–22 and fourth pereopod has 18 movable spines on dactyli.

2.—CL 7.5 mm; TL 18.2 mm. (USNM 171604). Female. Eyes visible from above. Telson, uropods and mandibular palp same as above. Antennal scale margin with 8 teeth. Third pereopod has 20–24 and fourth pereopod has 16 movable spines on dactyli.

3.—CL 7.5 mm; TL 19.1 mm. (USNM 144492). Female. Eyes visible from above. Telson, uropods and antennal scale same as paratype. Third pereopod has 22 movable spines on dactyli. Fourth pereopod missing.

4.—CL 6.5 mm; TL 17.2 mm. (USNM 144492). Female. Eyes visible from above. Telson, uropods and mandibular palp same as paratype. Antennal

scale margin with 8 teeth. Third pereopod has 24 and fourth pereopod has 15 movable spines on dactyli.

### Systematic Position of *Naushonia*

#### Order Decapoda

#### Supersection Macrura Reptantia

#### Section Thalassinidea

The Decapod section Thalassinidea is considered a valid group but there is much difference of opinion as to its number of families and its systematic position. Balss (1957) recognized only 4 families, but earlier Gurney (1938) recognized 7 distinct families based on a combination of adult and larval characteristics: the Axianassidae, Axiidae, Callianassidae, Callianideidae, Laomediidae, Thalassinidae and Upogebiidae. Gurney discussed these families in detail and gave a key to their determination. The thalassinids are all burrowing forms characterized by a well calcified, compressed carapace; a symmetrical, extended, often feebly calcified abdomen ending in a well developed tail fan; first pereopods chelate or subchelate, second chelate, subchelate or simple, and third legs always non-chelate (Wear and Yaldwyn, 1966).

#### Family LAOMEDIIDAE Borradaile, 1903

The family Laomediidae at present consists of 3 thalassinid genera and 8 described species. According to Wear and Yaldwyn (1966), these are characterized by "having a linea thalassinica; first legs subequal and chelate or subchelate; second pereopods subchelate or simple; no appendix interna on pleopods; uropods with transverse sutures; podobranchs on at least second and third maxillipeds and first and second pereopods, and epipods on the first to fourth pereopods." Chace (1939) divides the Laomediidae into 2 subfamilies: Laomediinae and Naushoniinae. The Naushoniinae are distinguished from the Laomediinae by the subchelate rather than chelate first legs, the well-developed antennal scale that is absent or rudimentary in the Laomediinae, and the simple instead of subchelate last pereopods.

DeMan (1928) considered the family Axianassidae untenable and included its only genus (*Axianassa*) in the family Laomediidae. However, the two species of this genus (*Axianassa intermedia* and *A. mineri*) lack some of the major characters of the laomediids, including transverse sutures on the uropods and exopodites on the third maxillipeds. According to Yaldwyn and Wear (1972), all examined adult species of the family Laomediidae have 18 gills though there may be some minor differences in their distribution. Both species of *Axianassa* have only 17 gills. Therefore, in the present study, only *Jaxea*, *Laomedia*, and *Naushonia* are included in the Laomediidae.

## Subfamily LAOMEDIINAE

*Jaxea* Nardo, 1847 is known from 2 named species, *J. nocturna* from the Mediterranean and North Atlantic (deMan, 1928; Zariquey-Alvarez, 1968) and *J. novazealandiae* from New Zealand (Wear and Yaldwyn, 1966).

*Laomedia* de Haan, 1849 is known from 2 described species, *L. astacina* from Korea and Japan (deMan, 1928; Sakai, 1962) and *L. healyi* from eastern Australia (Yaldwyn and Wear, 1972). A third species of *Laomedia*, still undescribed, was found in eastern Australia by Yaldwyn and Wear (1972) during their study of *L. healyi*. Larvae from Sydney Harbour attributed to *Jaxea* sp. by Dakin and Colefax (1940) probably belong to one of these eastern Australian species of *Laomedia*. A first stage larva from Samoa believed by Gurney (1938) to belong to *Jaxea* sp. also may represent an undescribed species of *Laomedia* since this larva has characters more similar to *Laomedia* than to *Jaxea* (Sakai and Miyake, 1964; Goy and Provenzano, 1978).

## Subfamily NAUSHONIINAE

The genus *Naushonia* Kingsley, 1897 is known from 4 species: *N. crangonoides* from off Massachusetts (Kingsley, 1897); *N. portoricensis* from Puerto Rico (Rathbun, 1901); *N. perrieri* from the Red Sea (Nobili, 1904); and *N. macginitiei* from southern California (Glassell, 1939). Larval stages probably belonging to *N. portoricensis* were described by Gurney and Lebour (1939) from Bermuda and larvae found off Samoa and the Great Barrier Reef (Gurney, 1938) might belong to *N. perrieri*. There are at least 2 additional, apparently separate, species of *Naushonia* that are undescribed and known only from their larvae, off New South Wales (Dakin and Colefax, 1940) and from the Adriatic Sea (Kurian, 1956; Goy and Provenzano, 1978).

Review of the Genus *Naushonia*

*Naushonia* was founded by Kingsley (1897) for a single adult male specimen collected in the sand on Naushon Island, near Woods Hole, Massachusetts. A second adult, an ovigerous female, was collected by Gray (1901) from a 10 inch deep burrow in the sand on Ram Island, in Great Harbor, Woods Hole. Both of these specimens are now in the Gray Museum, Marine Biological Laboratory, Woods Hole. Four more adults are known from Massachusetts at Bass River, Vineyard Sound, and Elizabeth Islands (Williams, 1974), which are in the USNM collection. Larvae believed to belong to *N. crangonoides* have been collected from the Woods Hole area during July, August, and September (Thompson, 1903; Fish, 1925); in Delaware Bay from August to October (Deevey, 1960); in Narragansett Bay in August (Hillman, 1964); and in Chesapeake Bay from August to September (San-

Table 1. Comparison of some characters of first juvenile stages of *Naushonia crangonoides* and *Naushonia portoricensis*.

	<i>N. crangonoides</i>	<i>N. portoricensis</i>
Total Length	4.80 mm	3.25 mm
Rostrum	No lateral teeth	Lateral tooth on side
Rostral apical process	Absent	Present
Linea thalassinica	Distinct	Faint
Antennal scale	6 marginal teeth	3 marginal teeth
Mandibular palp	Unsegmented	Three-segmented

difer, 1972; Goy, 1976). In these last 2 collections, first stage larvae of *Naushonia* were most numerous near the bay mouth, suggesting a breeding population of *N. crangonoides* somewhere near the mouth of Chesapeake Bay. This theory was recently confirmed by Langton and Brodeur (1978) when they found 3 adult *N. crangonoides* in the stomach of a stingray, *Dasyatis centroura*, collected approximately 15 nautical miles northeast of the mouth of Chesapeake Bay. A juvenile *N. crangonoides* (TL 11.0 mm) has been collected in Bogue Sound, North Carolina (Williams, personal communication, 1977) extending the species known range over 700 nautical miles south of its type-locality.

Chace (1939) synonymized with *Naushonia* the genera *Homoriscus* Rathbun, 1901 and *Coralliocrangon* Nobili, 1904. This added 3 more species to *Naushonia*: *N. portoricensis*, *N. macginitei*, and *N. perrieri*. *Naushonia portoricensis* is known from Puerto Rico (Rathbun, 1901), Cuba (Chace, 1939), Bermuda (Gurney and Lebour, 1939) and is extended to Ascension Bay, Quintana Roo, Mexico from material examined in the present study. *N. macginitei* is known from southern California (Glassell, 1938) and is extended south to Enseñada de San Francisco, Sonora, Mexico from material examined in the present study. *N. perrieri* is known only from 2 specimens collected in French Somaliland, Red Sea.

Chace (1939) devised a tentative key to the 4 species of *Naushonia*. From the results of the present study, this key can no longer be considered valid. There are lateral movable spines on at least the fourth pereopod dactyl of all species. In *N. crangonoides* specimens less than 20 mm TL have their eyes visible from above. The postlarva to the fourth juvenile stage of *N. crangonoides* has the telson armed with a single pair of lateral spines like *N. portoricensis*. Also the fifth juvenile stage of *N. crangonoides* has a 3-segmented mandibular palp and an antennal scale with 5 marginal teeth, the same number as *N. portoricensis* of similar size.

There is a strong possibility that the ranges of *N. crangonoides* and *N. portoricensis* may overlap along the southeast coast of the United States.

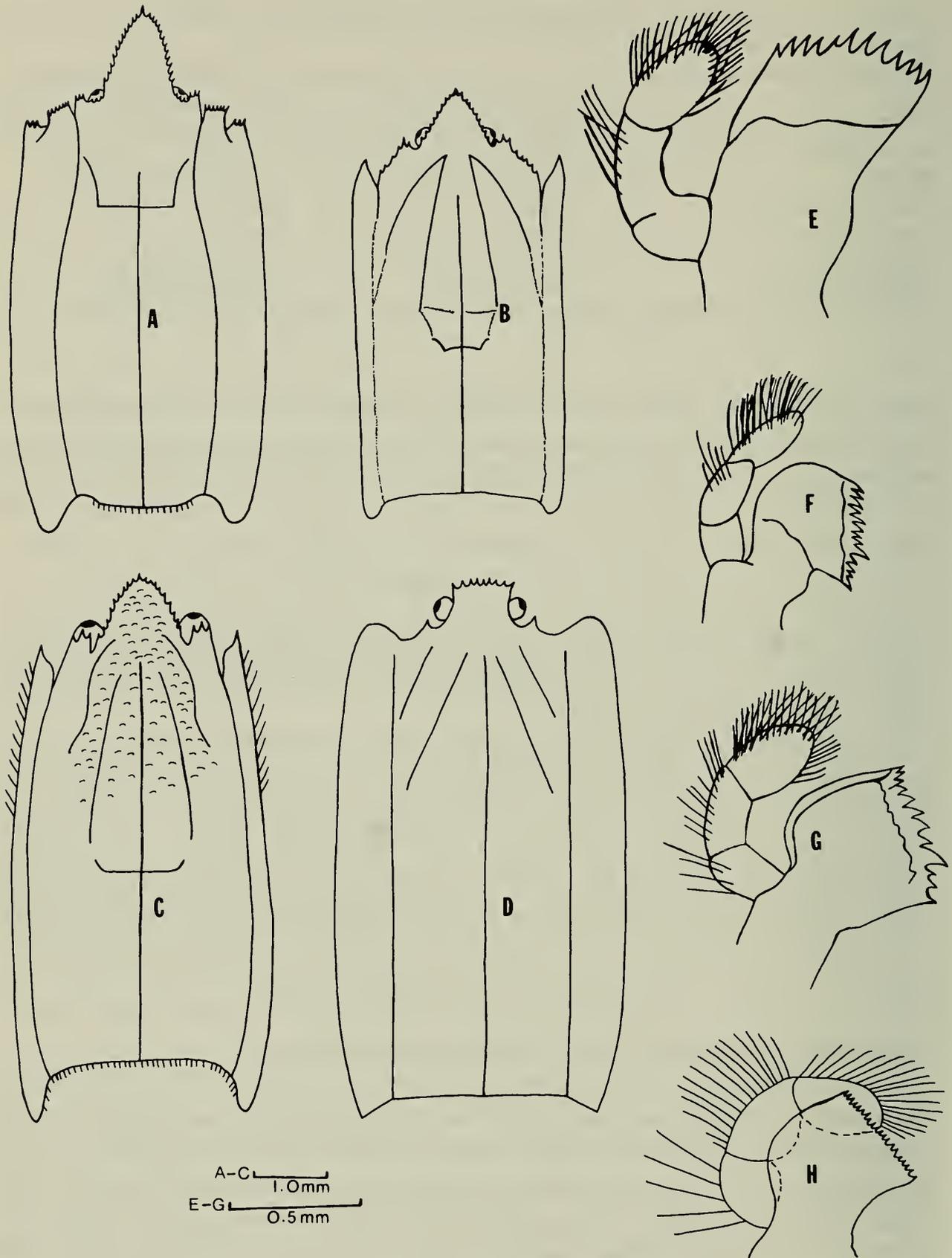


Fig. 6. Carapace of *Naushonia crangonoides* (A); *N. portoricensis* (B); *N. macginitei* (C); and *N. perrieri* (D). Mandibles of *N. crangonoides* (E); *N. portoricensis* (F); *N. macginitei* (G); and *N. perrieri* (H). (D and H adapted from Nobili, 1906.)

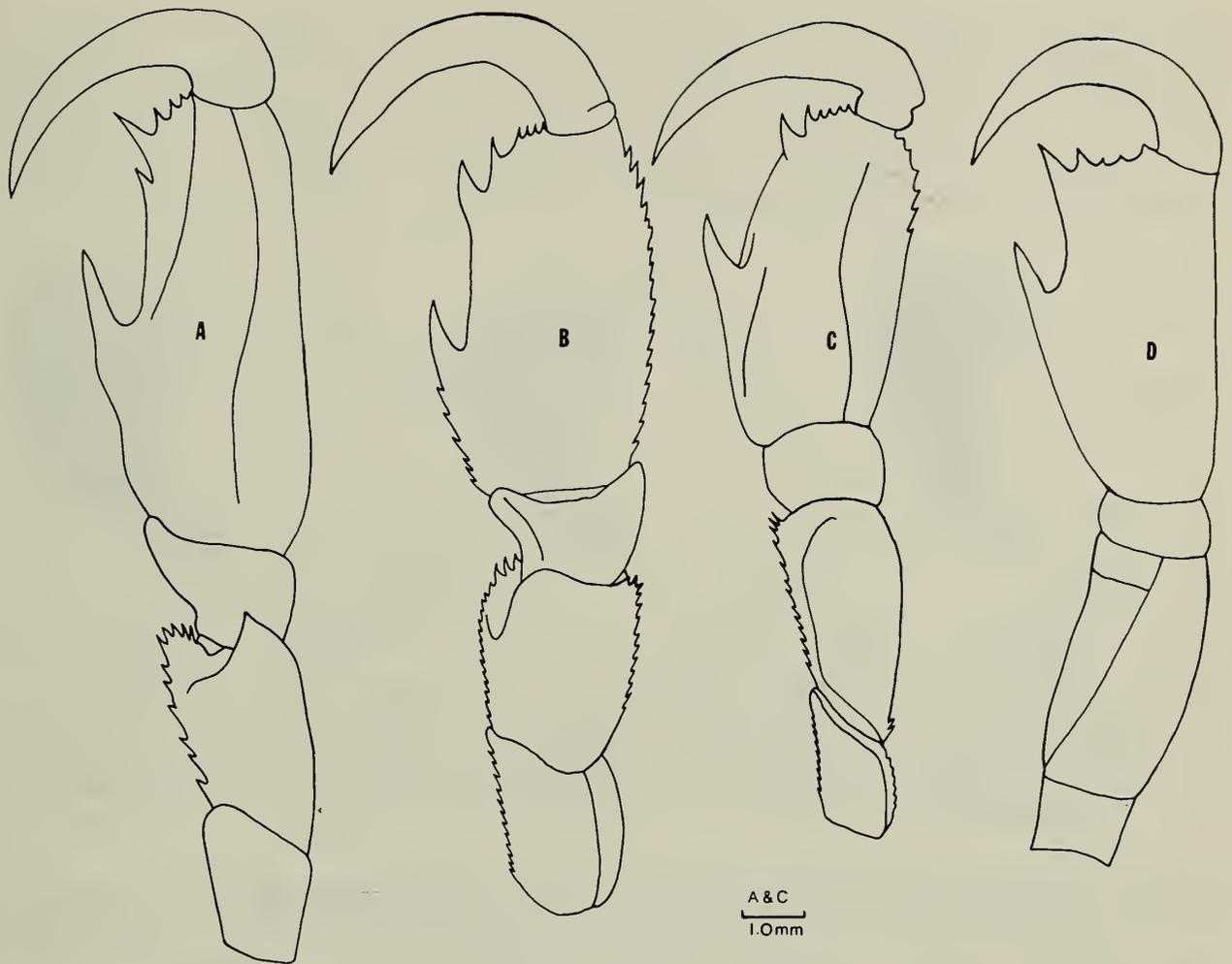


Fig. 7. Chelipeds of *Naushonia crangonoides* (A); *N. portoricensis* (B; adapted from Chace, 1939); *N. macginitei* (C); and *N. perrieri* (D; adapted from Nobili, 1906).

The early juvenile stages of *N. crangonoides* bear a close resemblance to specimens of the much smaller species *N. portoricensis*. The first juvenile stage of *N. portoricensis* described by Gurney and Lebour (1939) is quite similar to the first juvenile stage of *N. crangonoides*, but they show some differences (Table 1). Many of the characters given by Chace (1939) to separate these 2 species will overlap at the smaller size ranges. The antennal scale, telson and uropods at these sizes will enable one to differentiate the 2 species. The smallest *N. portoricensis* we examined (5.6 mm TL) has an antennal scale with 4 marginal teeth with the distal tooth curved inward, while the fifth juvenile stage of *N. crangonoides* (6.0 mm TL) has an antennal scale with 5 marginal teeth. The telsons of both these specimens have no external spines but the uropodal exopodite of *N. portoricensis* has 2 spines on the lateral margin which ends in a strong movable spine. The uropodal exopodite of the fifth juvenile stage of *N. crangonoides* has 5 external spines on the lateral margin which ends in a stout movable spine.

The adults of the 4 species of *Naushonia* are generally similar in morphology but show differences in detail. Their carapaces (Figs. 6A, B, C, D)

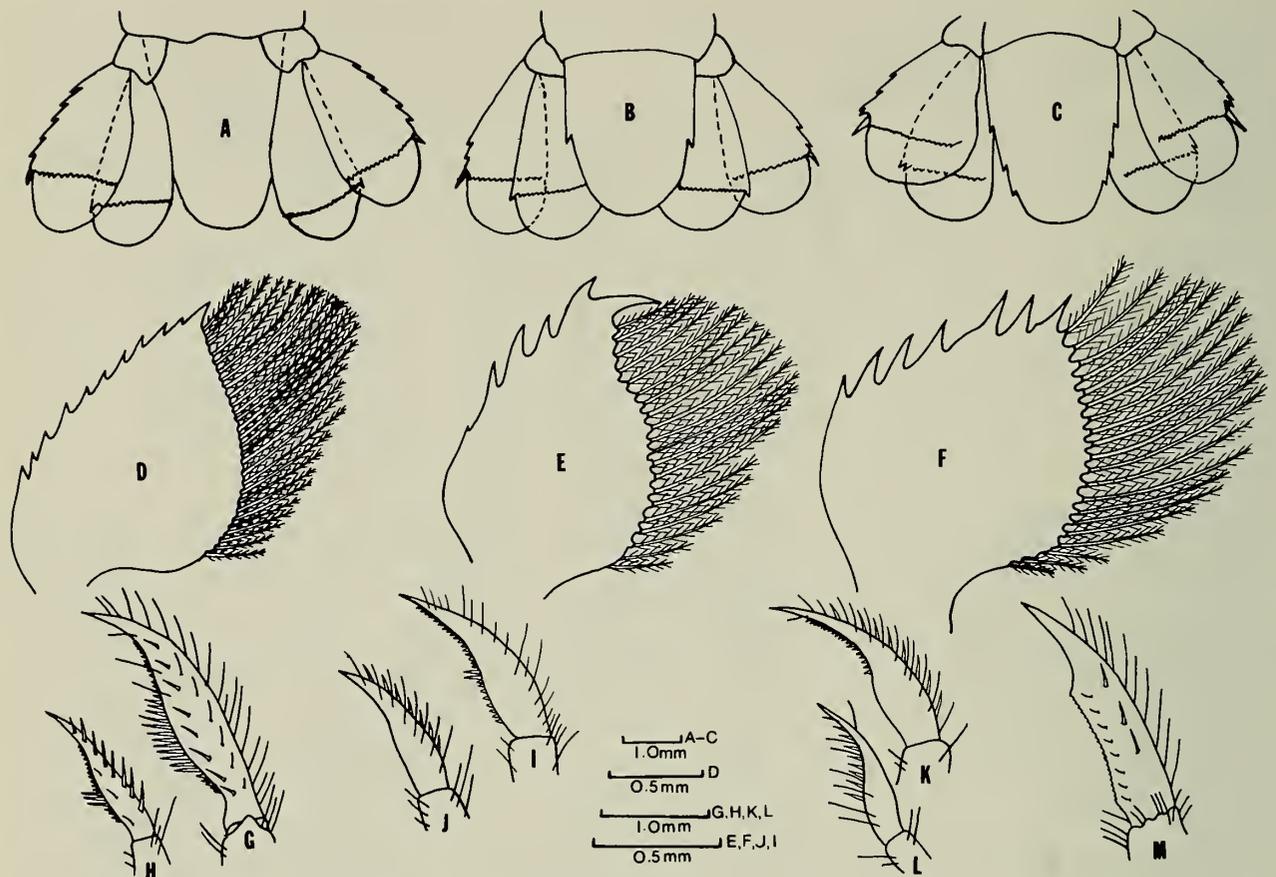


Fig. 8. Telsons of *Naushonia crangonoides* (A); *N. portoricensis* (B), and *N. macginitei* (C). Antennal scales of *N. crangonoides* (D); *N. portoricensis* (E); and *N. macginitei* (F). Dactyli of third and fourth pereopods of *N. crangonoides* (G, H); *N. portoricensis* (I, J); *N. macginitei* (K, L); and *N. perrieri* (M; adapted from Nobili, 1906).

are very much the same but that of *N. macginitei* is more granulose in the rostral area. The mandibles (Figs. 6E, F, G, H) are essentially the same, except that *N. crangonoides* has a fusion of segments in the palp giving the general appearance of a 2-segmented palp whereas the other species clearly have a 3-segmented palp. The chelipeds (Figs. 7A, B, C, D) show differences. The ischium is toothed in *N. portoricensis* and *N. macginitei* but smooth in *N. crangonoides* and *N. perrieri*. *N. crangonoides* has teeth on the inner border of the merus, as does *N. portoricensis* and *N. macginitei*, but the inner border of *N. perrieri*'s merus is smooth. The outer margin of the merus is toothed in *N. portoricensis*, smooth in *N. crangonoides* and *N. perrieri*, and with 2 teeth at the base in *N. macginitei*. The propodus is very similar in *N. crangonoides* and *N. perrieri* but shows some differences in the other 2 species. In *N. portoricensis*, the inner border of the propodus is toothed below the prominent tooth and has its outer margin toothed along its entire length. In *N. macginitei*, the inner border of the propodus is smooth below the prominent tooth and the outer margin is only toothed on its upper length. The telson, uropods and antennal scales of the species of *Naushonia* seem to show the largest differences in morphology. In *N. cran-*

*gonoides*, the telson (Fig. 8A) has no spines, the uropods have complete transverse sutures, and the uropodal exopodite has 5 spines on the lateral margin which ends in a strong movable spine. In *N. portoricensis*, the telson (Fig. 8B) has a spine on its lateral margin, the uropods have complete transverse sutures, and the exopodite of the uropod has 2 spines on its lateral margin which ends in a strong movable spine. The telson of *N. macginitei* (Fig. 8C) has 3 spines on its lateral margin, the uropods have incomplete transverse sutures, and the uropodal exopodite has 2 spines on its lateral margin ending with 2 small spines and a large movable spine. The antennal scale of *N. crangonoides* (Fig. 8D) bears 11 marginal teeth; the scale of *N. macginitei* (Fig. 8F) bears 7–8 marginal teeth; and the scale of *N. portoricensis* (Fig. 8E) bears 6 marginal teeth, with the distal tooth the largest and curved inward. Nobili (1904, 1906) did not adequately describe or illustrate the telson, uropods and antennal scale of *N. perrieri* to show differences from the other 3 species of *Naushonia*. Some or all of the dactyli of the last 3 pereopods in *Naushonia* have lateral movable spines. These movable spines are on the third and fourth pereopods (Figs. 8H, G, K, L) of *N. crangonoides* and *N. macginitei*; on the fourth pereopod (Fig. 8J) of *N. portoricensis*; and on the last three pairs of pereopods (Fig. 8M) of *N. perrieri*.

Although more material of the Red Sea species needs to be examined, the following key will distinguish the 4 species:

1. Uropods with complete transverse sutures.
  - A. Linea thalassinica pronounced, carinae of the carapace weak; telson without lateral spine; antennal scale with 10 or more marginal teeth ..... *N. crangonoides*
  - B. Linea thalassinica not pronounced, carinae of carapace well marked; antennal scale with less than 10 marginal teeth.
    - a. Telson with lateral spine; antennal scale with 6 marginal teeth, distal tooth largest and curved inwards; lateral movable spines on fourth pereopod only ..... *N. portoricensis*
    - b. Lateral movable spines present on all 3 posterior pereopods ..... *N. perrieri*
2. Uropods with incomplete transverse sutures; uropodal exopodites with 2 lateral spines, margin ending with 2 small spines and stout movable spine ..... *N. macginitei*

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