XFWS-A 599 1-26 (1970)
U.S. Fish Wildl. Serv.
Spec. Sci. Rep. Fish.

599

Diagnostic Characters of Juveniles of the Shrimps *Penaeus aztecus aztecus*, *P. duorarum duorarum*, and *P. brasiliensis* (Crustacea, Decapoda, Penaeidae)

SPECIAL SCIENTIFIC REPORT–FISHERIES No. 599

UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES

SPECIAL SCIENTIFIC REPORT--FISHERIES

Robert L. Hacker, *Editor*
Mary S. Fukuyama, *Associate Editor*

Special Scientific Report--Fisheries are preliminary or progress reports and reports on scientific investigations of restricted scope. Established as Special Scientific Reports in 1940, nos. 1-67 were issued from that date to 1949, when the new series, Special Scientific Report--Fisheries, with new serial numbering, was started.

Special Scientific Report--Fisheries are distributed free to libraries, research institutions, State agencies, and scientists.

UNITED STATES DEPARTMENT OF THE INTERIOR
Walter J. Hickel, *Secretary*
Russell E. Train, *Under Secretary*
Leslie L. Glasgow, *Assistant Secretary*
for Fish and Wildlife, Parks, and Marine Resources
Charles H. Meacham, *Commissioner, U.S. FISH AND WILDLIFE SERVICE*
Dayton L. Alverson, Acting Director, BUREAU OF COMMERCIAL FISHERIES

Diagnostic Characters of Juveniles of the Shrimps *Penaeus aztecus aztecus, P. duorarum duorarum,* and *P. brasiliensis* (Crustacea, Decapoda, Penaeidae)

By
ISABEL PÉREZ FARFANTE

United States Fish and Wildlife Service
Special Scientific Report--Fisheries No. 599

Washington, D.C.
FEBRUARY 1970

CONTENTS

Diagnostic Characters of Juveniles of the Shrimps *Penaeus aztecus aztecus, P. duorarum duorarum,* and *P. brasiliensis* (Crustacea, Decapoda, Penaeidae)

By

ISABEL PÉREZ FARFANTE, Systematic Zoologist

Bureau of Commercial Fisheries National Center for Systematics
U.S. National Museum
Washington, D.C. 20560

ABSTRACT

Illustrated tables are presented for the identification and sex determination of juveniles (with carapace lengths of 8 mm. or more) of three grooved shrimps of the genus *Penaeus* occurring in various areas along the North American Atlantic coast, in the Gulf of Mexico, and in the Bermudas. Included is an account of the development of the petasmata, thelyca, and appendices masculinae.

INTRODUCTION

Many investigations have been made of juveniles of *Penaeus* that live in estuarine waters along the Atlantic and Gulf coasts of the United States. Particular attention has been given to their movements, habits, growth rates, and responses to fluctuations in temperature and salinity. Such studies are continuing in the United States and are now also being made along the coasts of Mexico and Central and South America; but despite the attention that has been accorded these juveniles, little progress has been made in ascertaining characteristics that will permit their identification.

Fortunately, the ranges of the two species of nongrooved *Penaeus, P.* (*Litopenaeus*) *setiferus*[1] and *P.* (*Litopenaeus*) *schmitti,* apparently do not overlap, and therefore their identification presents no problem; juveniles of these species having a total length of 18 mm. or more may be separated from the young grooved shrimps by the short adrostal sulci. In contrast, the grooved *Penaeus* have overlapping ranges, and the juveniles are superficially so similar that identifying them has been almost impossible heretofore. The purposes of this investigation have been to study the development of the juveniles of these grooved shrimps and to discover characteristics that might allow their specific or subspecific determination. The possibility of being able to recognize these estuarine individuals permits more reliable conclusions concerning the ecology and behavior of the taxa represented, and aids in attempts to predict the probable annual abundance of each of them.

[1] The species of *Penaeus* have been grouped by Pérez Farfante (1969) in four subgenera, two of which are represented in American waters. The species with short adrostral sulci and a thelycum of the open type — in the western Atlantic *P. setiferus* and *P. schmitti* — belong to the subgenus *Litopenaeus,* and those species with long adrostral sulci, to *Melicertus.* The three taxa treated here belong to the latter subgenus.

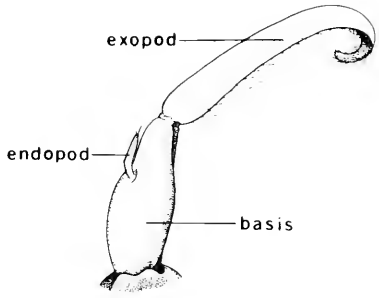
This work is based on the examination of some 5,000 specimens collected throughout the ranges of the taxa considered. The great majority of them are in the collections of the U.S. National Museum, and many are sorted according to size (carapace length). Other specimens examined are in the collections of the American Museum of Natural History; Chesapeake Biological Laboratory; Instituto Nacional de Investigaciones Biológico Pesqueras, Secretaría de Industria y Comercio de México; Gulf Coast Research Laboratory; Museum of Comparative Zoology, Harvard University; Peabody Museum of Natural History, Yale University, and Virginia Institute of Marine Science.

Burkenroad (1939) pointed out several diagnostic features which aid in the recognition of the larger juvenile grooved shrimps from the western Atlantic, and some of these were based on secondary sexual characters. Williams (1953) used the length of the adrostral sulci, characters of the rostrum, and color to identify juvenile *P.* (*L.*) *setiferus*, *P.* (*Melicertus*) *d. duorarum*, and *P.* (*Melicertus*) *a. aztecus*. The studies by Eldred (1958) on *P. d. duorarum* and Pérez Farfante (1969) of western Atlantic *Penaeus* constitute the only information available on the progressive changes in the development of the thelycum and petasma of *Penaeus* in eastern America. The shape and length of the rostrum, the length and width of the adrostral sulci (in shrimp from the Caribbean and the Atlantic coast of South America), and the width of the dorsolateral sulci of the sixth abdominal somite are usually helpful. In males, sternites XIII and XIV also exhibit peculiar features in some of the grooved shrimps. The most reliable characters for the identification of juveniles, however, seem to be the structure of the petasma and thelycum.

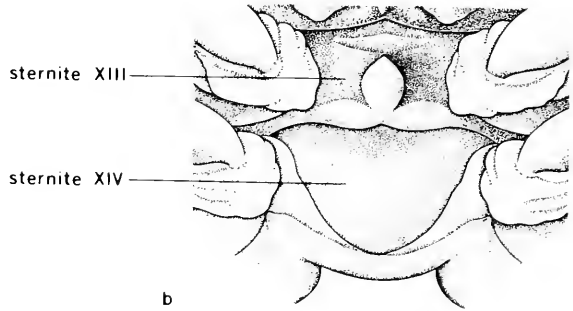
Facilitating this investigation was a previous knowledge of the local occurrence of the species and the time of the year when juveniles of the three shrimps are found in estuarine waters. For instance, *P. d. duorarum* is the only one of the three that occurs in Tampa Bay; only *P. a. aztecus* lives north of Chesapeake Bay, and only *P. d. duorarum* and *P. brasiliensis* frequent the waters of the Bermudas. Furthermore, *P. a. aztecus* juveniles first appear in estuaries of North Carolina and Texas much earlier in spring than those of the other *Penaeus*. Finally, comparison of progressively younger specimens with those of sizes readily identifiable made possible the recognition of the earlier developmental stages.

I present here a group of diagnostic characters that will permit identification of individuals with a c.l. (carapace length — the linear distance between the postorbital margin and the midposterior margin of the carapace) of as little as 8 mm., and t.l. (total length — measured from the tip of the rostrum to the tip of the telson) of about 35 mm. The typical features exhibited by each species and subspecies during a large part of the juvenile period are listed in the tables below, which are arranged in size sequences. For the recognition of small individuals (less than 11 mm. c.l.), all of the characters listed should be considered because occasionally one alone may not prove to be diagnostic.

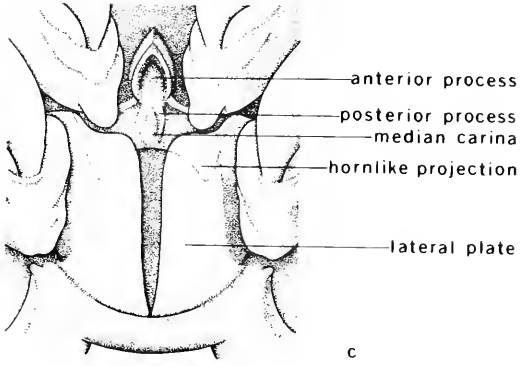
Figure 1 depicts the first pleopod, the posteroventral portion of the thorax, the thelycum, and the petasma — introducing the terminology utilized in the tables. Figures 2 and 3 illustrate the characters used in the identification of sex, and the remaining figures show the peculiar characters of the rostrum, dorsolateral sulcus, and the external genitalia, as well as the progressive changes in the latter, which allow the recognition of each taxon. The features cited were found to be reliable throughout the geographic range of each of the shrimps considered. Whereas the carapace length at which these characters first appear may vary slightly, they are present in all individuals at the carapace length cited. The rate of development of the petasmata and thelyca varies, consequently these structures do not attain the adult form when the shrimps reach a given length (e.g., 15 mm. c.l.) but rather within a definite range of lengths (e.g., 15 to 20 mm. c.l.). It seems that the range within which the external



a



b



c

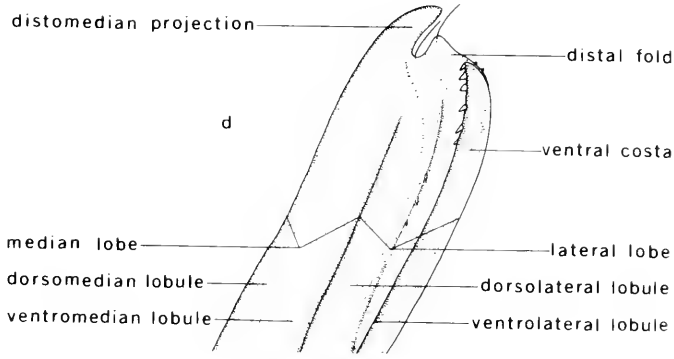


Figure 1.—Structures used in the identification of grooved *Penaeus*. a. Anterior (dorsal) view of first right pleopod. b. Posteroventral portion of thorax. c. Thelycum. d. Lateral view of distal portion of petasma.

genitalia of each species and subspecies attain the adult form (the animals reach the subadult stage) is constant, regardless of the locality in which the shrimps occur.

In *P. a. aztecus* the petasma and the thelycum often develop at a slower pace, relative to body length, than in the sympatric *P. d. duorarum*. For each length listed, I have compared the more advance representatives of *P. a. aztecus* with the least advanced members (i.e., least developed genitalia) of *P. d. duorarum*, and the differences presented herein seem to be valid.

Although there are still no infallible criteria on which recognition of every single juvenile under 10 mm. c.l. may be based (for instance, it is difficult to distinguish females of *P. brasiliensis* from females of the sympatric *P. d. duorarum*), the characters cited here allow the identification of many small and practically all larger juveniles.

IDENTIFICATION OF SEX IN VERY SMALL JUVENILES

In individuals as small as 4 mm. c.l., about 18 mm. t.l., sex in the three taxa can be determined by the position and size of the endopod of the first pair of pleopods. The endopod in males is located more proximally on the basis and is a little longer than in females (figs. 2 and 3). Also, in males of that length, sternite XIV bears a posteromesial ridge (figs. 4a and 5a), whereas in females sternite XIV is rather evenly produced to a central elevation (figs. 4b and 5b).

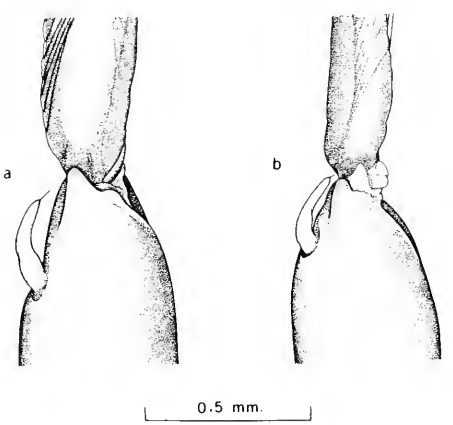


Figure 2.—*Penaeus aztecus aztecus.* Anterior (dorsal) view of endopod of first right pleopod. a. ♂ 5.5 mm. c.l., White Oak River, N.C. b. ♀ 5.5 mm. c.l., Mississippi Sound, Miss.

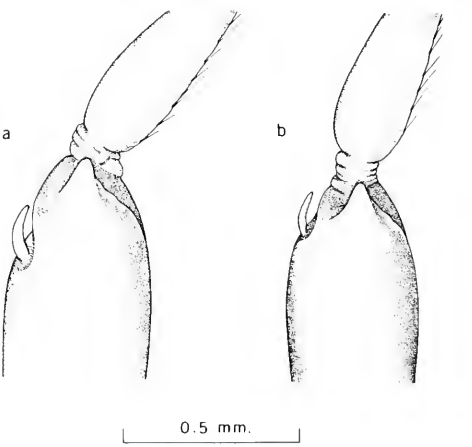


Figure 3.—*Penaeus duorarum duorarum.* Anterior (dorsal) view of endopod of first right pleopod. a. ♂ 4 mm. c.l., Mississippi Sound, Miss. b. ♀ 4 mm. c.l., Mississippi Sound, Miss.

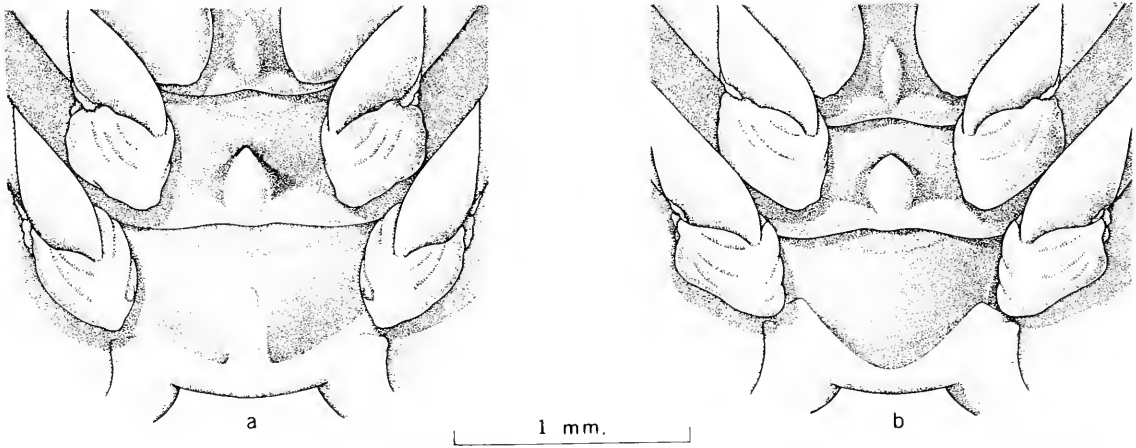


Figure 4.—*Penaeus aztecus aztecus.* Sternites XIII and XIV. a. ♂ 5 mm. c.l., Galveston Bay, Tex. b. ♀ 5 mm. c.l., Galveston Bay, Tex.

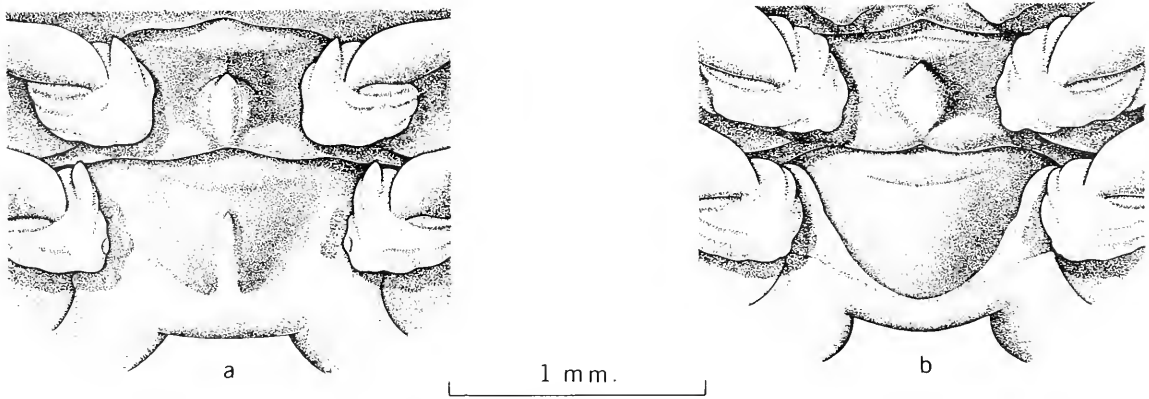


Figure 5.—*Penaeus duorarum duorarum.* Sternites XIII and XIV. a. ♂ 5.5 mm. c.l., Tampa Bay, Fla. b. ♀ 5 mm. c.l., Tampa Bay, Fla.

DISTINGUISHING FEATURES OF THE ROSTRA AND DORSOLATERAL SULCI

Penaeus aztecus aztecus	*Penaeus duorarum duorarum*	*Penaeus brasiliensis*
Carapace length, 8-20 mm.		
Rostrum		
Long, extending anteriorly beyond distal antennular segment, sometimes reaching to distal one-third of broadened portion of lateral antennular flagellum, its length to 80 percent c.l.; often sinuous, distal half with dorsal margin concave and tip upturned, proximal half with dorsal margin convex (fig. 6a).	Short, usually extending anteriorly to end of distal antennular segment, sometimes reaching to proximal one-fourth of broadened portion of lateral antennular flagellum, its length usually to 70 percent c.l., sometimes to 75 percent c.l.; straight distally, proximodorsal margin convex (fig. 6b).	Long, usually extending anteriorly beyond distal antennular segment, sometimes reaching to distal one-third of broadened portion of lateral antennular flagellum, its length to 80 percent c.l.; usually almost straight along entire length (fig. 6c).

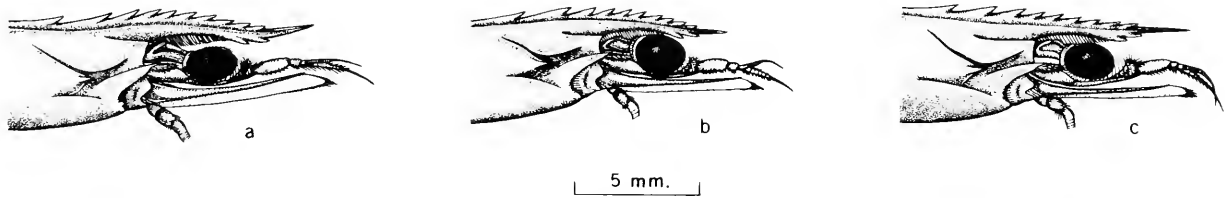


Figure 6.—Rostra. a. *Penaeus aztecus aztecus*, ♂ 9 mm. c.l., White Oak River, N.C. b. *P. duorarum duorarum*, ♂ 9 mm. c.l., Tampa Bay, Fla. c. *P. brasiliensis*, ♂ 9 mm. c.l., Biscayne Bay, Fla.

Dorsolateral sulcus

Broad, ratio keel height-sulcus width, modal value 1.25 (fig. 7a).

Narrow, ratio keel height-sulcus width, modal value 4.5 (fig. 7b).

Narrow, ratio keel height-sulcus width, modal value 5 (fig. 7c).

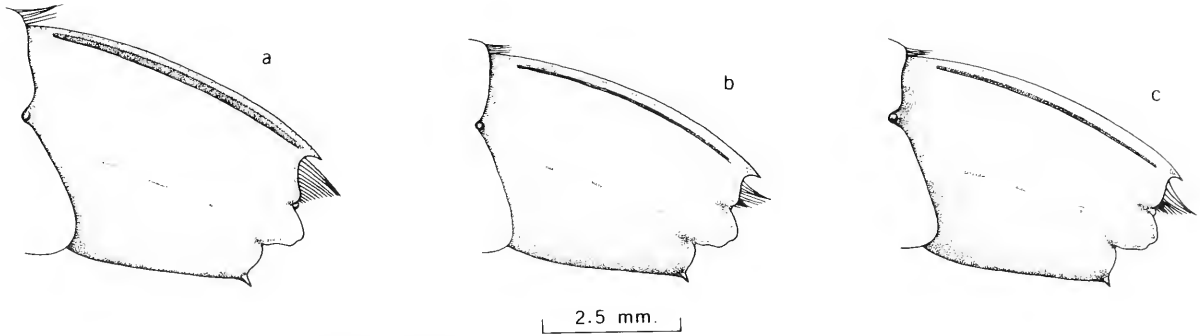


Figure 7.—Sixth abdominal somites. a. *Penaeus aztecus aztecus*, ♀ 9 mm. c.l., Lake Pontchartrain, La. b. *P. duorarum duorarum*, ♀ 9 mm. c.l., Tampa Bay, Fla. c. *P. brasiliensis*, ♀ 9 mm. c.l., Biscayne Bay, Fla.

IDENTIFICATION OF TAXA, MALES

Penaeus aztecus aztecus

Petasma with lobules of median and lateral lobes barely discernible; ventral costa indistinct (fig. 8a). Process on posteromesial portion of sternite XIII blunt or rather blunt anteriorly, broadly convex ventrally.

Penaeus duorarum duorarum

Carapace length, 8 mm.

Petasma with lobules of median and lateral lobes well defined; ventral costa distinct (fig. 8b). Process on posteromesial portion of sternite XIII pointed anteriorly, strongly convex or subangular ventrally.

Penaeus brasiliensis

Petasma with lobules of median and lateral lobes well defined; ventral costa distinct (fig. 8c). Process on posteromesial portion of sternite XIII pointed anteriorly, strongly convex or subangular ventrally.

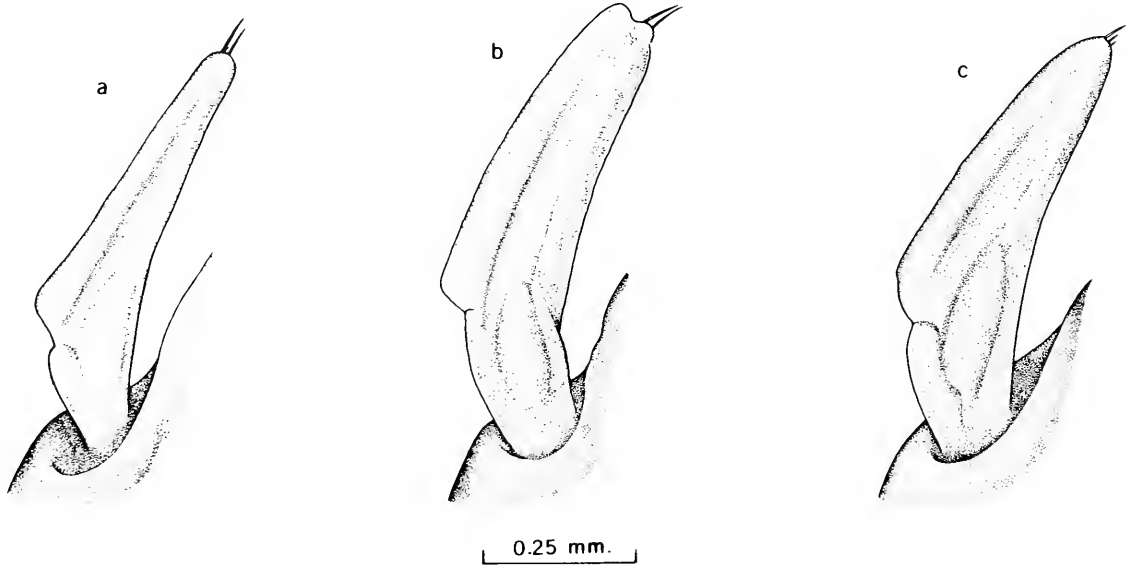


Figure 8.—Petasmata, lateral view of right half. a. *Penaeus aztecus aztecus*, ♂ 8 mm. c.l., White Oak River, N.C. b. *P. duorarum duorarum*, ♂ 8 mm. c.l., Tampa Bay, Fla. c. *P. brasiliensis*, ♂ 8 mm. c.l., Biscayne Bay, Fla.

Petasma with median lobe not projecting distally; ventral costa barely discernible (fig. 9a). Process on posteromesial portion of sternite XIII blunt anteriorly, broadly convex ventrally; sternite XIV with posteromesial rib not pointed anteriorly (fig. 10a). Appendix masculina subelliptical, unarmed or with 1 or 2 minute spines (figs. $11a_1$ and $11a_2$).

Petasma with median lobe projecting distally; ventral costa strong, bearing minute teeth on distal portion of attached margin; free margin often with narrow, extended edge bearing minute spinules (fig. $9b_1$), spinules sometimes present at 9 mm. c.l. (fig. $9b_2$). Process on posteromesial portion of sternite XIII pointed anteriorly, strongly convex or subangular ventrally; sternite XIV with posteromesial rib pointed anteriorly (fig. 10b). Appendix masculina from broadly subelliptical to kidney shaped, usually with 5 or 6 distal spines, sometimes with as few as 2 (figs. $11b_1$ and $11b_2$).

Petasma with median lobe usually projecting distally; ventral costa strong, sometimes bearing minute teeth on or adjacent to distal portion of attached margin; free margin never extended, always lacking spinules (fig. 9c). Process on posteromesial portion of sternite XIII pointed anteriorly, strongly convex or subangular ventrally; sternite XIV with posteromesial rib pointed anteriorly (fig. 10c). Appendix masculina broadly subelliptical, usually with 5 or 6 distal spines, sometimes with as few as 2 (fig. 11c).

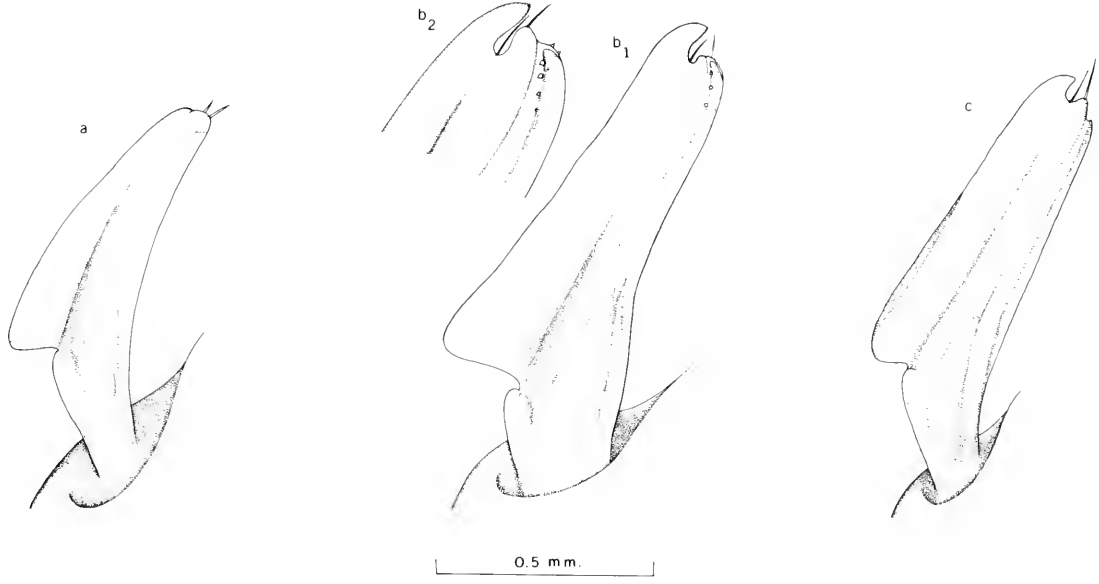


Figure 9.—Petasmata, lateral view of right half. a. *Penaeus aztecus aztecus*, ♂ 10 mm. c.l., Lake Pontchartrain, La. b_1. *P. duorarum duorarum*, ♂ 10 mm. c.l., Tampa Bay, Fla. b_2. Same, ♂ 9 mm. c.l., Pettiford Creek, N.C. c. *P. brasiliensis*, ♂ 10 mm. c.l., Biscayne Bay, Fla.

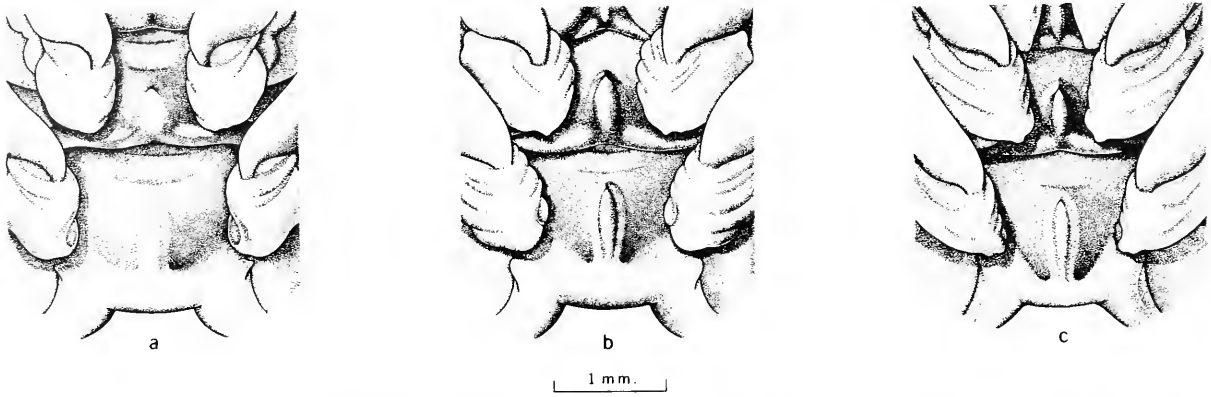


Figure 10.—Sternites XIII and XIV. a. *Penaeus aztecus aztecus*, ♂ 10 mm. c.l., Laguna de la Mancha, Veracruz, Mexico. b. *P. duorarum duorarum*, ♂ 10 mm. c.l., Cat Island, La. c. *P. brasiliensis*, ♂ 10 mm. c.l., Biscayne Bay, Fla.

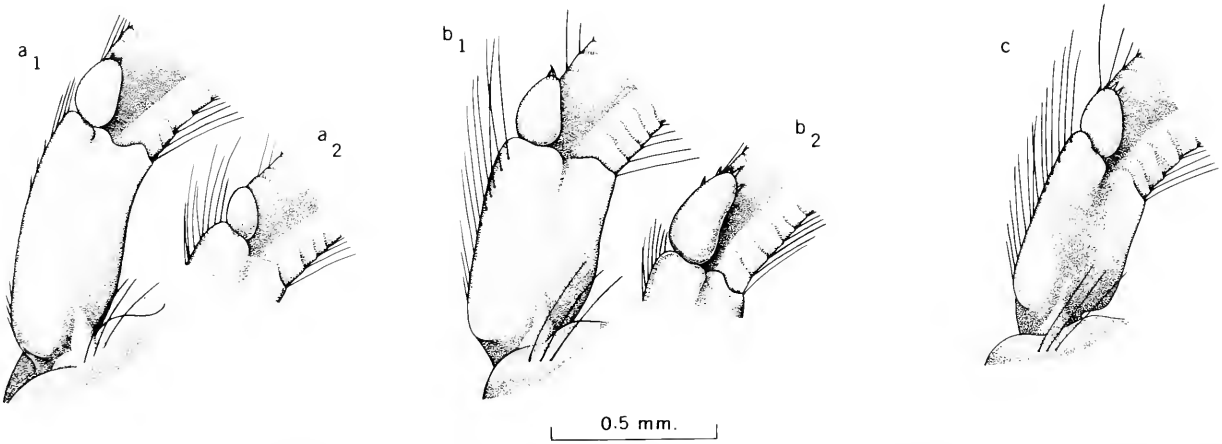


Figure 11.—Appendices masculinae, anterior surface. a_1. *Penaeus aztecus aztecus*, ♂ 10 mm. c.l., Lake Pontchartrain, La. a_2. Same, ♂ 10 mm. c.l., Hall Creek, tributary of Queen Creek, N.C. b_1. *P. duorarum duorarum*, ♂ 10 mm. c.l., Cat Island, La. b_2. Same, ♂ 10 mm. c.l., Tampa Bay, Fla. c. *P. brasiliensis*, ♂ 10 mm. c.l., Biscayne Bay, Fla.

Carapace length, 11 mm.

Petasma with median lobe not or barely projecting distally; ventral costa distinct, with distal extremity rather acute, broadening gradually proximally, unarmed, usually lacking teeth on attached margin and never bearing spinules on unextened free margin (fig. 12a). Sternite XIV with posteromesial rib blunt anteriorly and rounded along entire length.

Petasma with well-developed distomedian projection; ventral costa strong, with distal extremity blunt, broadening rapidly proximally, bearing teeth on attached margin and often spinules on narrow extended free margin (fig. 12b). Sternite XIV with posteromesial rib pointed and sharp anteriorly.

Petasma with well-developed distomedian projection; ventral costa strong, with distal extremity acute, broadening gradually proximally, bearing teeth on or adjacent to attached margin, lacking spinules on unextended free margin (fig. 12c). Sternite XIV with posteromesial rib pointed and sharp anteriorly.

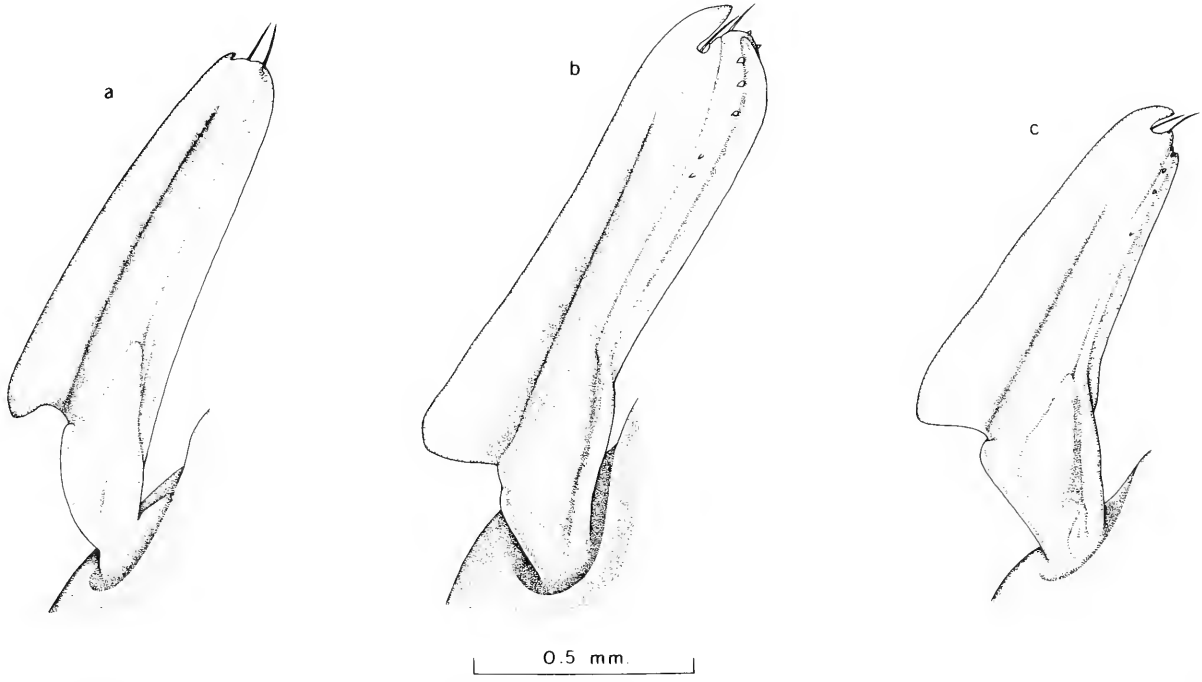


Figure 12.—Petasmata, lateral view of right half. a. *Penaeus aztecus aztecus*, ♂ 11 mm. c.l., Hall Creek, tributary of Queen Creek, N.C. b. *P. duorarum duorarum*, ♂ 11 mm. c.l., Lantana, Fla. c. *P. brasiliensis*, ♂ 11 mm. c.l., Biscayne Bay, Fla.

Distomedian projection of petasma slightly developed; ventral costa relatively thin, with distal extremity broadening gradually proximally, lacking spinules on unextended free margin, often with minute teeth on attached margin, and with apex joined to adjacent membranous portion of ventrolateral lobule; latter with distal portion relatively broad, lacking rib on inner surface, usually with outer surface unarmed (fig. 13a).

Distomedian projection of petasma well developed; ventral costa thick, with distal extremity broadening rapidly proximally, bearing minute spinules on narrow, extended free margin and rather strong teeth on attached margin, and with apex joined to adjacent membranous portion of ventrolateral lobule; latter with distal portion broad, forming fan shaped fold, lacking rib on inner surface but with short, longitudinal row of spines on outer surface proximal to teeth (fig. 13b).

Distomedian projection of petasma well developed; ventral costa thick, with distal extremity broadening gradually proximally, lacking spinules on unextended free margin, armed with teeth on or adjacent to attached margin, and with apex usually free from adjacent membranous portion of ventrolateral lobule; latter with distal portion extremely narrow, bearing inwardly projecting short rib — rudiment of typical tonguelike lamella found in larger individuals — and armed with short, longitudinal row of spines on outer surface proximal to teeth (fig. 13c).

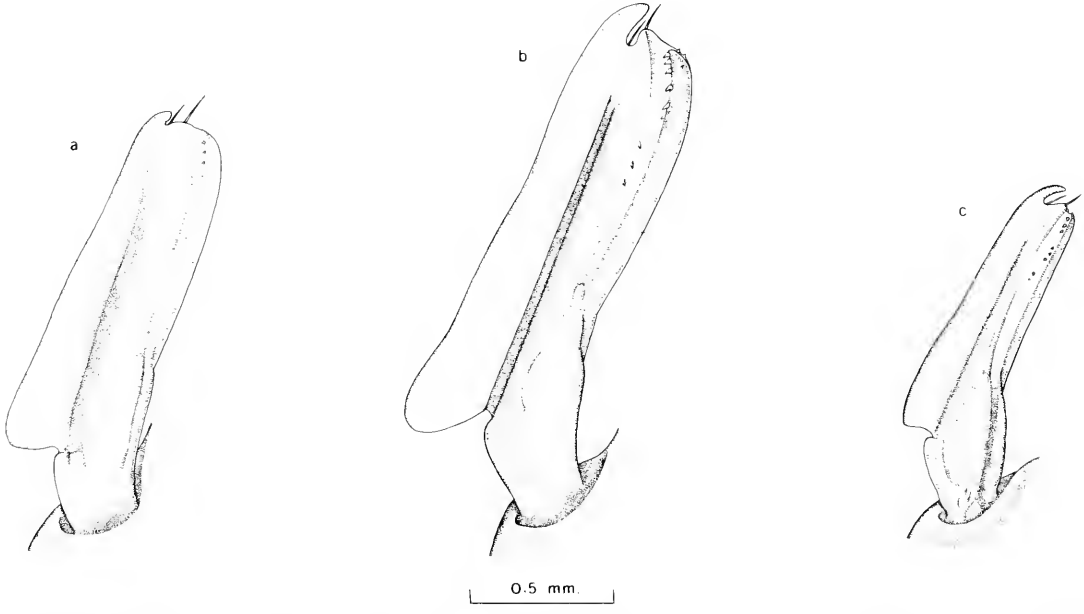


Figure 13.—Petasmata, lateral view of right half. a. *Penaeus aztecus aztecus*, ♂ 12 mm. c.l., Tuxpan, Veracruz, Mexico. b. *P. duorarum duorarum*, ♂ 12 mm. c.l., Card Sound, Fla. c. *P. brasiliensis*, ♂ 12 mm. c.l., Biscayne Bay, Fla.

Petasma with distomedian projection small; ventral costa with distal portion lacking spinules on free margin, but bearing minute teeth on attached margin, and with apex joined to adjacent membranous portion of ventrolateral lobule; latter with distal portion rather broad, lacking rib on inner surface, plain or with barely discernible spines on outer surface (fig. 14a).

Petasma with distomedian projection strongly developed; ventral costa with distal portion armed with spinules on free margin and row or group of relatively large teeth on attached margin, and with apex attached to adjacent membranous portion of ventrolateral lobule; latter with distal portion broad, forming fan shaped fold, lacking rib on inner surface, and armed with short, longitudinal row of spines on outer surface proximal to teeth on ventral costa (fig. 14b).

Petasma with distomedian projection strongly developed; ventral costa with distal portion lacking spinules on free margin, but armed with short row of teeth on or adjacent to attached margin, and with apex usually free from adjacent membranous portion of ventrolateral lobule; latter with distal portion narrow, bearing inwardly projecting short rib, and armed with longitudinal row of spines on outer surface proximal to teeth (fig. 14c).

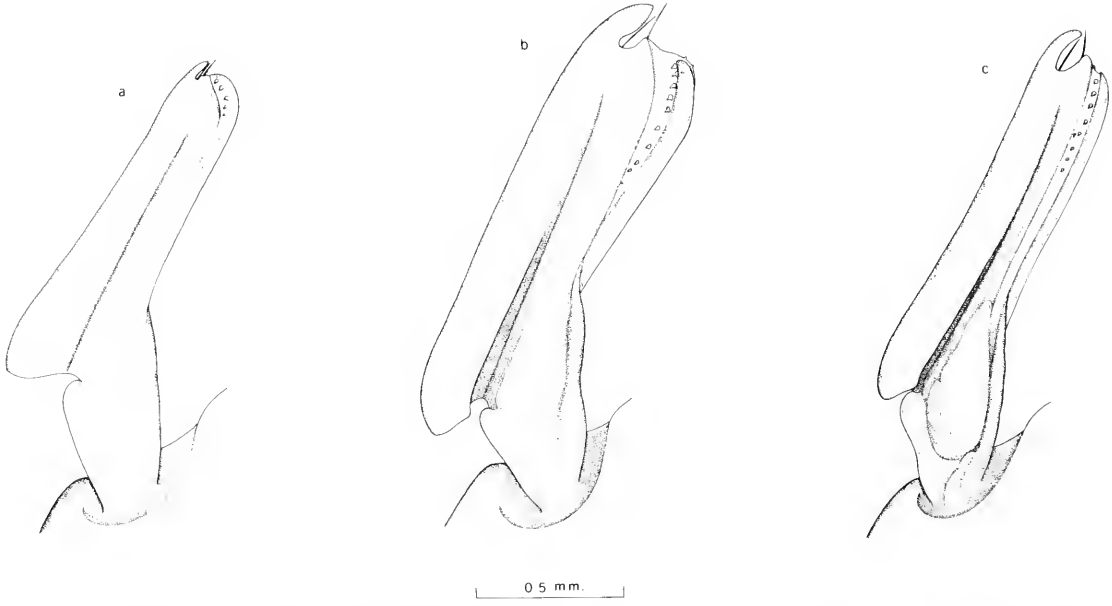


Figure 14.—Petasmata, lateral view of right half. a. *Penaeus aztecus aztecus*, ♂ 13 mm. c.l., Mississippi Sound, Miss. b. *P. duorarum duorarum*, ♂ 13 mm. c.l., Biscayne Bay, Fla. c. *P. brasiliensis*, ♂ 13 mm. c.l., Biscayne, Fla.

Carapace length, 15 mm.

Petasma with distomedian projection short; ventral costa with distal portion turning proximally in gentle arc, increasing in width gradually, lacking spinules on free margin, with row of small, subapical teeth on attached margin; ventrolateral lobule with minute scattered spines (fig. 15a). Appendix masculina subelliptical, with spines along distal and distolateral margins (fig. 16a).

Petasma with distomedian projection long and broad; ventral costa with distal portion turned rather abruptly proximally, increasing in width rapidly, armed with spinules on free margin and with subapical group of strong teeth on and adjacent to attached margin, followed by row of smaller teeth proximally; ventrolateral lobule with distal portion lacking lamella, but bearing 1 row of minute spines on outer surface, proximal to teeth on ventral costa, often expanded into 2 rows proximally (fig. 15b). Appendix masculina ovate to subtriangular, with marginal spines present distally, extending from one-third to two-thirds of median margin to as much as base of distal two-thirds of lateral margin (fig. 16b). Petasmal endopods occasionally joined at 14 mm. c.l., usually at larger size (fig. 17b). Petasma attaining adult form (animal in subadult stage) from 14 to 20 mm. c.l.

Petasma with distomedian projection long and relatively narrow; ventral costa with distal portion almost straight or turned proximally in arc, lacking spinules on free margin, usually armed with 1 or 2 irregular, subapical rows of teeth on or adjacent to attached margin; ventrolateral lobule with distal portion bearing inwardly projecting tonguelike lamella, and sometimes armed with 1 or 2 rows of minute spines on outer surface proximal to teeth on ventral costa (fig. 15c). Appendix masculina subelliptical to ovate, with marginal spines present on distal one-fourth to almost two-thirds (fig. 16c). Petasmal endopods occasionally joined at 15 mm. c.l., joining usually at larger size (fig. 17c). Petasma attaining adult form (animal in subadult stage) from 15 to 20 mm. c.l.

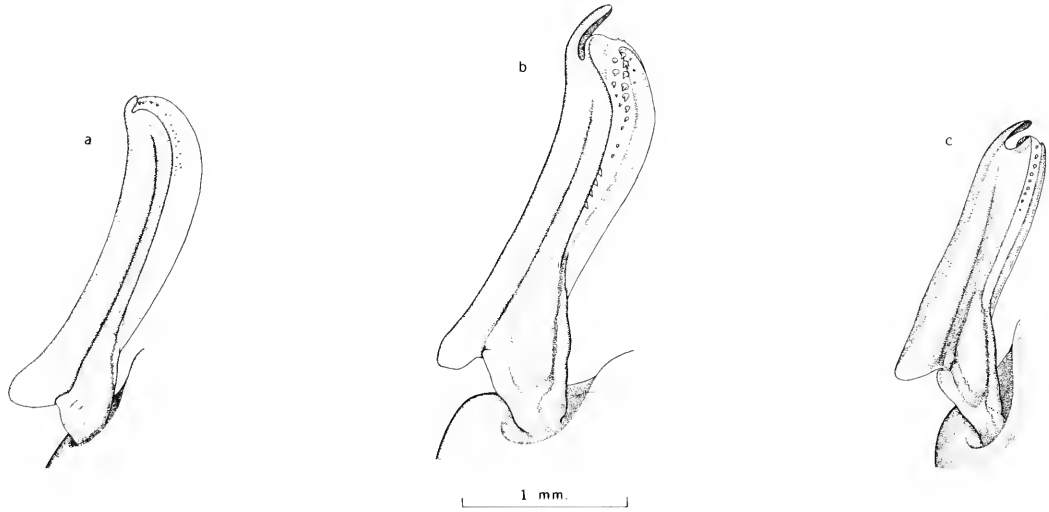


Figure 15.—Petasmata, lateral view of right half. a. *Penaeus aztecus aztecus*, ♂ 15 mm. c.l., Rio Tuxpan, Veracruz, Mexico. b. *P. duorarum duorarum*, ♂ 15 mm. c.l., Biscayne Bay, Fla. c. *P. brasiliensis*, ♂ 15 mm. c.l., Biscayne Bay, Fla.

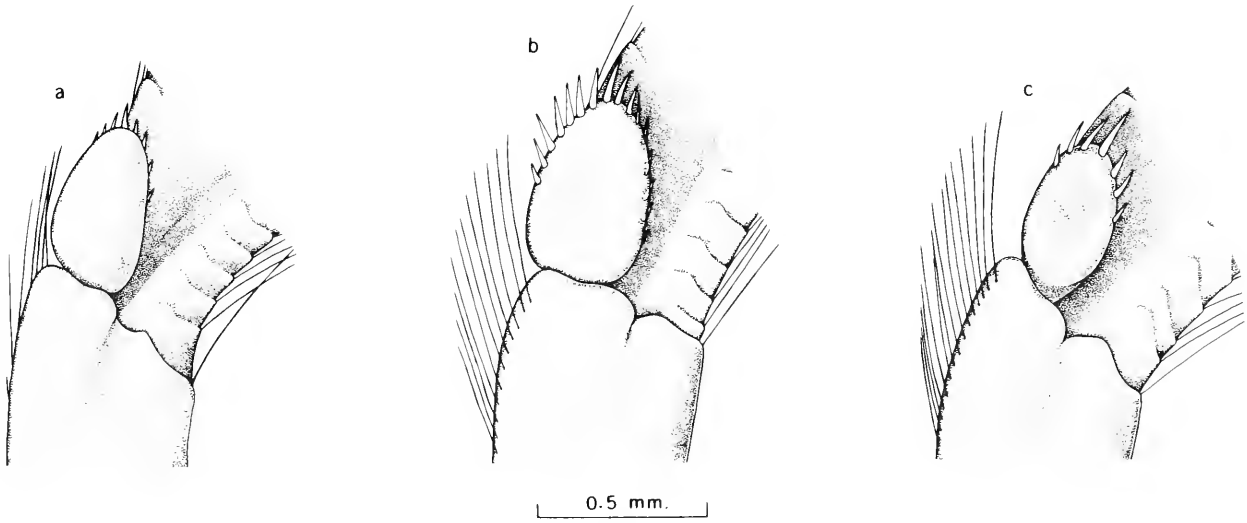


Figure 16.—Appendices masculinae, anterior surface. a. *Penaeus aztecus aztecus*, ♂ 15 mm. c.l., Tamaulipas, Tampico, Mexico. b. *P. duorarum duorarum*, ♂ 15 mm. c.l., Biscayne Bay, Fla. c. *P. brasiliensis*, ♂ 15 mm. c.l., Biscayne Bay, Fla.

Carapace length, 17 mm.

Petasma with distal portion of ventral costa increasing gradually in width and turning proximally in gentle arc, lacking spinules on free margin, armed with narrow patch of teeth on attached margin; ventrolateral lobule with minute scattered spines (fig. $17a_1$).

Subadult stage often attained at 15 mm. c.l. (see above). Specimens that have not attained subadult stage show characters indicated for 15 mm. c.l.

Subadult stage often attained at 16 mm. c.l. (see above). Specimens that have not attained subadult stage show characters indicated for 15 mm. c.l.

Carapace length, 19 mm.

Petasmal endopods, with characters as indicated for 17 mm. c.l., occasionally joined, usually at larger size (fig. $17a_2$). Petasma attaining adult form (animal in subadult stage) from 19 to 23 mm. c.l.

Subadult stage often attained at 15 mm. c.l. Specimens that have not attained subadult stage show characters indicated for 15 mm. c.l.

Subadult stage often attained at 16 mm. c.l. Specimens that have not attained subadult stage show characters indicated for 15 mm. c.l.

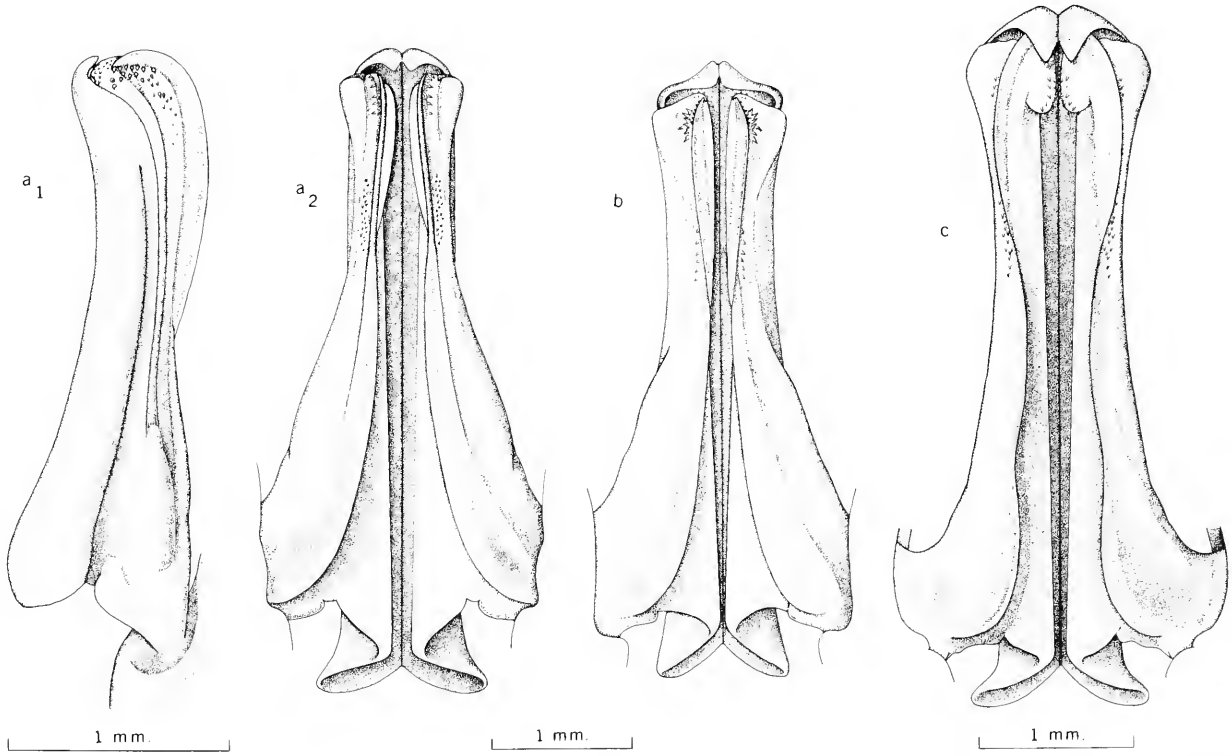


Figure 17.—Petasmata. a_1. **Lateral view of right half,** *Penaeus aztecus aztecus*, ♂ **17 mm. c.l., Tuxpan, Veracruz, Mexico. Ventral views:** a_2. *P. aztecus aztecus*, ♂ **19 mm. c.l., Lake Pontchartrain, La. b.** *P. duorarum duorarum*, ♂ **16.5 mm. c.l., Key West, Fla. c.** *P. brasiliensis*, ♂ **16.5 mm. c.l., Biscayne Bay, Fla.**

IDENTIFICATION OF TAXA, FEMALES
(Based on the thelycum)

Penaeus aztecus aztecus	*Penaeus duorarum duorarum*	*Penaeus brasiliensis*
	Carapace length, 8 mm.	
Anterior process short, blunt anteriorly, and broadly convex ventrally. Lateral plates narrow, inner margins forming broad arc, with anteromedian margins usually far removed from apices of paired subtriangular projections extending caudad from sternite XIII; least distance from apex to adjacent lateral plate greater than width of plate at that level (fig. 18a).	Anterior process elongate, pointed anteriorly, and strongly convex or subangular ventrally. Lateral plates relatively broad, inner margins forming U-shaped gap, with anteromedian margins near apices of subtriangular projections extending caudad from sternite XIII; least distance from apex to adjacent lateral plate same or less than width of plate at that level (fig. 18b).	Anterior process elongate, narrow, sharply pointed anteriorly, and strongly convex or subangular ventrally. Lateral plates relatively broad, inner margins forming U-shaped gap, with anteromedian margins near apices of subtriangular projections extending caudad from sternite XIII; least distance from apex to adjacent lateral plate same or less than width of plate at that level (fig. 18c).

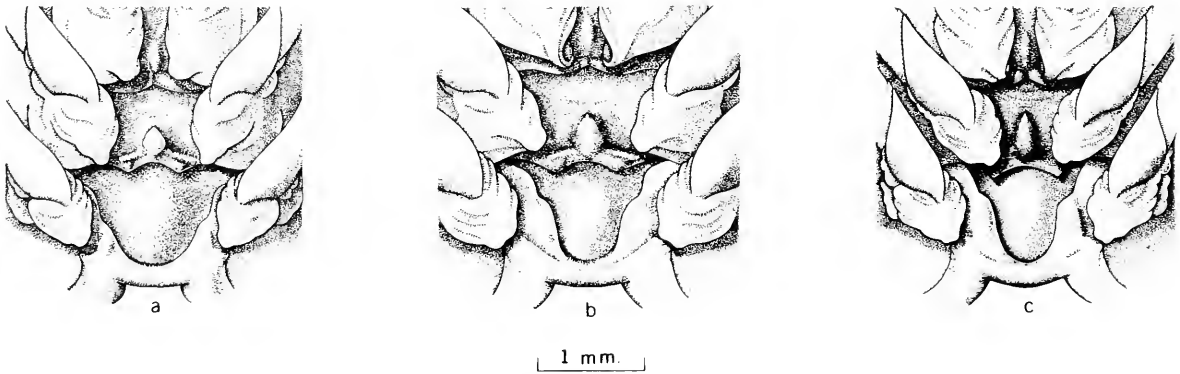


Figure 18.—Thelyca. a. *Penaeus aztecus aztecus*, ♀ 8 mm. c.l., Mississippi Sound, Miss. b. *P. duorarum duorarum*, ♀ 8 mm. c.l., Tampa Bay, Fla. c. *P. brasiliensis*, ♀ 8 mm. c.l., Sewall Point, Fla.

Carapace length, 10 mm.

Midposterior margin of sternite XIII usually bearing minute knob, rudiment of posterior process, (knob often present at 9 mm. c.l.). Lateral plates with median margins forming broad cleft and with anteromedian margins broadly rounded; distance from apices of lateral projections of sternite XIII to lateral plates usually at least one-half width of plate at that level (fig. 19a).

Midposterior margin of sternite XIII lacking knob, posterior process slightly elevated anterior to midposterior margin of sternite XIII, immediately caudad to anterior process. Lateral plates with median margins forming relatively narrow cleft, and anteromedian margins strongly curved, almost touching or covering apices of lateral projections of sternite XIII (fig. 19b).

Midposterior margin of sternite XIII lacking knob, posterior process slightly elevated anterior to midposterior margin of sternite XIII, immediately caudad to anterior process. Lateral plates with median margins forming relatively narrow cleft, and anteromedian margins angular or strongly curved, almost touching or covering apices of lateral projections of sternite XIII (fig. 19c).

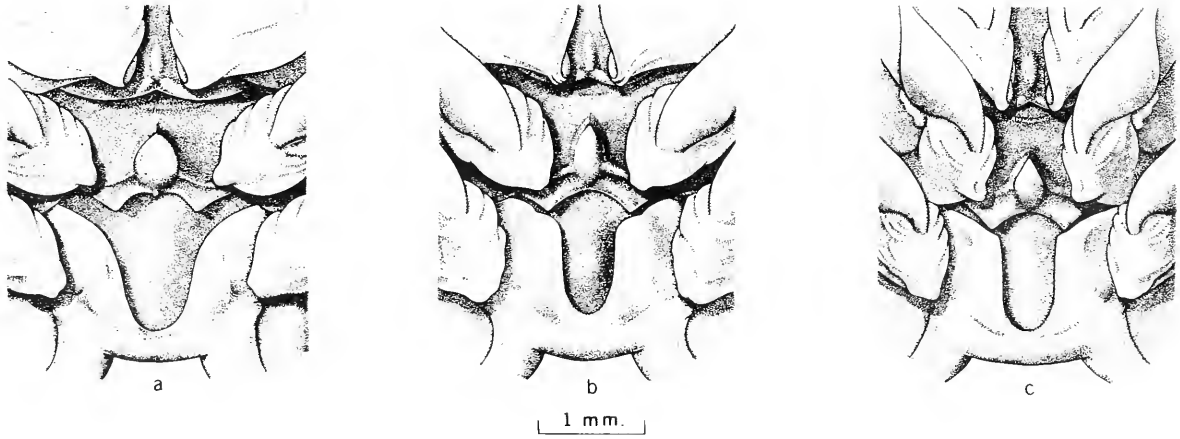


Figure 19.—Thelyca. a. *Penaeus aztecus aztecus*, ♀ 10 mm. c.l., Galveston Bay, Tex. b. *P. duorarum duorarum*, ♀ 10 mm. c.l., Tampa Bay, Fla. c. *P. brasiliensis*, ♀ 10 mm. c.l., Biscayne Bay, Fla.

Carapace length, 12 mm.

Posterior process produced caudally from posterior margin of sternite XIII. Lateral plates with anteromedian margins broadly rounded, close to or covering tip of lateral, hornlike projections of sternite XIII (fig. 20a).

Posterior process not produced caudally from posterior margin of sternite XIII, but often with minute knob—rudiment of median carina—at posterior portion. Lateral plates with markedly rounded anteromedian margins usually covering posterior portion of lateral, hornlike projections of sternite XIII (fig. 20b).

Posterior process not produced caudally from posterior margin of sternite XIII, usually lacking knob at posterior end. Lateral plates with anteromedian margins often angular or produced anteriorly, usually covering posterior portion of lateral, hornlike projections of sternite XIII (fig. 20c).

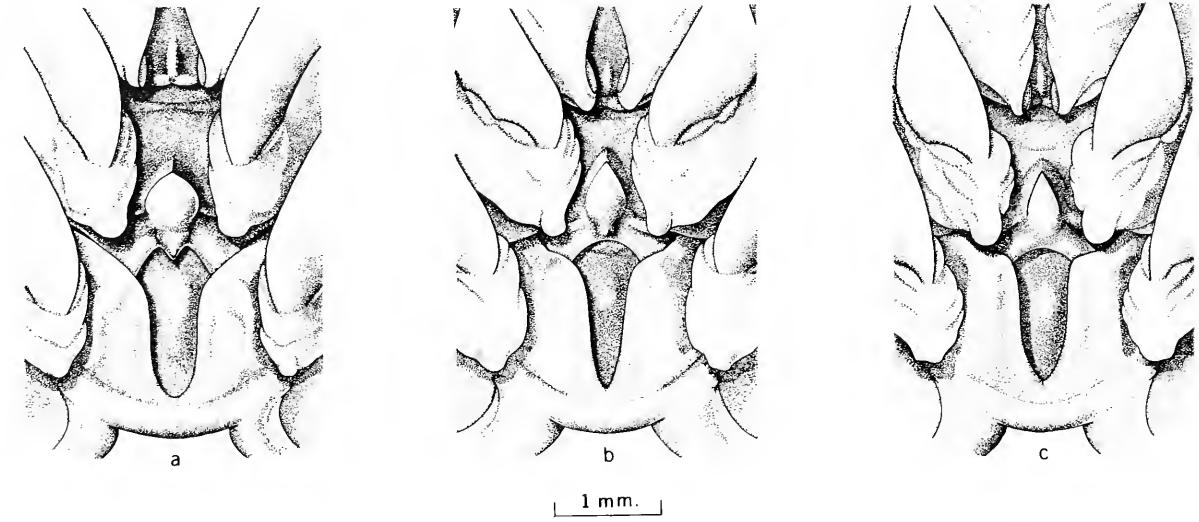


Figure 20.—Thelyca. a. *Penaeus aztecus aztecus*, ♀ 12 mm. c.l., Veracruz, Mexico. b. *P. duorarum duorarum*, ♀ 12 mm. c.l., Tampa Bay, Fla. c. *P. brasiliensis*, ♀ 12 mm. c.l., Biscayne Bay, Fla.

Carapace length, 13 mm.

Anterior process relatively broad. Posterior process strongly produced caudally from posterior margin of sternite XIII, bearing barely distinct posteromedian carina. Lateral plates with anteromedian margins broadly rounded (fig. 21a).

Anterior process relatively broad. Posterior process not produced caudally from posterior margin of sternite XIII, often bearing median carina. Lateral plates with anteromedian margins usually rounded (fig. 21b).

Anterior process narrow. Posterior process not produced caudally from posterior margin of sternite XIII, lacking median carina, but sometimes bearing minute knob at midposterior margin. Lateral plates with anteromedian margins usually subangular or slightly produced anteriorly (fig. 21c).

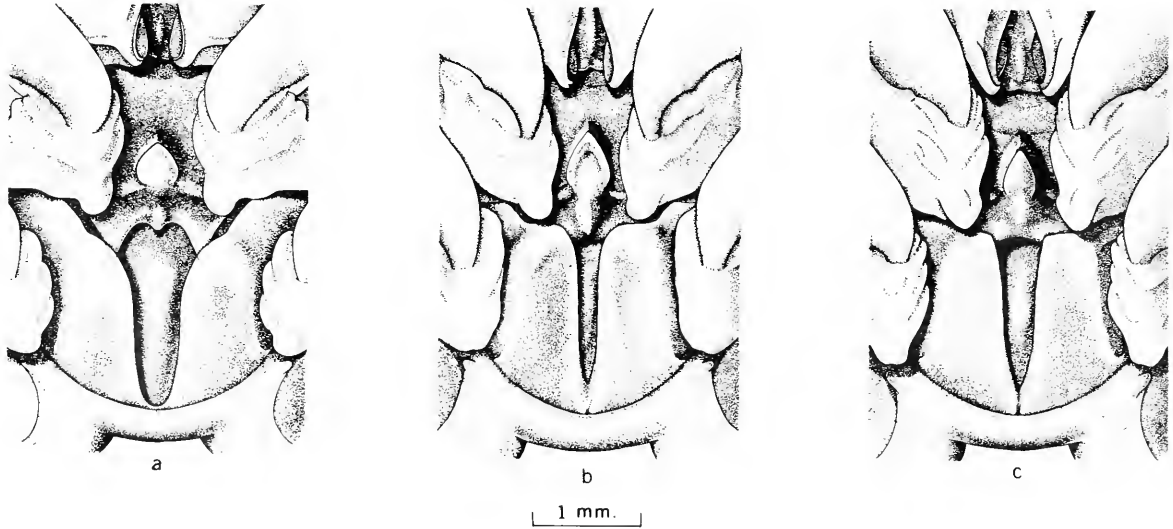


Figure 21.—Thelyca. a. *Penaeus aztecus aztecus*, ♀ 13 mm. c.l., Galveston Bay, Tex. b. *P. duorarum duorarum*, ♀ 13 mm. c.l., Lantana, Fla. c. *P. brasiliensis*, ♀ 13 mm. c.l., Biscayne Bay, Fla.

Carapace length, 14 mm.

Anterior process relatively broad. Posterior process strongly produced caudally, with caudalmost portion bearing elongate posteromedian carina, often bifurcate anteriorly. Lateral plates with anteromedian margins broadly rounded, relatively far removed from posterior process (fig. 22a).

Anterior process relatively broad. Posterior process not produced caudally, bearing short, undivided median carina. Lateral plates with anteromedian margins usually strongly curved, often approaching posterior process (fig. 22b).

Anterior process narrow. Posterior process not produced caudally, but sometimes posterior margin bearing small, carinate, spinelike, median projection. Lateral plates with anteromedian margins angular or produced anteriorly, often approaching posterior process (fig. 22c).

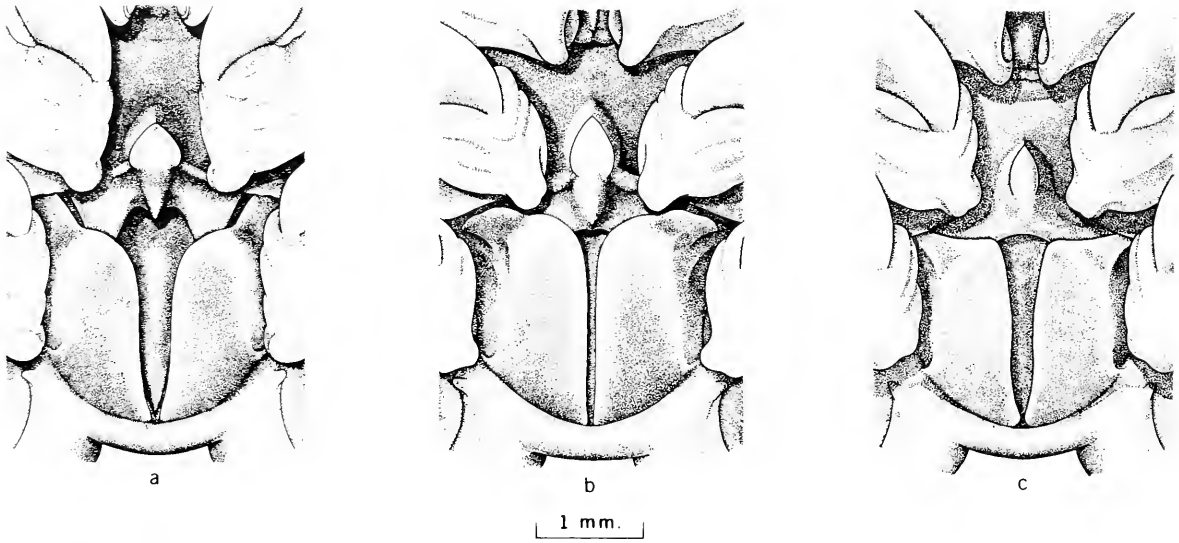


Figure 22.–Thelyca. a. *Penaeus aztecus aztecus*, ♀ 14 mm. c.l., Estero Tabasco, Rio Tuxpan, Veracruz, Mexico. b. *P. duorarum duorarum*, ♀ 14 mm. c.l., Card Sound, Fla. c. *P. brasiliensis*, ♀ 14 mm. c.l., Biscayne Bay, Fla.

Carapace length, 15-17 mm.

Posterior process with arms of bifurcate median carina reaching or almost reaching base of anterior process. Lateral plates with median margins separated by narrow cleft; anteromedian margins not produced but forming broad arcs, with gaps between them and posterior process; median carina always exposed (figs. 23a and 24a).

In females with 18 to 23 mm. c.l., lateral plates meeting or nearly meeting, and anteromedian margins forming arcs, leaving posterior process widely exposed. Carapace length of 18 mm. minimum at which thelycum assumes adult form, but in some females lateral plates may be noncontiguous even at 22 m. c.l.; therefore, subadult stage attained from 18 to 23 mm. c.l. (fig. 25a).

Posterior process with prominent, undivided median carina almost reaching base of anterior process. Lateral plates with median margins meeting or almost meeting; anteromedian margins forming narrow arcs almost contiguous to or covering caudal portion of posterior process, but leaving median carina exposed (fig. 23b).

Carapace length of 15 mm. minimum at which thelycum assumes adult form, but in some females lateral plates may be noncontiguous even at 20 mm. c.l.; therefore, subadult stage attained from 15 to 21 mm. c.l. (fig. 24b).

Posterior process lacking median carina, but sometimes posterior margin bearing carinate, spinelike median projection, situated between, and often dorsal to horns (fig. 25b). Lateral plates with median margins meeting, or almost meeting; anteromedian margins angular or produced anteriorly, occasionally almost reaching anterior process; median projection, if present, covered when lateral plates meet (fig. 23c).

Carapace length of 15 mm. minimum at which thelycum assumes adult form, but in some females lateral plates may be noncontiguous even at 19 mm. c.l.; therefore subadult stage attained from 15 to 20 mm. c.l. (fig. 24c).

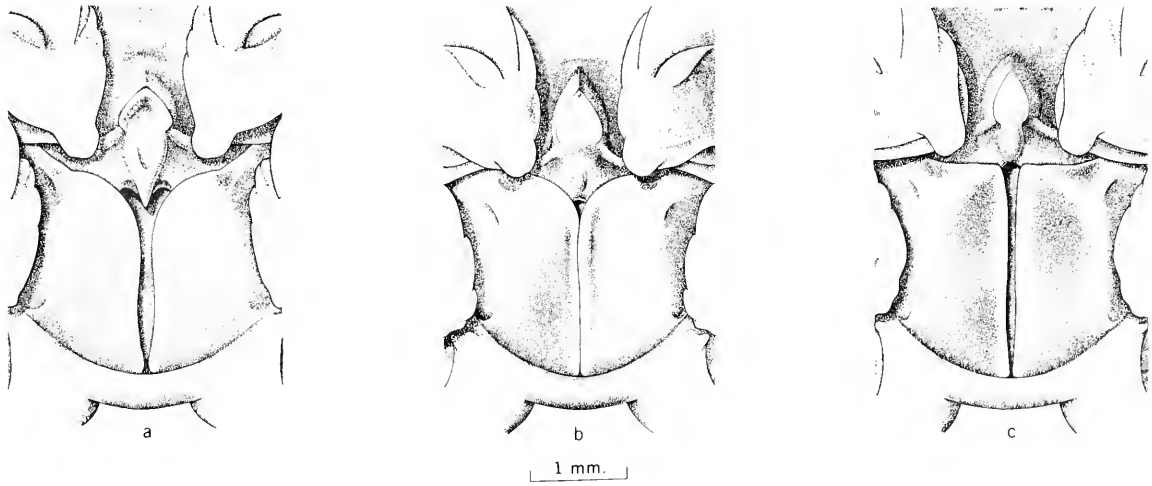


Figure 23.—Thelyca. a. *Penaeus aztecus aztecus*, ♀ 16 mm. c.l., Lake Pontchartrain, La. b. *P. duorarum duorarum*, ♀ 16 mm. c.l., Cat Island, La. c. *P. brasiliensis*, ♀ 16 mm. c.l., Biscayne Bay, Fla.

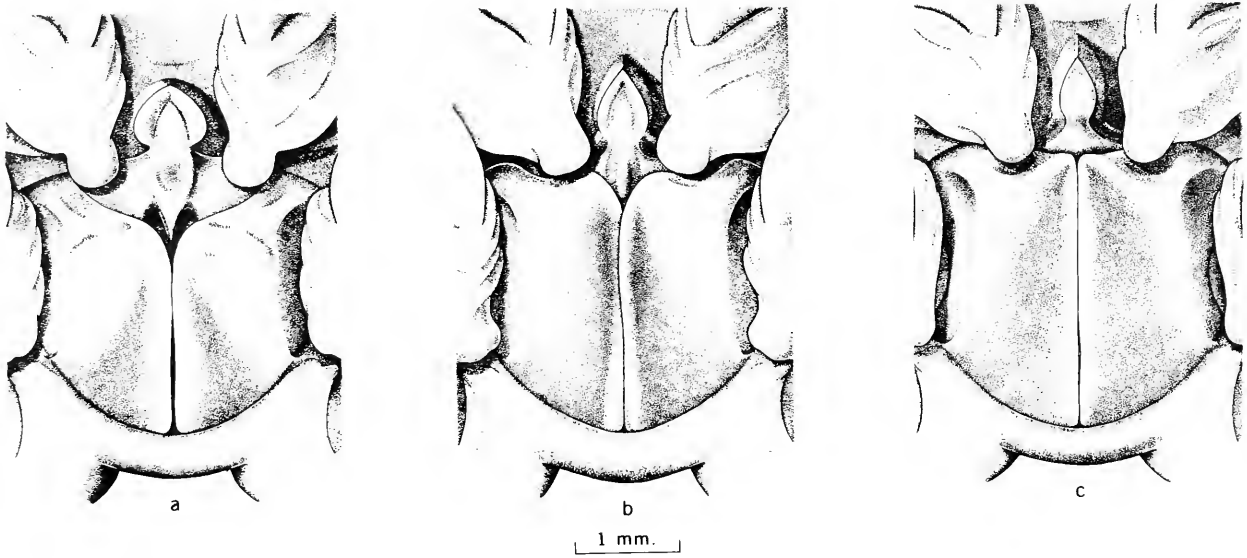


Figure 24.—Thelyca. a. *Penaeus aztecus aztecus*, ♀ 17 mm. c.l., Lake Pontchartrain, La. b. *P. duorarum duorarum*, ♀ 17 mm. c.l., Buttonwood Canal, Fla. c. *P. brasiliensis*, ♀ 17 mm. c.l., Bermudas.

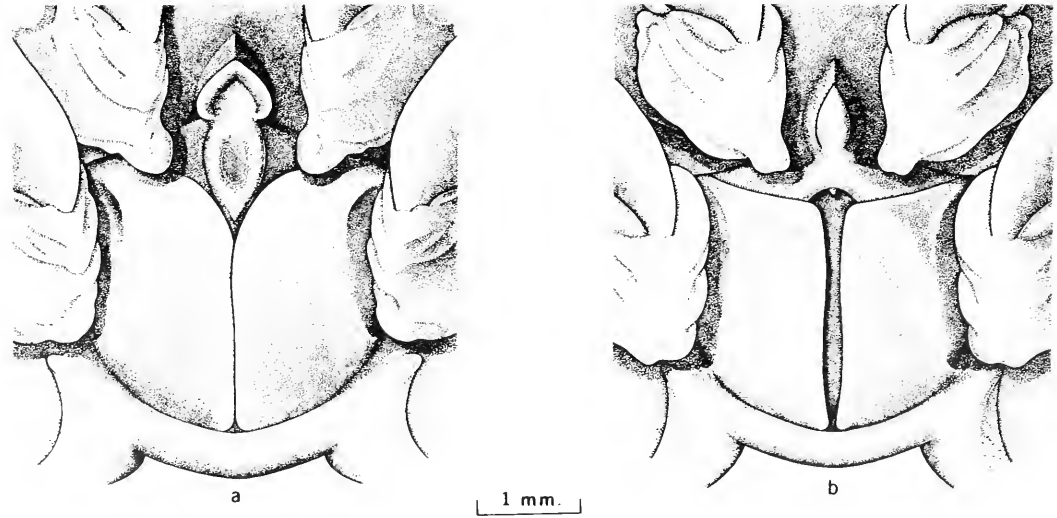


Figure 25.—Thelyca. a. *Penaeus aztecus aztecus*, ♀ 18 mm. c.l., Bocainas, Laguna de Tamiabua, Veracruz, Mexico. b. *P. brasiliensis*, ♀ 16 mm. c.l., Biscayne Bay, Fla.

ACKNOWLEDGMENTS

Horton H. Hobbs, Jr., gave me valuable advice in the preparation of the manuscript, and Fenner A. Chace and Raymond B. Manning offered a number of criticisms of the final draft. Maria M. Dieguez prepared the excellent illustrations.

LITERATURE CITED

BURKENROAD, MARTIN D.
1939. Further observations on Penaeidae of the northern Gulf of Mexico. Bull. Bingham Oceanogr. Collect. 6, art. 6, 62 pp.

ELDRED, BONNIE.
1958. Observations on the structural development of the genitalia and the impregnation of the pink shrimp, *Penaeus duorarum* Burkenroad. Fla. State Bd. Conserv. Tech. Ser. 23, 26 pp.

PÉREZ FARFANTE, ISABEL.
1969. Western Atlantic shrimps of the genus *Penaeus*. U.S. Fish. Wildl. Serv., Fish. Bull. 67: 461-591.

WILLIAMS, AUSTIN B.
1953. Identification of juvenile shrimp (*Penaeidae*) in North Carolina. J. Elisha Mitchell Sci. Soc. 69: 156-160.

MS #1901
GPO 996-457

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States — now and in the future.

UNITED STATES
DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BUREAU OF COMMERCIAL FISHERIES
WASHINGTON, D.C. 20240

OFFICIAL BUSINESS

Return this sheet to above address, if you do NOT wish to receive this material ☐, or if change of address is needed ☐ (indicate change and give ZIP Code).

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR