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

Joseph W. Goy and Anthony J. Provenzano, Jr.

*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.

## 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. macginitei*, *N. portoricensis*, the paratype of *Homoriscus* (=*Naushonia*) *macginitei* 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 exoskelton. 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 m
cluded all telson processes and setae.

### Juvenile Stages of *Naushonia c*

In the first few molts after the postlarval stag
*shonia crangonoides* does not change drastically
There is a gradual development of adult charac
the major morphological changes that occur fi
through the fifth juvenile stage.

The telson and uropods are unchanged unti
reached.

In the first juvenile stage, the antennule is sim
but the 6 aesthetascs are now located on the
external flagellum, 2 per segment. This append
until the fifth juvenile stage.

The antenna of the first juvenile stage is unc
stage, except that there are 20 plumose setae
scale. This appendage also does not change ap
venile stage.

The mandibles show the most significant cha
molt. The postlarval stage has symmetrical ma
cutting edge provided with 4 small teeth. The p
mented, bearing a minute seta terminally. In t
cutting edge of the mandible (Fig. 1B) has the 4
a small medial tooth, and the palp is still uns
terminal rows of 5 spines. In the second juveni
1C) has a cutting edge with 8 terminal and 2 sul
now 2-segmented, with the first segment bearing
and the second segment having 13 terminal stou
stage has the mandible (Fig. 1D) basically unc
stage, except the cutting edge has only 10 sm
second segment of the palp bears 14 terminal sp
stage, the mandible (Fig. 1E) has 4 large and 9
edge. The palp shows signs of a third segment b
2 long plumose setae on the outer margin of the fi
spines on the second segment.

The maxillule of the juvenile stages is unch
stage, except more spines and plumose setae dev
endites with each succeeding molt.

The maxilla of the juvenile stages is also simi
The number of setae increases on the 4 inner lob
scaphognathite. The endopodite remains unseg

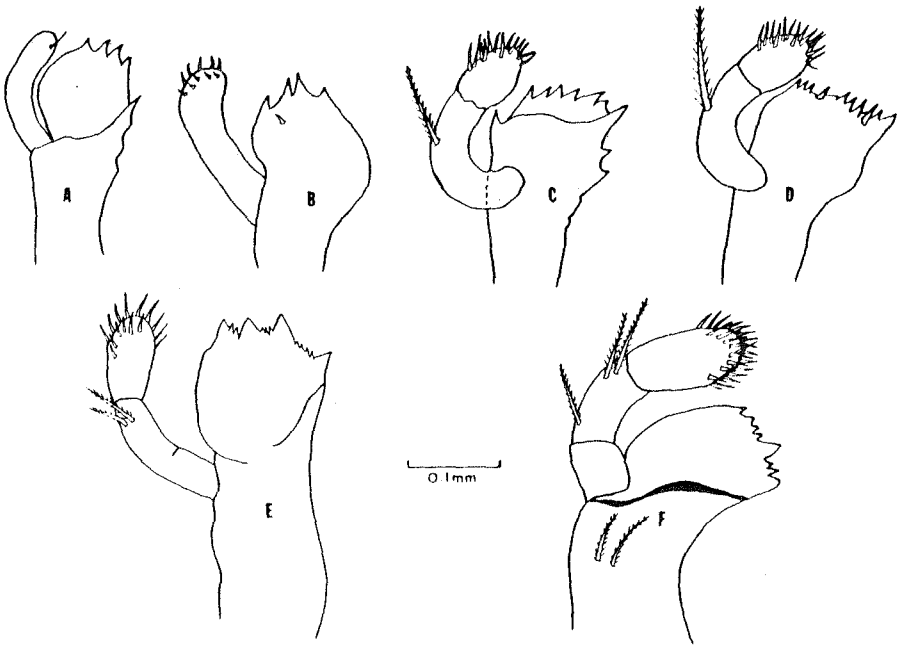


Fig. 1. *Naushonia crangonoides*: Mandibles of postlarva (A); First juvenile (B); Second juvenile (C); Third juvenile (D); Fourth juvenile (E); and Fifth Juvenile (F).

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 expodite 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



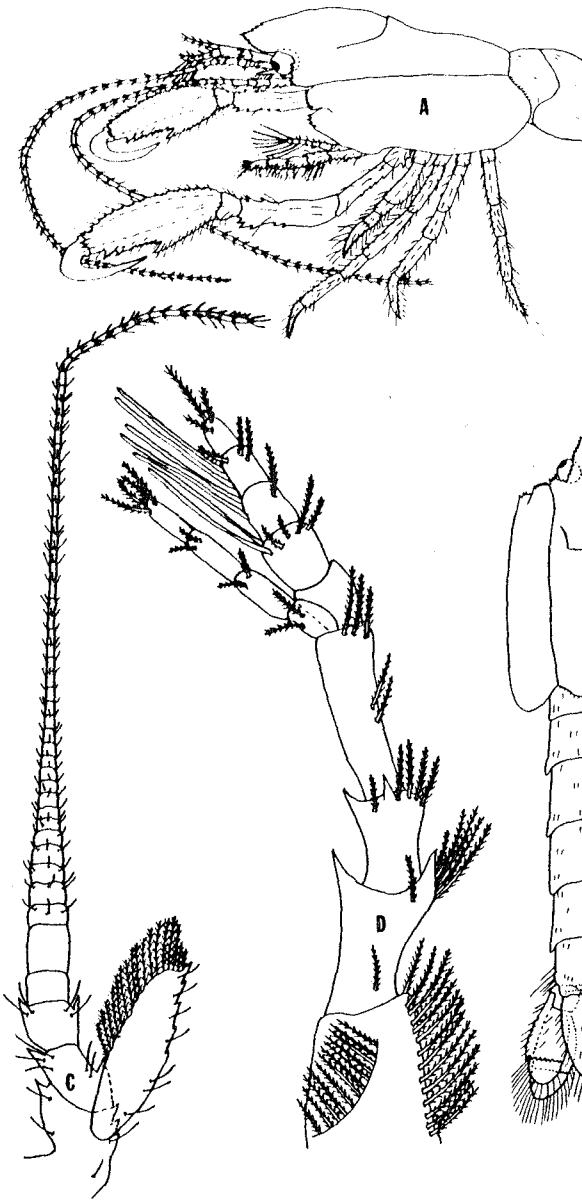


Fig. 2. *Naushonia crangonoides*: Fifth juvenile stage: La
Antenna (C); and Antennule (D).

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 pereiopods 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



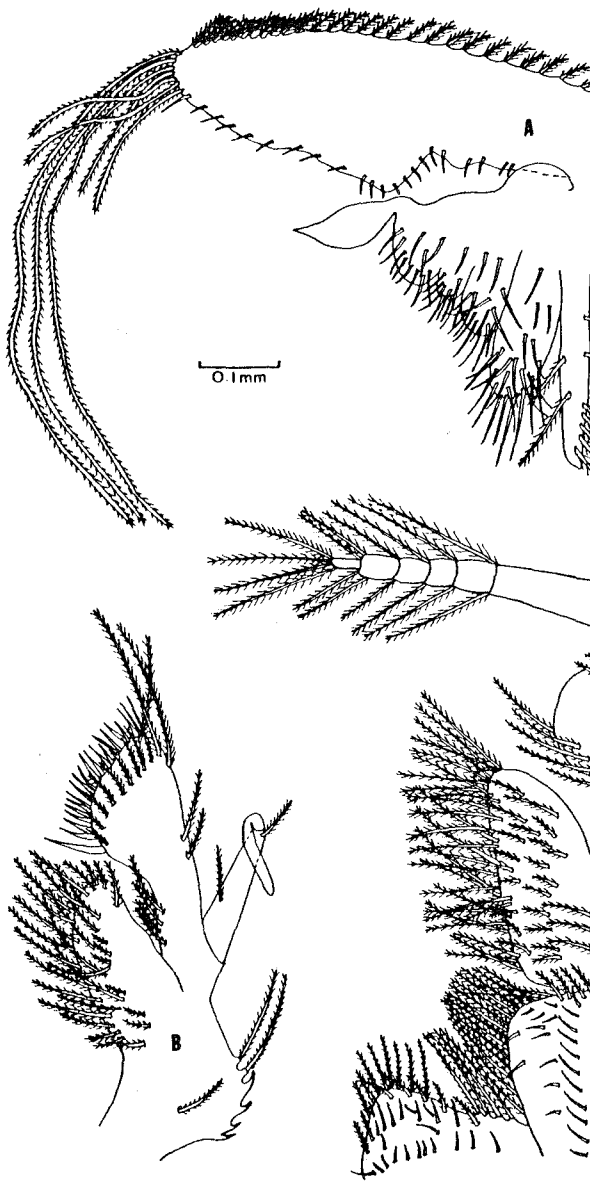


Fig. 3. *Naushonia crangonoides*: Fifth juvenile stage ap
(B); and First maxilliped (C).

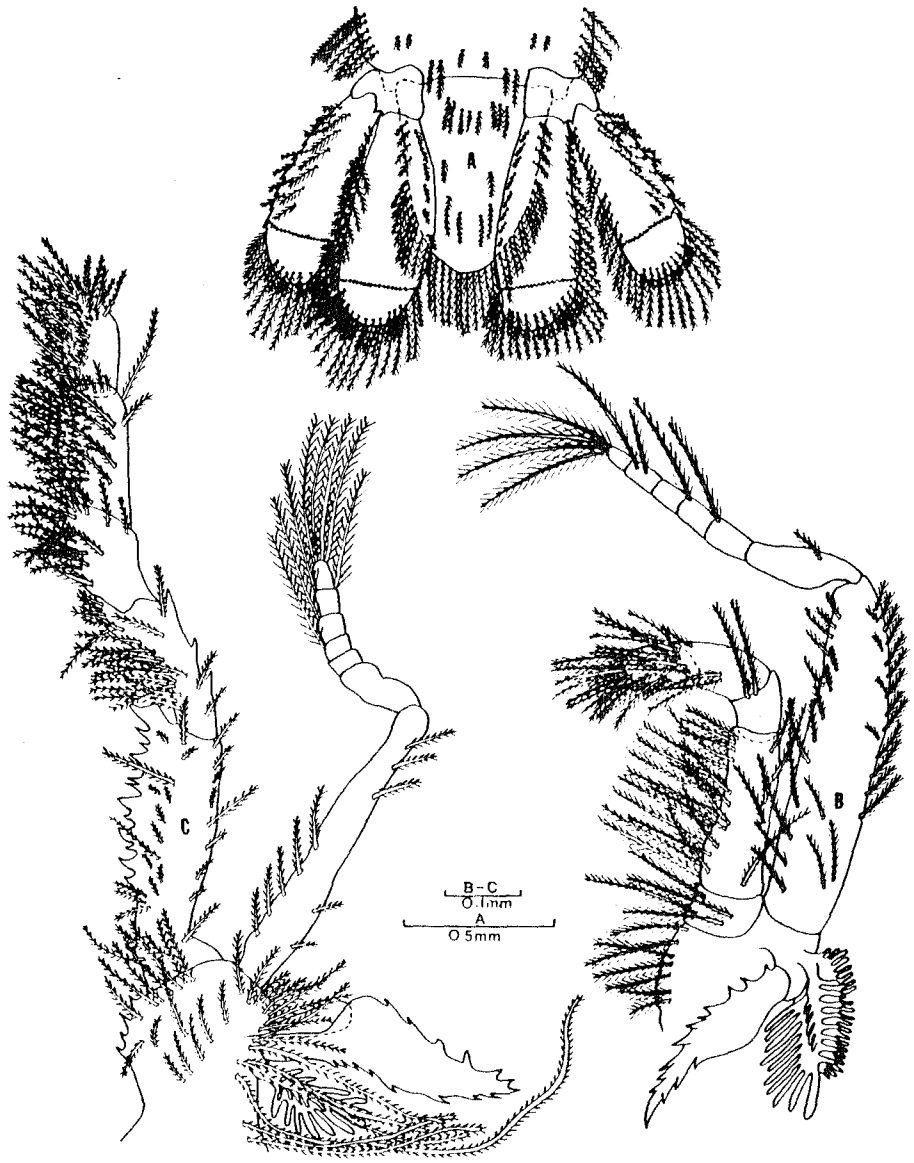


Fig. 4. *Nanshonia crangonoides*: Fifth juvenile stage appendages: Telson (A); Second maxilliped (B); and Third maxilliped (C).



outer setae and 17 plumose setae on inner marg
pering consisting of 51 segments, most having cir

Mandible (Fig. 1F) with only 2 large and 6 sma
Palp 3-segmented, with second segment having
terminal segment bearing 24 spines.

Maxillule (Fig. 3B) with 2-segmented endopodit
ment and with first segment bearing plumose se
inner margin. Basipodite bearing 4 teeth and 2
Coxal endite with 30 feathered setae marginally
endite with 30 feathered setae marginally and su
rounded with 2 and 4 plumose setae on outer a
tively; terminally 19 stout teeth and 3 long plumos
9 shorter plumose setae.

Maxilla (Fig. 3A) with following setation on 4 i
lobe of coxal endite; 8 on distal lobe; 15 on prox
21 on distal lobe. Unsegmented endopodite beari
and 2 proximally on outer margin, and 2 plumo
Scaphognathite broad with 60 plumose setae on ou
setae on inner margin. Long tapering proximal lo
setae and 3 longer, whip-like plumose setae.

First maxilliped (Fig. 3C) with 2-lobed basipoc
plumose setae and 21 shorter non-plumose set
plumose setae. Endopodite 2-segmented with dis
triangular, bearing 5 long plumose setae and 8 s
opodite 7-segmented with proximal segment wic
feathered setae on outer margin. Last 5 segment
seta on both sides near base, except terminal
plumose setae at apex. Epipodite large, serrate a
branch and mastigobranch.

Second maxilliped (Fig. 4B) with 5-segmented
mate segment slightly expanded. These segments
tae proximally to distally as follows: 4; 24; 2; 1(
mented with first segment having numerous shor
segments bearing long plumose setae; terminal
apex. Epipodite heavily serrate, with 2 arthrobra

Third maxilliped (Fig. 4C) having endopodite c
bearing 13 prominent teeth on inner border and
Second segment with 3 prominent teeth on outer
plumose setae; other 3 segments heavily setose.
segments with last 4 segments bearing long plum
plex consisting of small anterior lobe and bunch
setae, serrate-margined mastigobranch and po
branchs 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 pereiopods (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 pereiopods (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 pereiopods, small podobranch on second and third pairs, and slender mastigobranch on all 3 pairs. No gills on fifth pereiopods.

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 pereiopod has 12 and fourth pereiopod 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 pereiopod has 20 and fourth pereiopod has 12 movable spines on dactyli.

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



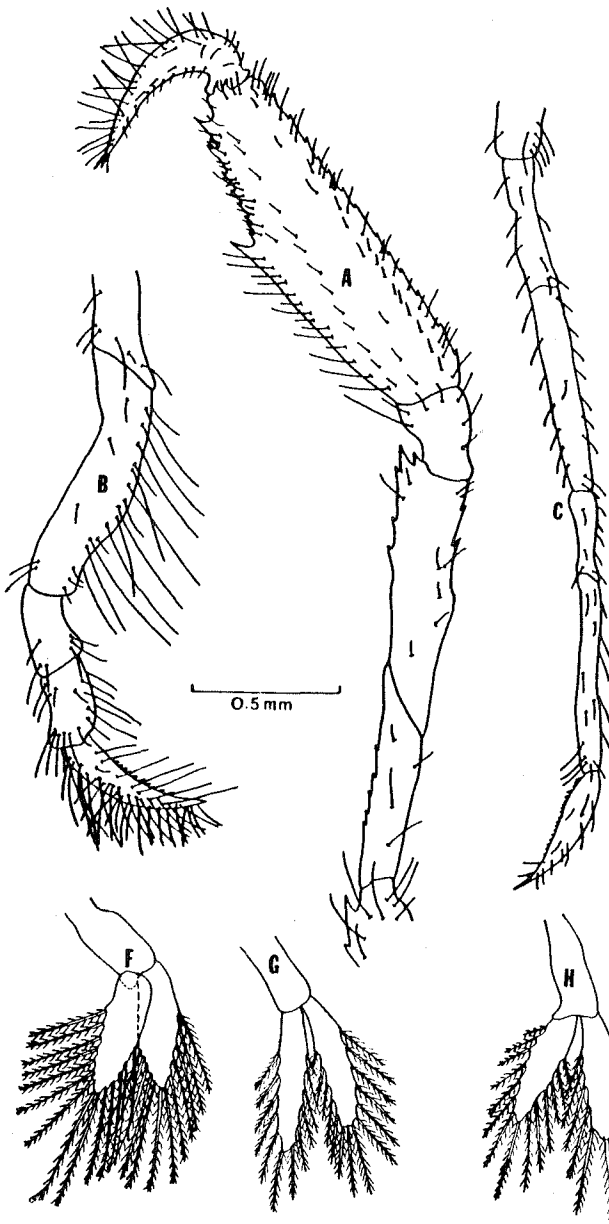


Fig. 5. *Naushonia crangonoides*: Fifth juvenile stage apper
pereiopod (B); Third pereiopod (C); Fourth pereiopod (D); Fifth p
(F); Third pleopod (G); Fouth pleopod (H); and Fifth pleopod (I

from above. Telson, uropods, antennal scale and mandibular palp same as above. Third pereiopod has 24 and fourth pereiopod 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 pereiopod has 20 and fourth pereiopod 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 pereiopods 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 pereiopods 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 pereiopod has none and fourth pereiopod 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 pereiopods missing.

*Naushonia macginitiei*

**1.**—CL 7.6 mm; TL 19.0 mm. (USNM 171605). Ovigerous female. Paratype of *Homoriscus* (=*Naushonia*) *macginitei*. 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 pereiopod has 20–22 and fourth pereiopod 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 pereiopod has 20–24 and fourth pereiopod 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 pereiopod has 22 movable spines on dactyli. Fourth pereiopod 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 pereiopod has 24
15 movable spines on dactyli.

Systematic Position of *Naus*

Order Decapoda
Supersection Macrura Rept
Section Thalassinidea

The Decapod section Thalassinidea is consider
is much difference of opinion as to its number of
position. Balss (1957) recognized only 4 families,
recognized 7 distinct families based on a combi
characteristics: the Axianassidae, Axiidae, Calli
Laomediidae, Thalassinidae and Upogebiidae. Gu
ilies in detail and gave a key to their determinatic
burrowing forms characterized by a well calcifie
symmetrical, extended, often feebly calcified abd
veloped tail fan; first pereiopods chelate or subch
chelate or simple, and third legs always non-che
1966).

Family LAOMEDIIDAE Borrada

The family Laomediidae at present consists o
8 described species. According to Wear and Yaldw
acterized by "having a linea thalassinica; first leg
subchelate; second pereiopods subchelate or sir
on pleopods; uropods with transverse sutures; po
ond and third maxillipeds and first and second pe
the first to fourth pereiopods." Chace (1939) div
2 subfamilies: Laomediinae and Naushoniinae. T
tinguished from the Laomediinae by the subchela
legs, the well-developed antennal scale that is ab
Laomediinae, and the simple instead of subchela

DeMan (1928) considered the family Axianassic
its only genus (*Axianassa*) in the family Laome
species of this genus (*Axianassa intermedia* and *A*
major characters of the laomediids, including tran
pods and exopodites on the third maxillipeds. A
Wear (1972), all examined adult species of the fa
gills though there may be some minor differences
species of *Axianassa* have only 17 gills. Theref
only *Jaxea*, *Laomedia*, and *Naushonia* are incl

## 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 (Sandifer, 1972; Goy, 1976). In these last 2 collect



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

| | *N. crangonoides* |
|---|---|
| Total Length | 4.80 mm |
| Rostrum | No lateral teeth |
| Rostral apical process | Absent |
| Linea thalassinica | Distinct |
| Antennal scale | 6 marginal teeth |
| Mandibular palp | Unsegmented |

*Naushonia* were most numerous near the bay mo population of *N. crangonoides* somewhere near Bay. This theory was recently confirmed by La when they found 3 adult *N. crangonoides* in t *Dasyatis centroura,* collected approximately 15 the mouth of Chesapeake Bay. A juvenile *N. cr* has been collected in Bogue Sound, North Ca communication, 1977) extending the species kno miles south of its type-locality.

Chace (1939) synonymized with *Naushonia* the bun, 1901 and *Coralliocrangon* Nobili, 1904. Thi *Naushonia*: *N. portoricensis, N. macginitei,* ar *portoricensis* is known from Puerto Rico (Rath 1939), Bermuda (Gurney and Lebour, 1939) and Bay, Quintana Roo, Mexico from material exam *N. macginitei* is known from southern Califor extended south to Enseñada de San Francisco, terial examined in the present study. *N. perri* specimens collected in French Somaliland, Red S

Chace (1939) devised a tentative key to the 4 sp the results of the present study, this key can no l There are lateral movable spines on at least the all species. In *N. crangonoides* specimens less t eyes visible from above. The postlarva to the f *crangonoides* has the telson armed with a single *N. portoricensis.* Also the fifth juvenile stage of segmented mandibular palp and an antennal scale same number as *N. portoricensis* of similar size.

There is a strong possibility that the ranges of *portoricensis* may overlap along the southeast c

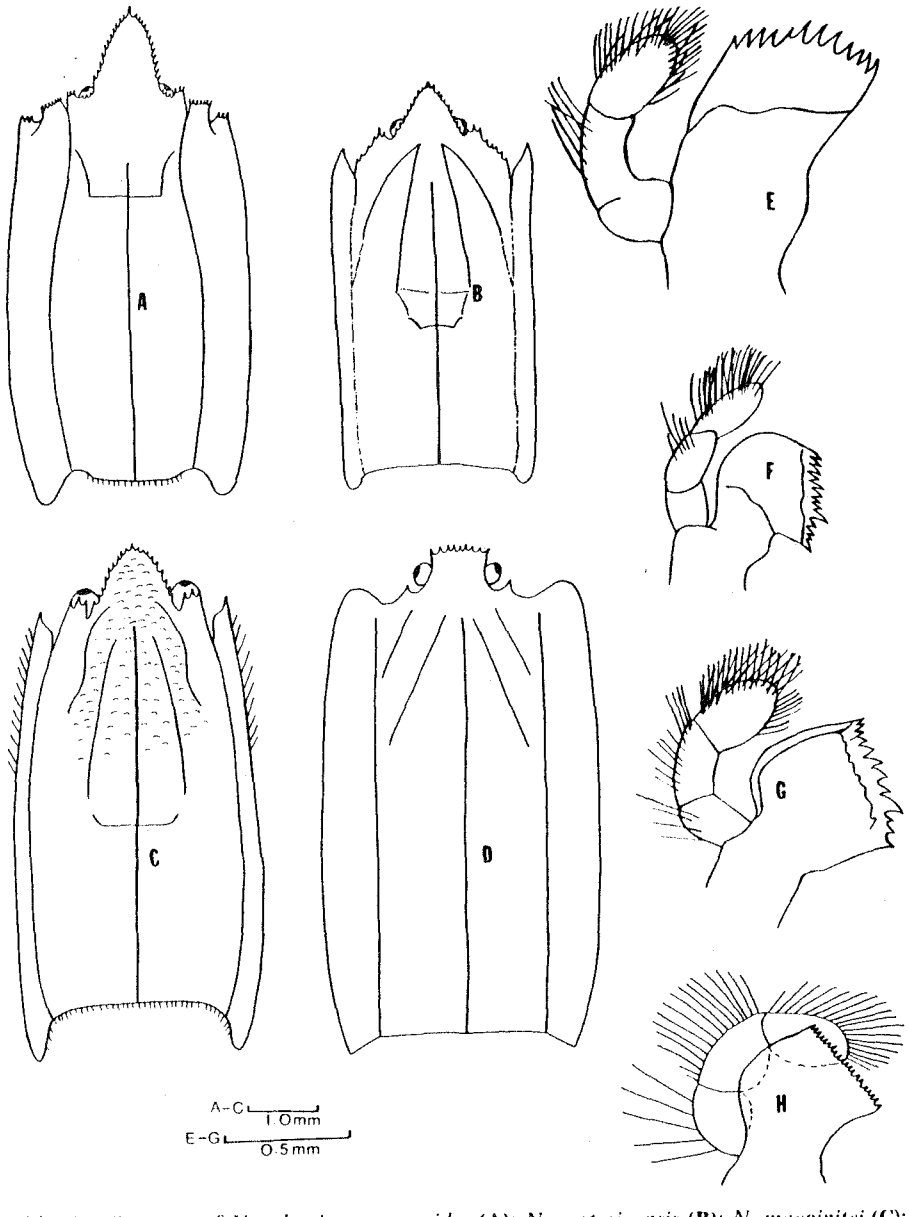


Fig. 6. Carapace of *Naushonia crangonoides* (**A**); *N. portoricensis* (**B**); *N. macginitei* (**C**); and *N. perrieri* (**D**). Mandibles of *N. crangonoides* (**E**); *N. portoricensis* (**F**); *N. macginitei* (**G**); and *N. perrieri* (**H**). (**D** and **H** adapted from Nobili, 1906.)



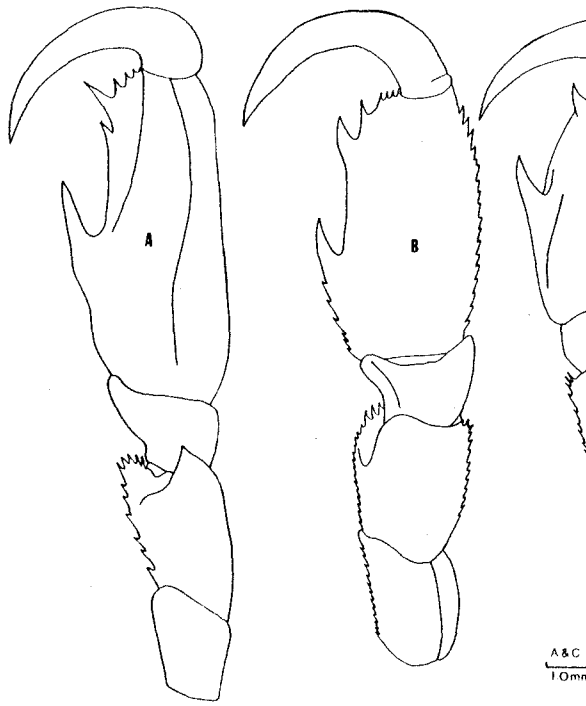


Fig. 7. Chelipeds of *Naushonia crangonoides* (**A**); *N.* Chace, 1939); *N. macginitei* (**C**); and *N. perrieri* (**D**; adapted

The early juvenile stages of *N. crangonoides* be specimens of the much smaller species *N. porto* stage of *N. portoricensis* described by Gurney a similar to the first juvenile stage of *N. crangono* differences (Table 1). Many of the characters separate these 2 species will overlap at the smalle scale, telson and uropods at these sizes will enab 2 species. The smallest *N. portoricensis* we exar antennal scale with 4 marginal teeth with the di while the fifth juvenile stage of *N. crangonoides* tennal scale with 5 marginal teeth. The telsons of no external spines but the uropodal exopodite spines on the lateral margin which ends in a st uropodal exopodite of the fifth juvenile stage o external spines on the lateral margin which ends

The adults of the 4 species of *Naushonia* are phology but show differences in detail. Their cara

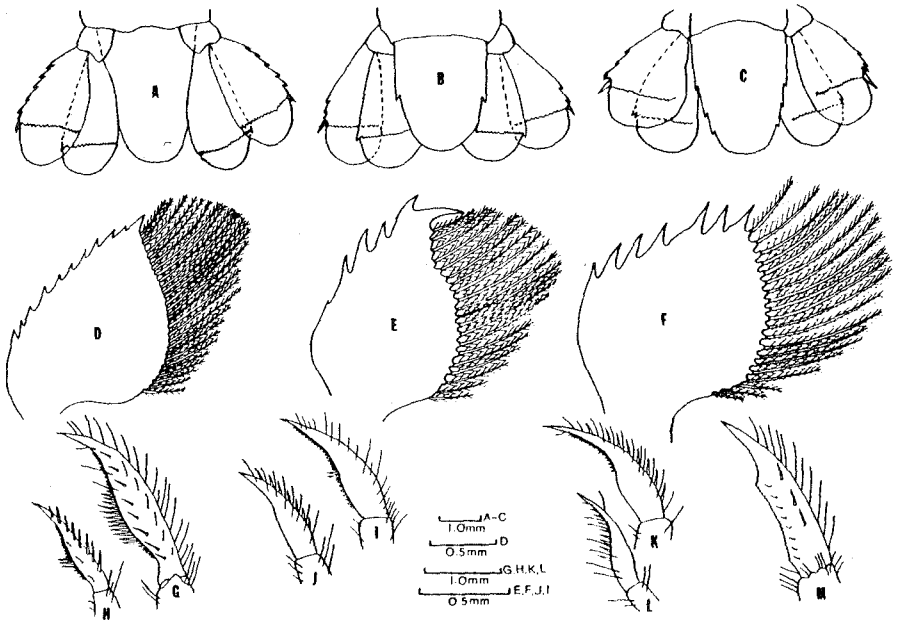


Fig. 8. Telsons of *Naushonia crangonoides* (**A**); *N. portoricensis* (**B**), and *N. macginitei* (**C**). Antennal scales of *N. crangonoides* (**D**); *N. portoricensis* (**E**); and *N. macginitei* (**F**). Dactyli of third and fourth pereiopods of *N. crangonoides* (**G, H**); *N. portoricensis* (**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. crangonoides*, the telson (Fig. 8A) has no spines, th
transverse sutures, and the uropodal exopodite l
margin which ends in a strong movable spine. In *N*
(Fig. 8B) has a spine on its lateral margin, the uro
verse sutures, and the exopodite of the uropod
margin which ends in a strong movable spine. Th
(Fig. 8C) has 3 spines on its lateral margin, the
transverse sutures, and the uropodal exopodite
margin ending with 2 small spines and a large mo
scale of *N. crangonoides* (Fig. 8D) bears 11 marg
*macginitei* (Fig. 8F) bears 7–8 marginal teeth; ar
*censis* (Fig. 8E) bears 6 marginal teeth, with the
curved inward. Nobili (1904, 1906) did not adequ
the telson, uropods and antennal scale of *N. pe*
from the other 3 species of *Naushonia*. Some or a
3 pereiopods in *Naushonia* have lateral movab
spines are on the third and fourth pereiopods (
*crangonoides* and *N. macginitei*; on the fourth
*portoricensis*; and on the last three pairs of perio
*rieri*.

Although more material of the Red Sea species
following key will distinguish the 4 species:

1. Uropods with complete transverse sutures.
   - A. Linea thalassinica pronounced, carinae of telson without lateral spine; antennal scale ginal teeth .....
   - B. Linea thalassinica not pronounced, carin marked; antennal scale with less than 10 m
     - a. Telson with lateral spine; antennal scale distal tooth largest and curved inwa spines on fourth pereiopod only .....
     - b. Lateral movable spines present on all 3 .....
2. Uropods with incomplete transverse sutures; with 2 lateral spines, margin ending with 2 s movable spine .....

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