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MEMOIRS OF THE HOURGLASS CRUISES

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STOMATOPOD CRUSTACEA

By

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ABSTRACT

Thirteen species of stomatopod crustaceans (*Lysiosquilla scabricauda*, *Acanthosquilla biminiensis*, *Platysquilla horologii*, *Meiosquilla quadridens*, *M. schmitti*, *Squilla grenadensis*, *S. rugosa*, *S. deceptrix*, *S. neglecta*, *S. empusa*, *Eurysquilla plumata*, *Parasquilla coccinea*, and *Gonodactylus bredini*) were captured in a 28 month sampling program at ten stations (6 to 73 m) along two transects on the central west Florida shelf. Variations in morphology and meristics of most species are presented. Postlarvae of *Acanthosquilla biminiensis*, *Parasquilla coccinea*, and an unidentified *Squilla* species (probably *S. deceptrix*) are described. Juveniles of *Meiosquilla quadridens*, *M. schmitti*, *Eurysquilla plumata*, *Parasquilla coccinea* and *Gonodactylus bredini* are described or compared with adults.

An ectocommensal folliculinid protozoan is reported from gills of an *Acanthosquilla biminiensis*.

Contribution No. 217

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Recruitment of smallest *Gonodactylus bredini* juveniles occurred during May through July; additional recruitment occurred from August through November. *Squilla deceptrix* and *S. rugosa* were captured most often at night; *Gonodactylus bredini* was captured in equal numbers during day and night. Gear selectivity is discussed in relation to species most often captured together.

Stomachs of eight species contained primarily crustaceans, polychaetes and sediments. Stomatopods contained in stomachs of Hourglass fishes are listed and discussed.

Zoogeographic analyses of Hourglass stomatopods revealed five species widely distributed in the western Atlantic, one reported only from the Gulf of Mexico, seven West Indian species at the northern limit of their range, and no strictly Carolinian species. Well-defined distributions within the study area are discussed in relation to several environmental factors; bottom type appears the most important.

INTRODUCTION

Stomatopod crustaceans are important members of most tropical and subtropical sublittoral communities. Our knowledge of stomatopod taxonomy has increased considerably in the past ten years, primarily through the research of Dr. Raymond B. Manning, but it is still incomplete. Six new western Atlantic species have been described since Dr. Manning's monograph on the stomatopods of that region was published in 1969. However, the full range of morphological variation among localized populations of many recognized species is unknown. In addition, the role of stomatopods in the community structure and other aspects of their biology are poorly understood.

This report is based on the Hourglass collections, a series of 28 monthly sampling cruises to 10 established stations on the central west Florida shelf by the R/V *Hernan Cortez*. These collections include 13 stomatopod species, almost one-half of those known from the Gulf of Mexico, including one new species, *Platysquilla horologii* Camp, 1971. Continuous resampling of the same population provided sufficient specimens to demonstrate the full range of morphological variability of certain species in this region. Several important differences between their morphology and previously published descriptions are noted. Additional information on predators, food items and feeding habits, commensal relationships, habitats, geographic and bathymetric distributions, faunal associations and diel cycles was also obtained for selected species.

ACKNOWLEDGMENTS

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Mr. John Couch, National Marine Fisheries Service Biological Laboratory, identified the folliculinid ciliates ectocommensal on *Acanthosquilla biminiensis*, for which I am grateful. I thank Dr. L. B. Holthuis, Rijksmuseum van Natuurlijke Historie, Leiden, for providing comparative

material and critically reading the manuscript. My special thanks go to Dr. Raymond B. Manning, National Museum of Natural History, Smithsonian Institution, for providing comparative material, answering innumerable questions, and providing advice on the manuscript.

METHODS AND MATERIALS

Most stomatopods examined were obtained from collections of the Hourglass Cruises, conducted on the west Florida shelf off Tampa Bay and Sanibel Island by the Florida Department of Natural Resources Marine Research Laboratory. Complete descriptions of stations, sampling gear, methods, and hydrographic data have been presented in Volume I, Part I of this series (Joyce and Williams, 1969).

Nighttime benthic samples were taken monthly from August 1965 through November 1967 with a 20-foot (6.1 m) flat or balloon trynet and a box dredge at 10 of the 16 Hourglass stations (Figure 1). Locations and depths of these stations are presented in Table 1. Hourglass Stations B, C and D were resampled each month during daylight hours to compare diel cycles. In addition, supplementary collections were made at each station during July 1966 and January 1967 using a 45-foot (13.7 m) otter trawl.

All stomatopods examined are deposited in the invertebrate reference collection of this Laboratory (FSBC I) or in the National Museum of Natural History (USNM), Smithsonian Institution, Washington, D.C.

All measurements are in millimeters (mm) and include:

(1) Total Length (TL) – measured along the dorsal midline, from the anterior margin of the rostral plate to a line between the apices of the submedian teeth of the telson. This measurement is cited for each species under "Material Examined," except for broken specimens.

(2) Carapace Length (CL) – measured on the midline of the carapace, from the anterior margin at the base of the rostral plate to the posterior median margin. This measurement is cited only for broken specimens under "Material Examined."

(3) Cornea Width (CW) – the greatest width of the cornea, measured perpendicular to the line of ocelli dividing the cornea into two sections.

(4) Rostral Plate Length (RPL) – measured on the midline from the anterior end, including apical spines if present, to the posterior median margin.

(5) Rostral Plate Width (RPW) – measured across greatest width of the plate.

(6) Antennular Peduncle Length – measured on the inferior margin from articulation to distal end where flagellae originate.

(7) Antennal Scale Length – measured from articulation to distal end, excluding setae.

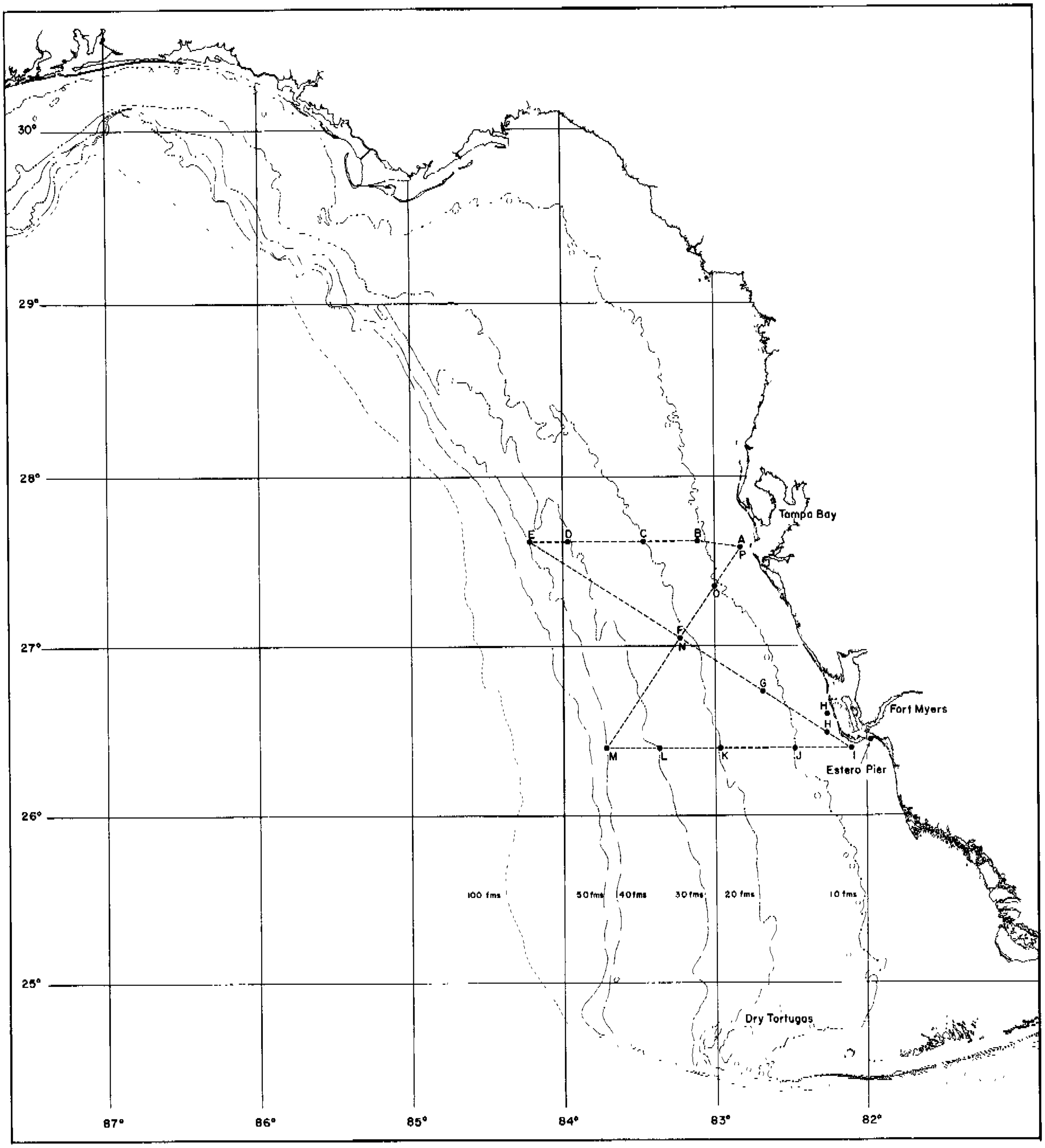


Figure 1. Hourglass cruise pattern and station locations.

TABLE 1. LOCATION AND DEPTH OF HOURGLASS STATIONS PRODUCING BENTHIC STOMATOPODS.

Station	Latitude*	Longitude*	Established Depth (meters)	Approximate Nautical Miles Offshore*
A	27°35'N	82°50'W	6.1	4, due W of Egmont Key
B	27°37'N	83°07'W	18.3	19, due W of Egmont Key
C	27°37'N	83°28'W	36.6	38, due W of Egmont Key
D	27°37'N	83°58'W	54.9	65, due W of Egmont Key
E	27°37'N	84°13'W	73.2	78, due W of Egmont Key
I	26°24'N	82°06'W	6.1	4, due W of Sanibel Island Light
J	26°24'N	82°28'W	18.3	24, due W of Sanibel Island Light
K	26°24'N	82°58'W	36.6	51, due W of Sanibel Island Light
L	26°24'N	83°22'W	54.9	73, due W of Sanibel Island Light
M	26°24'N	83°43'W	73.2	92, due W of Sanibel Island Light

*U.S. Coast and Geodetic Chart No. 1003, dated June 1966

(8) Antennal Scale Width – measured at widest point, excluding setae.

(9) Abdominal Width – measured at the fifth abdominal somite, just anterior to articulation of uropods.

(10) Telson Length – measured from anterior margin to bases of movable submedian teeth, or to an imaginary line between apices of fixed submedian teeth.

(11) Telson Width – measured across greatest width.

(12) Distance Between Submedian Teeth of Telson – measured from the apex of one fixed submedian tooth to that of the adjacent submedian tooth, or from the center of the articulation of one movable submedian tooth to that of the adjacent movable tooth.

All measurements were taken with an ocular micrometer or with vernier calipers.

Indices used include:

(1) Corneal Index (CI) – obtained by dividing the carapace length by the cornea width and multiplying by 100. This index is reported only for the Squillidae and for *Eurysquilla plumata* (Bigelow).

(2) Abdominal Width-Carapace Length Index – obtained by dividing the abdominal width by the carapace length and multiplying by 100. It is used to express relative slenderness of the body.

Morphological terminology follows Manning (1969:11-15), including abdominal armature and telson denticular formulas. The former of these is a shortened notation designating which abdominal carinae are spined. The formula: submedian, 5-6; intermediate, (2) 3-6; lateral, 1-6; marginal, 1-5, for instance, indicates that the submedian carinae are spined posteriorly only on the fifth and sixth somites, whereas the intermediate carinae are always spined on only the third through the sixth somites but occasionally are spined on the second somite. This is the formula for *Squilla rugosa* Bigelow. The telson denticular formula, used for members of the Squillidae, indicates the number of submedian, intermediate and lateral denticles on each side of the telson. For example, the formula for *S. rugosa* is: (2-3) 4-6, 7-12 (13), 1, indicating four to six (but occasionally as few as two or three) submedian denticles, seven to twelve (but occasionally as many as thirteen) intermediate denticles, and one lateral denticle.

Synonymies are restricted to the original description and previous Florida records.

Each "Material Examined" section is arranged first by station, then by chronological order of capture, and finally by method of capture on each date for easier retrieval of certain information during future analyses of Hourglass collections. Numbers of specimens captured each month at each station are presented in Appendix I.

Species diagnoses follow Manning (1969) and include characteristics and meristics based on all western Atlantic representatives. Certain meristics have been changed, however, to reflect new information gained through examination of Hourglass specimens.

All drawings were made with aid of a camera lucida on a dissecting microscope.

SYSTEMATICS

Twenty-eight species of stomatopod crustaceans are now known to occur in the Gulf of Mexico, including three (*Lysiosquilla campechiensis* Manning, *Nannosquilla taylori* Manning, and *Platysquilla horologii* Camp) which have so far not been found outside the Gulf. Three species [*Nannosquilla schmitti* (Manning), *Gonodactylus oerstedii* Hansen, and *G. spinulosus* Schmitt] have been reported in the Gulf only from the Florida Keys, and three (*Lysiosquilla campechiensis*, *Gonodactylus lacunatus* Manning, and *Alima hyalina* Leach) only from the coast of Mexico. *Pseudosquilla ciliata* (Fabricius) has been reported in the Gulf only from Mexico and the Florida Keys. Two of the remaining 18 species [*Lysiosquilla scabricauda* (Lamarck) and *Squilla empusa* Say] are known from the entire Gulf coast, while the rest have been found at widely separated localities in the Gulf.

Bathysquilla microps (Manning) has never been reported from the Gulf but probably inhabits the deeper waters. It has been collected from a depth of 728 m in the straits of Florida, southwest of Dry Tortugas (Manning, 1969:96). Scarcity of deeper water sampling probably accounts for the lack of Gulf of Mexico records.

Twenty species have been reported on the west Florida shelf (excluding the Keys), but five of these [*Squilla prasinolineata* Dana, *S. chydaea* Manning, *S. edentata* (Lunz), *Gonodactylus torus* Manning, *Lysiosquilla glabriuscula* (Lamarck)] have not been reported within the present study area. Thirteen of the remaining species are represented in Hourglass collections.

The following key to Gulf of Mexico stomatopods is based primarily on Manning's (1969) keys to all western Atlantic species. Species represented in Hourglass collections are asterisked. Following the key are systematic accounts of all Hourglass species and discussions of their morphological variability.

KEY TO THE STOMATOPODS OF THE GULF OF MEXICO

(After Manning, 1969)

1. Propodi of last 3 maxillipeds as broad or broader than long, beaded or ribbed ventrally; dorsal surface of telson without sharp median carina 2

1. Propodi of last 3 maxillipeds longer than broad, not beaded or ribbed ventrally; dorsal surface of telson with sharp median carina 9

2. Distal segment of endopod of first 2 walking legs elongate; proximal portion of lateral margin of endopod of uropod not folded over dorsally, at most angled inward 3

2. Distal segment of endopod of first 2 walking legs ovate; proximal portion of lateral margin of endopod of uropod folded over dorsally 5

3. Posterior margin of last 2 abdominal somites and dorsal surface of telson spinose . . . . *Lysiosquilla scabricauda* (Lamarck, 1818)*

3. Posterior margin of last 2 abdominal somites and dorsal surface of telson not spinose 4

4. Sixth abdominal somite and telson smooth dorsally and laterally . . . . *Lysiosquilla glabriuscula* (Lamarck, 1818)

4. Sixth abdominal somite and telson wrinkled and rough laterally . . . . *Lysiosquilla campechiensis* Manning, 1962

5. Dorsal surface of telson with fan-shaped row of 5 or more spines; telson with 2 pairs of fixed marginal teeth . . . . *Acanthosquilla biminiensis* (Bigelow, 1893)*

5. Dorsal surface of telson unarmed or with a single median projection 6

6. Posterior margin of dorsal surface of telson produced into false eave overhanging true posterior margin 7

6. Posterior margin of telson with single median projection, not produced into false eave . . . 8

7. Posterior margin of telson with 7 fixed teeth and denticles lateral to each movable submedian tooth; submedian denticles forming a curved row in posterior view . . . . *Nannosquilla schmitti* (Manning, 1962)

7. Posterior margin of telson with no more than 3-5 fixed teeth and denticles lateral to each movable submedian tooth; submedian denticles forming a "W" in posterior view . . . . *Nannosquilla taylori* Manning, 1969

8. Mandibular palp present; telson with 1 pair of fixed marginal teeth; rostral plate with apical spine . . . . *Coronis excavatrix* Brooks, 1886

8. Mandibular palp absent; telson with 4 pairs of fixed marginal teeth, mesial 2 pairs sharp; rostral plate lacking apical spine . . . . *Platysquilla horologii* Camp, 1971*

9. All marginal teeth of telson with movable apices . . . . [*Bathysquilla microps* (Manning, 1961) (Straits of Florida)]

9. At most, only submedian teeth of telson with movable apices 10

10. More than 4 intermediate denticles present on telson 11

10. No more than 2 intermediate denticles present on telson 21

11. Submedian teeth of telson with articulated, movable apices 12

11. Submedian teeth of telson with fixed apices 13

12. Submedian carinae of telson short, not extending anteriorly past base of spine of median carina . . . . *Meiosquilla quadridens* (Bigelow, 1893)*

12. Submedian carinae of telson long, extending anteriorly almost to anterior base of median carina . . . . *Meiosquilla schmitti* (Lemos de Castro, 1955)*

13. Lateral process of fifth thoracic somite bilobed; 2 rounded lobes present between spines of basal prolongation of uropod . . . . *Alima hyalina* Leach, 1817

13. Lateral process of fifth thoracic somite single 14

14. Dorsal surface of telson with numerous longitudinal carinae or tubercles in addition to carinae of marginal teeth 15

14. Dorsal surface of telson lacking supplementary dorsal carinae 17

15. Mesial margin of basal prolongation of uropod armed with slender spines; lateral processes of sixth and seventh thoracic somites produced posteriorly into spines 16

15. Mesial margin of basal prolongation of uropod at most irregularly serrate; lateral processes of sixth and seventh thoracic somites not produced posteriorly into spines . . . . *Squilla deceptrix* Manning, 1969*

16. Lateral process of fifth thoracic somite an anteriorly-curved spine; 4 epipods present . . . . *Squilla grenadensis* Manning, 1969*

16. Lateral process of fifth thoracic somite an acute lobe, directed laterally, anterior margin convex; 5 epipods present . . . . *Squilla rugosa* Bigelow, 1893*

17. Dactylus of claw with 5 teeth; lateral process of fifth thoracic somite a straight spine or spatulate lobe, directed laterally 18

17. Dactylus of claw with 6 teeth; lateral process of fifth thoracic somite an anteriorly-curved spine 19

18. Median carina of carapace not bifurcate anteriorly; lateral process of fifth thoracic somite a slender spine . . . . *Squilla prasinolineata* Dana, 1852

18. Median carina of carapace with anterior bifurcation; lateral process of fifth thoracic somite a spatulate lobe . . . . *Squilla neglecta* Gibbes, 1850*

19. Median carina of carapace with incomplete, poorly-marked anterior bifurcation . . . . *Squilla chydaea* Manning, 1962

19. Median carina of carapace with well-defined anterior bifurcation 20

20. Median carina of carapace composed of 2 or more subparallel rows of pits; distance from dorsal pit of carapace to anterior bifurcation more than 1/5 distance from bifurcation to anterior margin of carapace; inferior margin of dactylus of claw evenly curved . . . . *Squilla edentata edentata* (Lunz, 1937)

20. Median carina of carapace strong, not composed of 2 or more rows of pits; distance from dorsal pit to anterior bifurcation less than 1/5 distance from bifurcation to anterior margin; inferior margin of dactylus of raptorial claw sinuate . . . . *Squilla empusa* Say, 1818*

21. Ischiomeral articulation of raptorial claw terminal; merus grooved inferiorly throughout its length 22

21. Ischiomeral articulation of raptorial claw subterminal, merus projecting posteriorly beyond articulation; inferior groove on merus incomplete 24

22. Mesial spine of basal prolongation of uropod longer than lateral spine; dactylus of claw with more than 4 teeth . . . . *Eurysquilla plumata* (Bigelow, 1901)*

22. Lateral spine of basal prolongation of uropod longer than or subequal to mesial spine; dactylus of claw with 3 teeth 23

23. Basal prolongation of uropod with 2 spines, mesial margin unarmed; antennal protopod with channeled dorsal process; cornea cylindrical . . . . . . *Pseudosquilla ciliata* (Fabricius, 1787)

23. Basal prolongation with 3 spines, proximal smallest; antennal protopod without channeled dorsal process; cornea bilobed . . . . *Parasquilla coccinea* Manning, 1962*

24. Dactylus of claw with teeth; rostral plate without medial spine . . . . *Odontodactylus brevirostris* (Miers, 1884)

24. Dactylus of claw unarmed; rostral plate with slender medial spine 25

25. Dorsal surface of telson with spinules; knob (under posterior end of median carina) armed with 2-4 tubercles . . . . *Gonodactylus spinulosus* Schmitt, 1924

25. Dorsal surface of telson without spinules; knob unarmed 26

26. Telson of Oerstedii-type: intermediate marginal teeth distinctly separated from submedians; intermediate denticles situated anterior to apex of intermediate teeth; movable apices of submedian teeth present in specimens of all sizes 27

26. Telson of Bredini-type: intermediate marginal teeth not widely separated from submedians; intermediate denticles situated at or posterior to level of apex of intermediate teeth; movable apices of submedian teeth present in most juveniles, absent in adults 28

27. Endopod of uropod tapering distally, mesial margin sinuous, convex proximally, concave distally . . . . *Gonodactylus oerstedii* Hansen, 1895

27. Endopod of uropod oval, mesial margin convex or sinuous, not markedly concave distally . . . . *Gonodactylus torus* Manning, 1969

28. Carinae of submedian teeth of telson longitudinally sulcate, sulci carinate . . . . *Gonodactylus lacunatus* Manning, 1966

28. Carinae of submedian teeth of telson at most pitted, never longitudinally sulcate . . . . *Gonodactylus bredini* Manning, 1969*

Family Lysiosquillidae Giesbrecht, 1910

Lysiosquilla scabricauda (Lamarck, 1818)

Figure 2

Squilla scabricauda Lamarck, 1818, p. 188.

Lysiosquilla scabricauda: Bigelow, 1893, p. 101; Sharp, 1893, p. 106; Lunz, 1937, p. 7; Chace, 1954, p. 449; Menzel, 1956, p. 46; Manning, 1959, p. 17; 1961a, p. 101, text-figs. 1-2; 1967, p. 104; 1969, p. 24, text-figs. 2-4.

Lysiosquilla maculata: Boone, 1930, p. 29, pl. 3 [not *L. maculata* (Fabricius, 1793)].

Material Examined: HOURGLASS STATION D: Dactylus of one raptorial claw; 28 February 1967; dredge; FSBC I 7064.

Diagnosis: Dactylus of raptorial claw with 8-11 teeth, usually 9-10; fifth abdominal somite armed with posterior spinules; sixth abdominal somite and telson roughened dorsally, with numerous spinules and tubercles, irregularly arranged; endopod of uropod elongate, length about 2.5 times greatest width.

Discussion: Although *L. scabricauda* occurs in the Tampa Bay area, no whole specimens were taken during the Hourglass Cruises. The single dactylus taken at Station D is undoubtedly from this species, for it is large (length = 55.6 mm) and bears nine teeth (Figure 2).

Remarks: Moore and Boss (1966) reviewed records of epizoic *Parabornia squillina* (Bivalvia, Erycinidae) found on *L. scabricauda*. In addition to their three records from Mississippi and one from Panama, there are specimens of *Parabornia* in the Marine Research Laboratory invertebrate reference collection (FSBC I 6943) which were attached to the abdominal sterna of a large male *L. scabricauda* (FSBC I 6933) collected at Palm Beach Harbor, Florida, in 11.5 meters on 29-30 March 1969 by Mr. John Jolley. Specific identity of these bivalves is unknown.

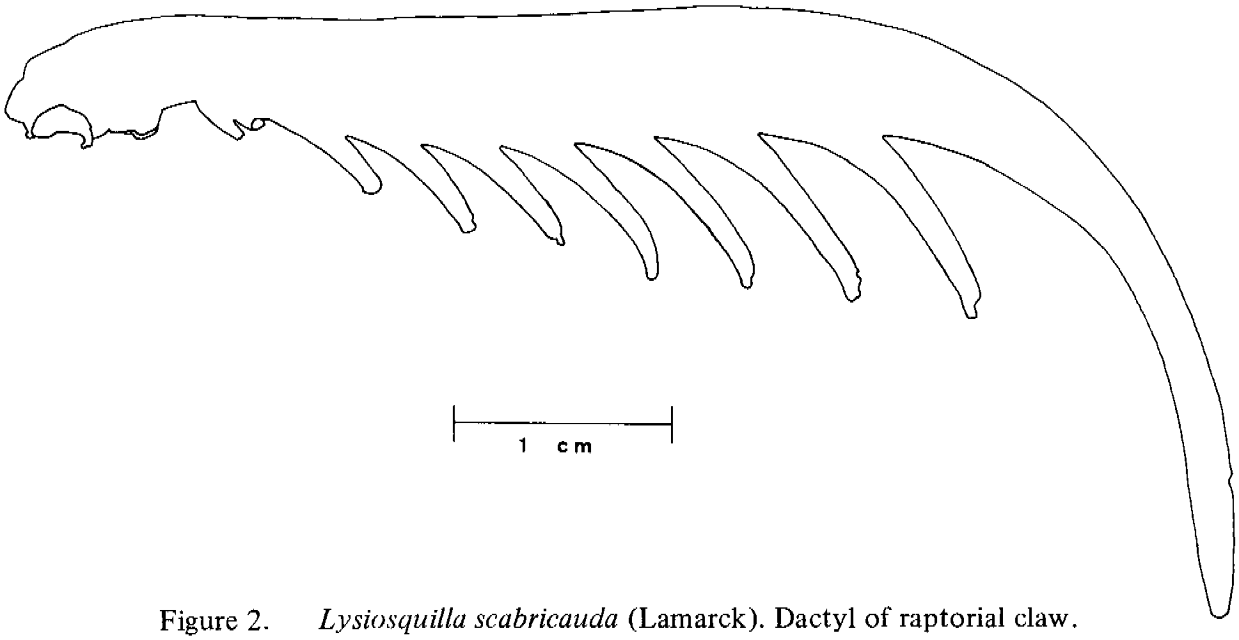


Figure 2. *Lysiosquilla scabricauda* (Lamarck). Dactyl of raptorial claw.

Acanthosquilla biminiensis (Bigelow, 1893)

Figure 3

Lysiosquilla biminiensis Bigelow, 1893, p. 102.

Acanthosquilla biminiensis: Manning, 1969, p. 63, text-figs. 14-15.

Material Examined: HOURGLASS STATION B: 1 ♀, 20.6; 31 August 1967; dredge; FSBC I 7066. – HOURGLASS STATION J: 1 damaged ♂, 22.3; 21 March 1966; trawl; FSBC I 7065. – OTHER MATERIAL: 1 ♂, 49.1; 2 miles SE of Cedar Key, Florida, 28°54.6'N, 83°10'W, 7.6m; hydraulic clam dredge; 12 June 1970; C. Kalman on R/V *Hernan Cortez*; FSBC I 7563. – 1 ♀ postlarva, 10.0; 28°50'N, 84°20'W, surface over 31.7 m; plankton net; 13 August 1969; J. Jolley on R/V *Hernan Cortez*; FSBC I 7561. – 1 ♀ postlarva, 8.7; same; 15.8 m over 31.7 m; plankton net; 13 August 1969; J. Jolley on R/V *Hernan Cortez*; FSBC I 7562. – 1 ♂ postlarva, 10.0; WSW of Cedar Key, Florida, 28°46'N, 84°37'W, 22 m over 44 m; plankton net; 12 August 1969; J. Jolley on R/V *Hernan Cortez*; FSBC I 7560.

Diagnosis: Cornea subglobular, with dorsal tubercle; rostral plate with anterolateral angles rounded, with single apical spine; dactylus of raptorial claw with 6-7 teeth; mandibular palp present; 3-5 submedian denticles on telson; 2 large fixed teeth on posterior margin of telson.

Discussion: All three adults examined differ in minute details from Manning's (1969:63) description of this species. Both specimens from Hourglass material differ by having fewer than 6-10

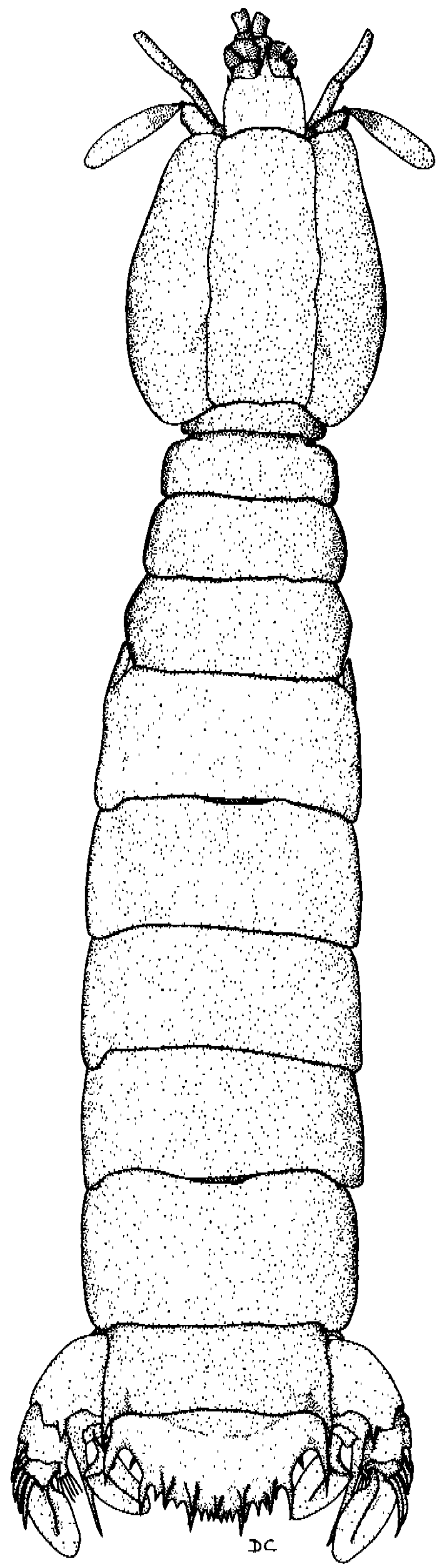


Figure 3. *Acanthosquilla biminiensis* (Bigelow), adult ♂: CL = 9.0 mm; TL = 49.1 mm; FSBC I 7563. Claws, walking legs, and setae omitted.

stiff setae on the distal lobe on the mesial margin of the uropodal exopod as reported by Manning (1969:66). The female from Hourglass Station B has three setae on the right uropod and four on the left. The male from Station J has three setae on each side. There is no indication of damage to these setae.

A more important difference is evident on the male from off Cedar Key. It has only three submedian denticles on each side of the midline on the posterior margin of the telson, thus changing the reported number of submedian denticles in this species from 4-5 to 3-5. The first and second intermediate denticles on the right side of this specimen are longer than the third and fourth, whereas on the left side the first and third are longer than the second and fourth which is the usual condition of these denticles in this species (Manning, 1969:64). As the relative lengths of these denticles are used to differentiate other species of *Acanthosquilla* (Manning, 1968:33) the fact that their lengths are not always in the same proportions should be considered in future investigations of this genus. Ontogeny of the denticles may explain these differing lengths.

Manning (1969:66) noted that a single male from Brazil differed from all other specimens he examined by having an uninterrupted black spot of chromatophores on the telson. The female from Hourglass Station B and the male from off Cedar Key have this feature, whereas the male from Hourglass Station J has the more typical pattern of a black spot interrupted along the midline.

The number of teeth on the dactylus of the raptorial claw ranges from 6 to 7 in this species (Manning, 1969:63). All intact specimens in this study have seven teeth on the claw; the male from Station J lacks claws.

The specimen from Station B is the only recorded female of this species. Measurements are: carapace length, 4.0; cornea width, 0.8; rostral plate length, 1.6, width, 1.5; abdomen width at fifth somite, 4.0; telson length, 1.5, width, 2.9.

Postlarva: (Figure 4) Eyes large. Cornea set obliquely on stalk, with thin trapezoidal lateral section and bilobed subglobular anterior section. Faint indication of dorsal tubercle present. Ocular scales fused. Eyes extended almost to end of antennular peduncle.

Antennular peduncle short, 62-64% carapace length. Antennular processes visible lateral to rostral plate as sharp, anterolaterally-directed spines.

Antennal scale short, 33-48% carapace length; width 33-44% scale length. Antennal protopod with one minute ventral papilla; low node in place of mesial papilla.

Rostral plate wider than long. Lateral margins convex proximally, slightly concave distally, sloping to narrow, rounded apex. Plate covering base of eyestalks, extending almost to cornea.

Carapace narrowed anteriorly, broadly rounded posterolaterally, without carinae or spines. Posterior margin straight.

Dactylus of raptorial claw slender; superior margin with seven teeth, penultimate subequal to antepenultimate; inferior margin evenly convex, with two subequal proximal lobes. Propodus of claw fully pectinate, with four proximal spines, first longest, second shortest. Dorsal ridge of carpus

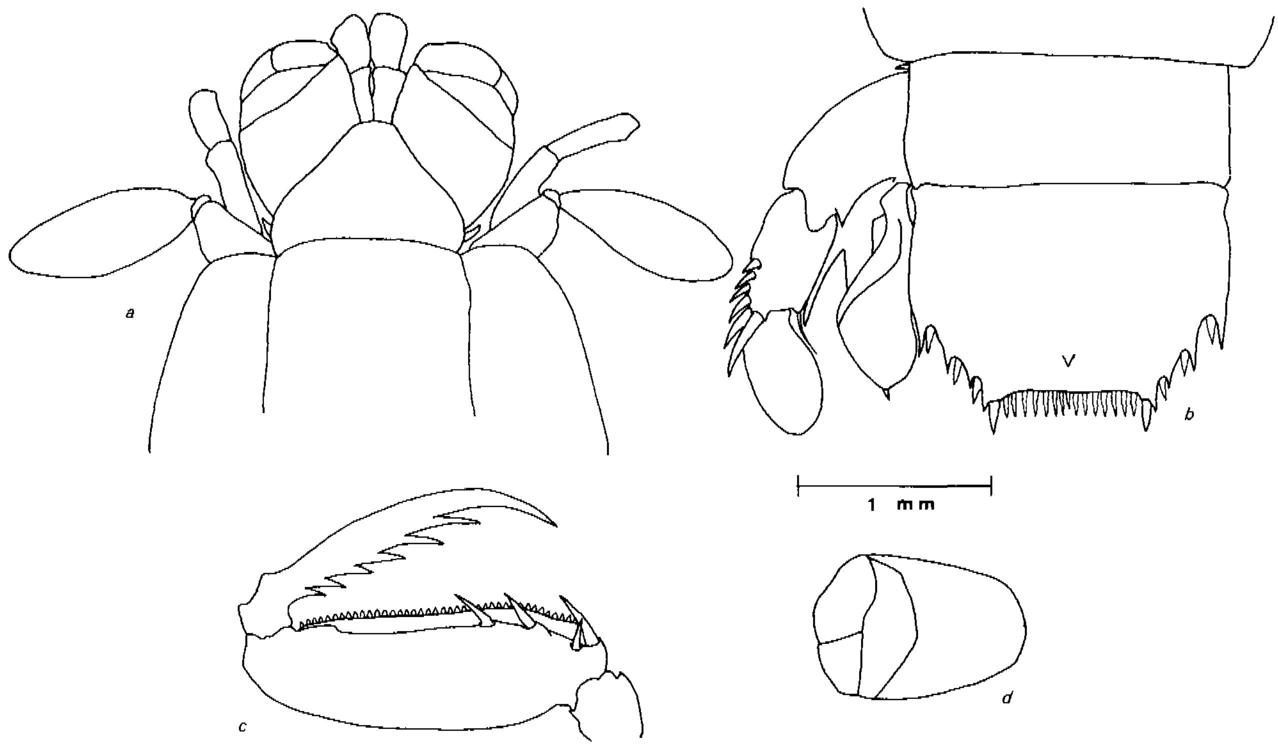


Figure 4. *Acanthosquilla biminiensis* (Bigelow), postlarva. *a*, anterior portion of body; *b*, telson and uropod; *c*, raptorial claw; *d*, eye. FSBC I 7560 and 7562. Setae omitted.

undivided, terminating in blunt projection. Merus about three times longer than ischium, grooved throughout its length for reception of propodus.

Mandibular palp of one segment, inconspicuous. Epipods five.

Lateral margin of fifth thoracic somite truncate. Lateral margins of sixth and seventh somites sinuous, broadly rounded anteriorly, more acutely rounded posteriorly, with short, rounded lateral projections. Ventral surface of eighth somite lacking median ventral keel or projection. Spines absent at bases of walking legs. Endopods of first two pair of walking legs subcircular, those of last pair ovate. On males, buds of copulatory tubes present. Length of walking legs unequal, first shortest, last longest.

Abdomen flattened, smooth, loosely articulated. Anterolateral plates articulated. Ventral margins of pleura sinuous. Sixth abdominal somite with single, short, subacute projections at posterolateral angles; short spine at underside of anterolateral angles immediately anterior to articulation with uropods, not prominent; ventral surface unarmed.

Telson subquadrate, wider than long; dorsal surface with single, acute median posterior spine, otherwise smooth. Posterior margin with 0-1 short median denticle; on either side of midline, a transverse row of 7 subequal submedian denticles with 3-4 minute spinules between each, a long movable submedian tooth, a short fixed submedian tooth, a first intermediate denticle, a first fixed intermediate tooth, a second intermediate denticle, a second fixed intermediate tooth, a lateral denticle, and a long fixed lateral tooth; first fixed tooth appressed to base of movable submedian tooth.

Basal segment of uropod with mesial and lateral carinae, mesial terminating in sharp spine. Proximal segment of exopod of uropod with six slender, graded, movable spines on lateral margin, last extending to midlength of distal segment; mesial margin ending in rounded lobe bearing one or two stiff setae. Distal segment of exopod ovate, lateral margin completely setose, mesial margin setose along distal half. Endopod of uropod triangular, proximal portion of lateral margin folded over. Spines of basal prolongation of uropod triangular in cross-section, mesial spine longer.

No dark chromatophores. Faint shade of circular spot on posterolateral corners of carapace present on one specimen only.

Discussion of Postlarvae: Alikunhi (1967) described postlarvae of *A. acanthocarpus* (Claus, 1871), *A. multifasciata* (Wood-Mason, 1895), and *A. tigrina* (Nobili, 1903) from the Indian Ocean and Gurney (1946:150) briefly characterized and illustrated a postlarval lysiosquillid from Bermuda which he obtained by holding a late larva through metamorphosis. Although Gurney was unable to identify his specimen, he speculated that it could be one of four species: *Lysiosquilla* (= *Acanthosquilla*) *biminiensis, L.* (= *Acanthosquilla*) *septemspinosa, L.* (= *Acanthosquilla*) *acanthocarpus,* or *L. valdiviensis* (= *Acanthosquilla multifasciata*). None of the latter three occur in the western Atlantic. Although no adults of *A. floridensis* (a species unknown to Gurney) and *A. biminiensis* have been reported from Bermuda, based on observations of the postlarvae described above, Gurney's specimen was probably *A. biminiensis*. His illustration closely resembles the present postlarval material but is too diagrammatic to be definitely identified. His brief description differs in several details from the description offered above, but may merely reflect normal variation within these postlarvae. Until a larger number of specimens can be compared for range of variation, Gurney's specimen should not be assigned to any species.

A summary of measurements and indices for present material appears in Table 2.

Postlarval characters which differ most from those of adults are the cornea, rostral plate and telson. The postlarval cornea is trisected, whereas the adult cornea is subglobular and undivided. The rostral plate is subtriangular with a rounded apex, whereas the adult rostral plate is subquadrate with a long apical spine. The telson has only one spine on the dorsal surface, and has more submedian denticles and fixed teeth on the posterior margin than do adults. Postlarvae have four fixed marginal teeth on the telson, whereas adults have only two. A converse situation exists in *A. tigrina*; adults have four fixed marginal teeth on the telson, whereas postlarvae have only two. Alikunhi (1967:925, 937) described how, through successive molts, certain postlarval intermediate denticles of *A. tigrina* become intermediate teeth in adults, and certain postlarval submedian teeth fail to grow longer, appearing as denticles in adults. This suggests that in *A. biminiensis* postlarvae the fixed submedian tooth and the first fixed intermediate tooth may fail to grow proportionally with the other two fixed teeth. Thus, the first and third intermediate denticles of adults are actually small teeth. This may explain why the first and third intermediate denticles are longer than the second and fourth in most adult specimens.

Characters distinguishing postlarvae of four species of *Acanthosquilla* are presented in Table 3.

TABLE 2. MEASUREMENTS (mm) AND INDICES FOR POSTLARVAE OF *ACANTHOSQUILLA BIMINIENSIS* (BIGELOW).

Collection Number (FSBC I)	7560	7561	7562
Number of specimens	1	1	1
Total length (TL)	10.0	10.0	8.7
Carapace length (CL)	2.2	2.1	2.1
Cornea width	0.7	0.7	0.7
Antennular peduncle length	1.4	1.3	1.3
Antennal scale length	0.9	0.7	1.0
Antennal scale width	0.4	0.3	0.3
Telson length	1.0	1.0	1.2
Telson width	1.7	1.8	1.5
Distance between submedian teeth of telson	0.8	0.7	0.7
Corneal Index (CI)	314	300	300
Antennular peduncle length as % CL	64	62	62
Antennal scale width as % scale length	44	43	33
Antennal scale length as % CL	41	33	48
Distance between submedian teeth of telson as % telson width	47	39	47
Number of submedian denticles on telson	15	14	15

Manning (1969:62) discussed the close affinities between *Acanthosquilla, Coronis, Platysquilla*, and *Nannosquilla* based on adult characters. The conservative nature of postlarvae is also helpful in determining relationships within a group. Giesbrecht (1910, pl. 6) illustrated postlarvae of *Lysiosquilla* (= *Nannosquilla*) *occulta* which bear close resemblance to the postlarvae described above. *Nannosquilla occulta* postlarvae differ from those of *A. biminiensis* in having spines at bases of the walking legs, submedian spines on the posterior dorsal margin of the sixth abdominal somite, only four spines on the proximal segment of the uropodal exopod, a greater number of submedian denticles on the telson and differing relative lengths of the spines of the basal prolongation of the uropod. Overall, however, close affinites of these postlarvae are evident, including the shape of rostral plates and the number and position of marginal teeth and denticles on the telsons. The latter feature on *A. biminiensis* postlarvae is also remarkably similar to that of *Platysquilla horologii* adults.

Remarks: Symbiotic relationships are a well-known feature of *Acanthosquilla* biology. Some species are associated with balanoglossid worms (Holthuis, 1967:3), and *Acanthosquilla humesi* Manning is the host of a cyclopoid copepod (Humes, 1965; Manning, 1968:35). A new, previously unreported association was discovered from Hourglass material. Each gill of the adult male from Station J was covered with ectocommensal protozoans of the family Folliculinidae. Preservation techniques used on Hourglass samples prevented further identification.

TABLE 3. CHARACTERS DISTINGUISHING POSTLARVAE OF FOUR SPECIES OF *ACANTHOSQUILLA*. ALL BUT *A. BIMINIENSIS* ARE AFTER ALIKUNHI (1967).

Character	*A. acanthocarpus*	*A. biminiensis*	*A. multifasciata*	*A. tigrina*
Cornea	Not specified (eyes elongated)	Trisected	Not specified	Not specified
Rostral plate	Concial	Subtriangular, rounded anteriorly, broader than long	Conical, smooth tip, broader than long	Blunt anteriorly
Number of teeth on raptorial dactylus	7	7	5-6	10-12
Proximal lobes on inferior margin of raptorial dactylus	2, small, inconspicuous	2, subequal	2, unequal	Not specified
Endopod of second walking leg	Not specified	Subricular	Oblong or rounded	Oblong or rounded; twice the size of endopod of first walking leg
Posterolateral angle of 6th abdominal somite	Subacute	Subacute	Subacute	Subacute
Number of spines on proximal segment of uropodal exopod	7	6	6	6
Shape of uropodal endopod	Not specified	Triangular	Somewhat oval	Not specified
Spines on basal prolongation of uropod	Lateral spine just over 1/2 length of mesial spine	Mesial longer than lateral	Mesial longer than lateral	Mesial barely longer than lateral
Marginal spination of telson (each side of midline)	10 submedian denticles, 4th longest; movable submedian tooth; 2 intermediate denticles; fixed intermediate tooth; 1 lateral denticle; fixed lateral tooth	0-1 median denticles; 7 subequal submedian denticles; movable submedian tooth; fixed submedian tooth; 1st intermediate denticle; 1st fixed intermediate tooth; 2nd intermediate denticle; 2nd fixed intermediate tooth; lateral denticle; fixed lateral tooth	7 submedian denticles, 3rd longest; fixed submedian tooth; 4 intermediate denticles; fixed intermediate tooth; lateral denticle; fixed lateral tooth	9 submedian denticles, 3rd longest; movable submedian tooth; 3 intermediate denticles; fixed intermediate tooth; lateral denticle; fixed lateral tooth
Pigmentation	Light pink shade on opaque white body	Indication of circles on posterolateral corners of carapace on one specimen	Almost absent	Sparsely developed
Size (TL)	10 mm (tip of ophthalmic somite to posterior margin of telson)	8.7–10.0 mm (tip of rostral plate to posterior margin of telson)	9 mm (tip of ophthalmic somite to posterior margin of telson)	9 mm (tip of ophthalmic somite to posterior margin of telson)

Platysquilla horologii Camp, 1971

Figure 5

Lysiosquilla excavatrix: Lunz, 1935, p. 153 [part]; Chace, 1954, p. 449 [part, listed] [not *Lysiosquilla excavatrix* Brooks, 1886].

Platysquilla undescribed species: Manning, 1969, p. 93.

Platysquilla horologii Camp, 1971, p. 119, fig. 1.

Material Examined: HOURGLASS STATION D: 1 ♀, 16.2; 9 September 1966; trawl; HOLOTYPE; USNM 128831. – HOURGLASS STATION E: 1 broken ♀, TL about 15.6; 2 August 1966; dredge; PARATYPE; USNM 128832. – 1 ♂, 13.1; 3 March 1967; dredge; PARATYPE; FSBC I 7268. – OTHER MATERIAL: 1 broken ♀, TL about 14; off Charlotte Harbor, Charlotte Co., Florida, 26°47'30"N, 83°25'15"W, 51.2 m, *Albatross* Sta. 2410; PARATYPE; USNM 9825.

Diagnosis: Antennal peduncle lacking mesial papillae, with two ventral papillae; three epipods present; rostral plate cordiform, without apical spine; dactylus of raptorial claw with eleven teeth; telson with four pairs of fixed marginal teeth, mesial two pairs sharp.

Discussion: Camp (1971) presented a complete account of known variation within this species.

The male paratype from Hourglass Station E is actually a better representative of *P. horologii* than the female holotype. Unfortunately, this male was not discovered in these collections until after the holotype had been designated as such in the records of the National Museum of Natural History.

Platysquilla horologii differs from its congeners, *P. eusebia* and *P. enodis*, by lacking the mesial papillae of the antennal protopods and the apical spine on the rostral plate, by having a cordiform rather than subquadrate rostral plate, and by possessing only three epipods. When it was described, the generic definition had to be amended to include it (Camp, 1971). Each of the four extant specimens closely resemble postlarvae of *Acanthosquilla bimiensis*, described above (Figure 4). The close similarity of *P. horologii* with other known lysiosquillid postlarvae and the great difference of its more conservative characters from those of its congeners suggest that these four specimens are postlarvae and the adults of this species are unknown. Conversely, they possibly represent a neotenous group, similar to the squillid genus *Meiosquilla* (Manning, 1969:103). I do not believe these specimens are postlarvae, even though they have certain postlarval characters and are much smaller than adults of their cogeners, since both copulatory tubes of the single male are well-developed. These structures are usually represented only by buds on postlarvae of other stomatopods. When additional specimens become available for study, and if it is shown that present specimens are adults, then differences between *P. horologii* and its cogeners may possibly warrant the erection of a separate subgenus.

Family Squillidae Latreille, 1803

Meiosquilla quadridens (Bigelow, 1893)

Figure 6

Squilla quadridens Bigelow, 1893, p. 101; 1894, p. 511; Springer & Bullis, 1956, p. 23 [listed]; Manning, 1959, p. 20 [part, listed]; Bullis & Thompson, 1965, p. 13 [part, listed].

Meiosquilla quadridens: Manning, 1969, p. 106, text-figs. 31, 33a; Camp, 1971, p. 125 [listed].

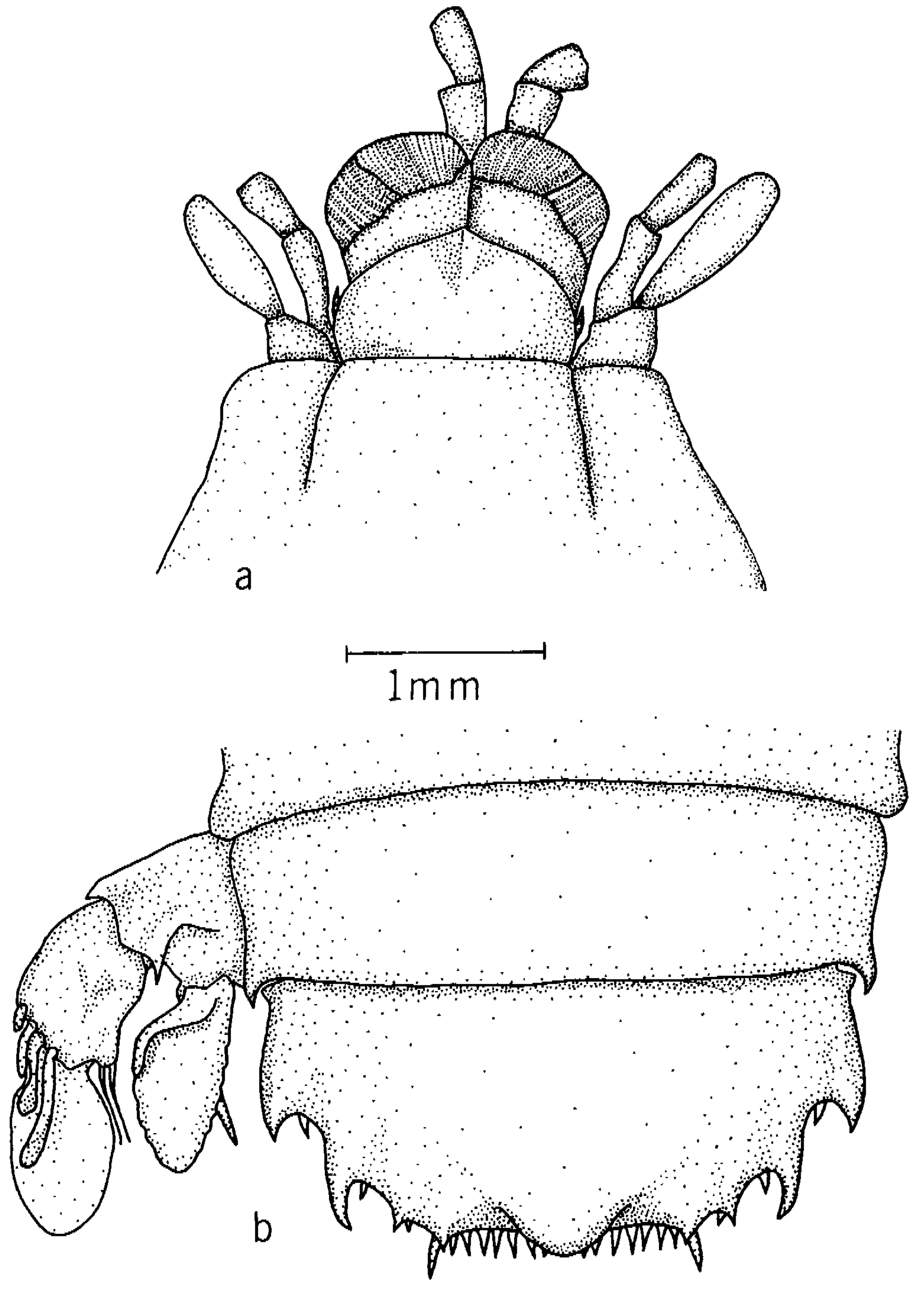


Figure 5. *Platysquilla horologii* Camp, adult ♀ paratype from Station E: TL = about 15.6 mm; USNM 128832. *a*, anterior portion of body; *b*, sixth abdominal somite, telson, and uropod. Setae omitted.

Material Examined: HOURGLASS STATION D: 1 juv., 12.6; 7 June 1966; dredge; FSBC I 7067. – 1 ♂, 22.8; 1 September 1966; dredge; FSBC I 7069. – 2 ♂, 29.7-30.8; 1 ♀, about 18.1; 9 October 1966; trawl; FSBC I 7070. – 1 ♀, 26.0; 9 October 1966; dredge; FSBC I 7071. - 1 ♀, 23.8; 9 November 1966; from stomach of *Lepophidium jeannae*; FSBC I 7072. – 1 ♂, 32.0; 20 November 1966; from stomach of *Syacium papillosum*; FSBC I 7073. – 1 broken ♂, CL 5.3; 2 December 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7074. – 1 juv. ♂, 13.0; 3 June 1967; dredge; FSBC I 7075. – 1 ♂, 19.8; 12 July 1967; dredge; FSBC I 7076. – 2 ♀, 19.7-23.4; 2 August 1967; dredge; FSBC I 7077. – 3 juv., 1 damaged, 12.2–about 13.0; 1 September 1967; dredge; FSBC I 7079. – 1 ♀, 24.5; 6 October 1967; dredge; FSBC I 7078. – 1 ♂, 34.8; 3 November 1967; trawl; FSBC I 7080. - HOURGLASS STATION E: 1 broken ♂, CL 4.4; 19 July 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7081. – 1 ♀, 29.8; 19 July 1966; trawl; FSBC I 7082. - 1 broken ♂, CL 6.3; 2 August 1966; trawl; FSBC I 7083. – 1 juv., 11.7; 2 ♀, 14.0–18.2; 2 August 1966; dredge; FSBC I 7084. – 1 broken ♀, CL 5.2; 2 December 1966; from stomach of *Prinotus alatus*; FSBC I 7085. – 2 ♂, 13.0 – 13.2; 2 December 1966; dredge; FSBC I 7269. – 1 broken ♀, CL about 4.0; 3 March 1967; dredge; FSBC I 7270. – 1 ♀, 24.4; 4 April 1967; from stomach of *Urophysis regius*; FSBC I 7086. – 1 broken ♀, CL 5.6; 2 August 1967; dredge; FSBC I 7087. - 1 ♂, 31.4; 3 November 1967; trawl; FSBC I 7088. – HOURGLASS STATION K: 1 ♂, 31.6; 4 September 1965; dredge; FSBC I 7089. – HOURGLASS STATION L: 1 broken ♀, CL 5.3; 6 August 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7090. – 1 ♂ fragment, CL 2.6; 6 August 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7091. – 1 broken specimen; 6 August 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7092. – 1 ♂, 16.9; 1 ♀, 19.2; 6 August 1966; trawl; FSBC I 7093. – 2 ♂, 12.7–about 24.3; 2 ♀, 22.6-26.0; 5 September 1966; dredge; FSBC I 7094. – 1 broken ♀, CL 6.4; 13 November 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7095. – 1 ♀, 14.6; 8 April 1967; dredge; FSBC I 7096. – 1 ♀, 24.3; 16 May 1967; dredge; FSBC I 7097. - 1 ♂, 25.2; 6 July 1967; dredge; FSBC I 7098. - 1 broken ♀, CL 5.4; 5 September 1967; from stomach of *Scorpaena brasiliensis*; FSBC I 7099. - 1 ♀, 26.0; 12 October 1967; trawl; FSBC I 7100. – 1 ♀, 18.3; 12 October 1967; dredge; FSBC I 7101. – HOURGLASS STATION M: 1 ♀, 21.5; 6 July 1966; from stomach of *Synodus intermedius*; FSBC I 7102. – 1 ♂, 21.6; 22 July 1966; from stomach of *Holocentrus bullisi*; FSBC I 7103. – 1 ♂, 22.6; 1 ♀, 27.5; 6 August 1966; trawl; FSBC I 7104. – 1 ♂ fragment; 3 ♂, 14.3–30.0; 4 ♀, 13.0–25.0; 5 September 1966; dredge; FSBC I 7105. - 1 ♀, 24.2; 5 September 1966; trawl; FSBC I 4457. - 1 damaged ♂, 29.4; 13 November 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7106. - 1 ♂, 35.3; 13 November 1966; from stomach of *Urophysis regius*; FSBC I 7107. – 1 ♂, 24.0; 1 broken specimen, CL about 3.2; 13 November 1966; dredge; FSBC I 7108. – 1 broken ♀, CL 7.1; 7 December 1966; from stomach of *Lepophidium jeannae*; FSBC I 7109. – 1 ♂, about 10.7; 13 January 1967; FSBC I 7110. – 1 ♂, 24.5; 31 January 1967; trawl; FSBC I 7111. – 1 broken ♀, CL about 4.5; 8 April 1967; dredge; FSBC I 7112. – 1 fragment; 6 July 1967; dredge; FSBC I 7274. – 1 ♂, 31.6; 1 ♀, 31.6; 5 September 1967; trawl; FSBC I 7113. – 2 ♀, 16.7–26.0; 15 November 1967; dredge; FSBC I 7114. – 1 broken ♂, CL 6.1; 15 November 1967; from stomach of *Syacium papillosum*; FSBC I 7271.

Diagnosis: Dactylus of claw with 4 teeth; 4 epipods present; lateral processes of sixth and seventh thoracic somites rounded posteriorly; submedian carinae of telson short; denticles 4-6, 6-10, 1.

Discussion: Several characters show wide variation in the material examined, especially among juveniles. One of these is the posterior portions of the lateral carinae of the carapace, which are

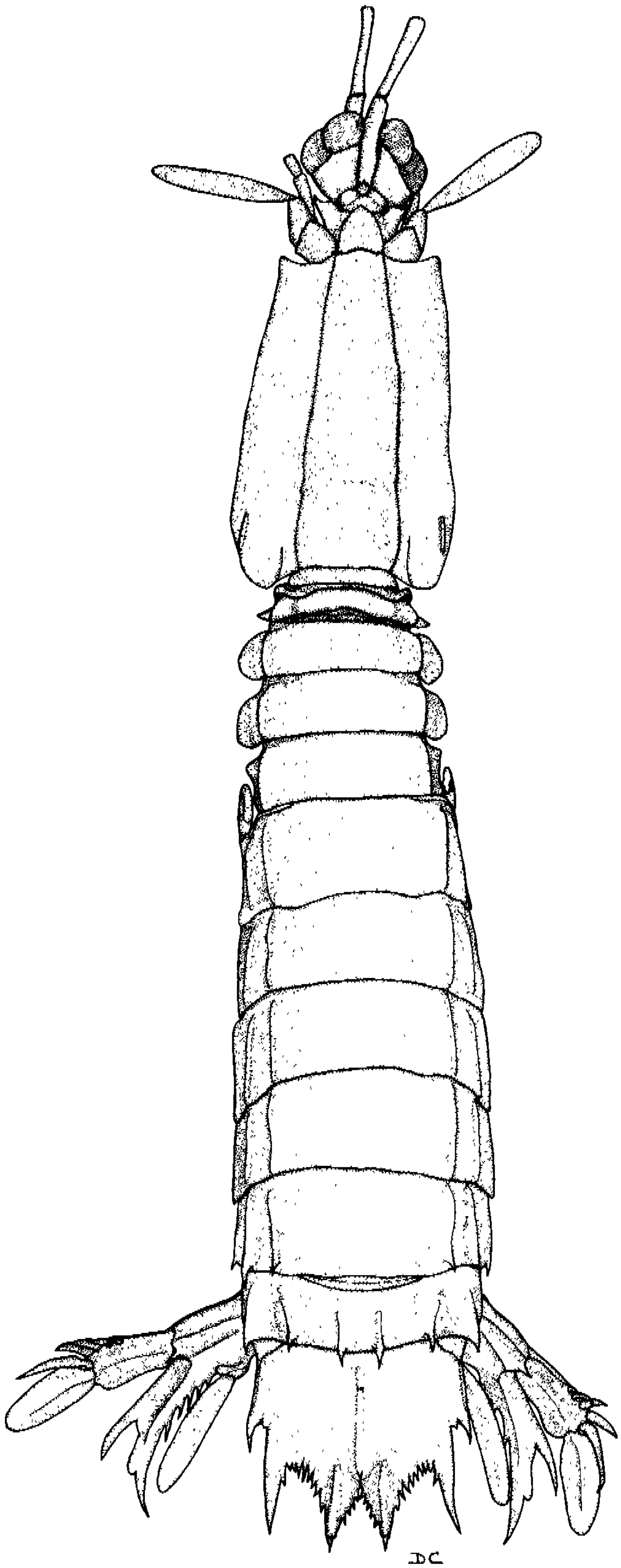


Figure 6. *Meiosquilla quadridens* (Bigelow), adult ♂: CL = 6.2 mm; TL = 25.2 mm; FSBC I 7098. Claws, walking legs, and setae omitted.

absent from all specimens less than TL 13 mm. Only two of ten specimens TL 13-18.2 mm have these carinae, and only two of forty-eight specimens greater than TL 18.2 mm lack them.

The proximal ends of the dactyli of the claws usually have deep notches on the outer margins in this species (Manning, 1969:109). Nine large specimens (CL greater than 5 mm) have no notch; all others in each size class do.

Manning (1969:110) noted that the lateral processes of the fifth thoracic somite may be either rounded or sharp in anterior view and are usually rounded on small specimens. These processes are always rounded on small Hourglass specimens (CL less than 2.9 mm), are rounded on 9 of 14 specimens CL 2.9-4.4 mm, and are sharp on 42 of 47 specimens CL 4.5-8.8 mm.

Number and spination of abdominal carinae also vary among Hourglass specimens. Manning (1969:110) noted that three small specimens (less than TL 30 mm) differed from the remainder of his material by having less conspicuous abdominal carinae. All Hourglass specimens less than CL 3.0 mm have inconspicuous abdominal carinae, four of nine specimens CL 3.0-3.7 mm have inconspicuous carinae, and the remaining 50 intact specimens greater than CL 3.7 mm have conspicuous carinae. Small specimens also have fewer spined abdominal carinae. Large specimens (CL greater than 4.4 mm) always have spined intermediate and lateral carinae on the fifth and sixth somites and occasionally have spined lateral carinae on the fourth somite. All specimens less than CL 3.5 mm, however, have spined intermediate and lateral carinae only on the sixth somite. Specimens of intermediate size (CL 3.5-4.4 mm) show both conditions. In addition, all specimens greater than CL 4.7 mm have spined marginal carinae on the fourth somite, whereas Manning (1969:109) found them spined only occasionally.

Number of denticles on the telson also varies. One adult, CL 6.2 mm, has eleven intermediate denticles on one side of the telson, whereas all others fall within the previously reported range of 6-10. Number of submedian denticles on most intact specimens less than CL 3.2 mm is greater than the previously reported range of 4-6. One of these small specimens has seven denticles on each side, two have eight denticles, four have nine denticles, and one has ten. One of those with 9 submedian denticles on its existing exoskeleton (CL 2.9 mm; FSBC I 7084) has only 5 on the underlying exoskeleton, indicating that the increased numbers of these denticles on juveniles are lost in one molt to the next stage.

Manning (1969:110) noted that only the largest male he examined (TL 33.4 mm) exhibited sexual dimorphism by having the margins of the telson swollen. In the Hourglass material, all males greater than TL 24.5 mm exhibit sexual dimorphism of this character.

Two aberrant specimens were found in the Hourglass material. One female, TL 26 mm (FSBC I 7071), has intermediate carinae of the fifth thoracic somite produced dorsally into short, erect processes which are taller than all other carinae. A similar condition is found on two specimens of *Squilla deceptrix* Manning, 1969 from Hourglass material. In addition, one male *M. quadridens*, TL 30.8 mm (FSBC I 7070), has both lateral teeth and the left lateral denticle of the telson undeveloped (Figure 7). No sign of damage is evident, and the right lateral denticle is present.

Specimens of *M. quadridens* less than TL 14 mm are difficult to distinguish from comparable-sized *M. schmitti* because the submedian carina of the telson in the latter is usually undeveloped at that size. A comparison of small specimens of these species was made, and the following features were noted: (1) The lateral processes of the fifth thoracic somite are usually more produced in *M. schmitti* than in *M. quadridens*. (2) The inner margin of the basal prolongation of the uropod has more spines (9-10) in *M. schmitti* than in *M. quadridens* (3-5). This is the most reliable character distinguishing small specimens of these species. (3) The outer margin of the penultimate segment of the exopod of the uropod may have as many as six (rarely seven) movable spines in *M. schmitti*, whereas *M. quadridens* never has more than five such spines. (4) Both the species have a minute, inconspicuous ventral spine anterior to the articulation of the uropod on the sixth abdominal somite. This feature is never present on adult *M. quadridens* and has never been reported on small specimens of this species.

A summary of corneal indices for these specimens is presented in Table 4.

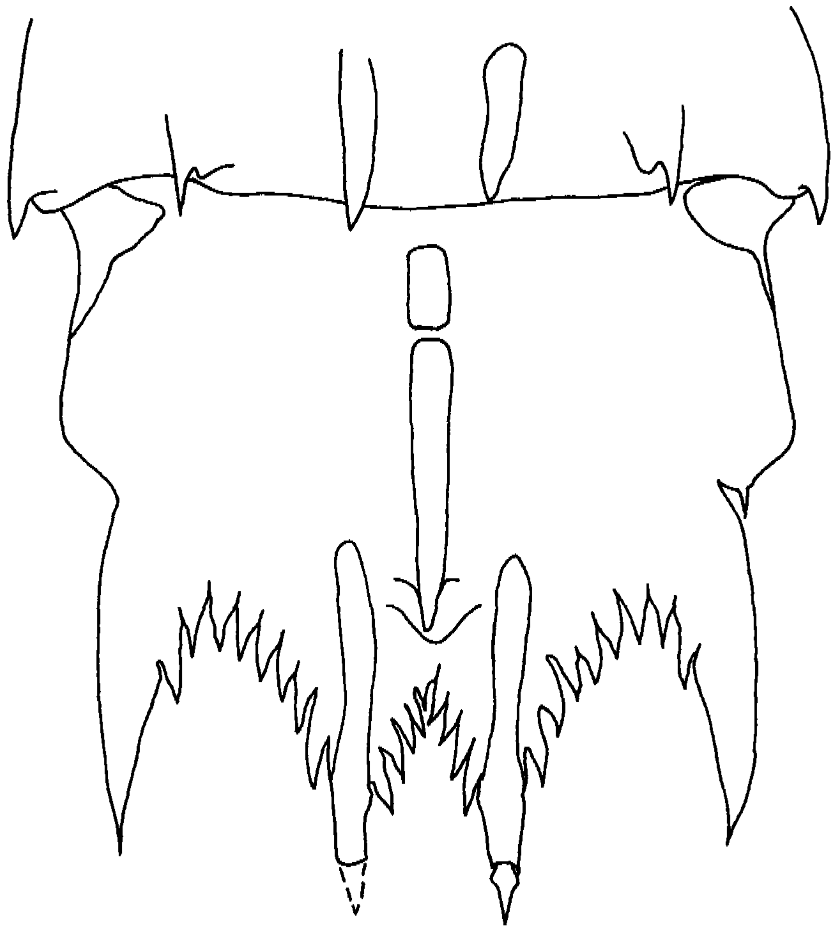


Figure 7. *Meiosquilla quadridens* (Bigelow), aberrant ♂ telson lacking lateral spines and left lateral denticle: FSBC I 7070.

TABLE 4. RANGE AND MEAN OF CORNEAL INDICES (CI) OF 62 SPECIMENS OF *MEIOSQUILLA QUADRIDENS* (BIGELOW).

Size Class (CL, mm)	n	CI Range	CI Mean
2.5-2.9	6	260-322	291
3.0-3.9	8	318-389	357
4.0-4.9	7	338-400	373
5.0-5.9	15	371-454	407
6.0-6.9	15	388-478	423
7.0-7.9	5	433-494	465
8.0-8.9	6	421-489	455

Meiosquilla schmitti (Lemos de Castro, 1955)

Figure 8

Squilla schmitti Lemos de Castro, 1955, p. 8, text-figs. 5-8, pl. 1, figs. 32-33.

Squilla quadridens: Manning, 1959, p. 20 [part], [not *S. quadridens* Bigelow, 1893].

Meiosquilla schmitti: Manning, 1969, p. 111, text-figs. 32, 33b.

Material Examined: HOURGLASS STATION B: 1 damaged ♂, about 15.5; 1 December 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7115. – 1 damaged ♀, about 18.8; 1 December 1966; from stomach of *Prionotus pectoralis*; FSBC I 7116. – 1 ♀, 25.9; 25 January 1967; trawl; FSBC I 7117. – 1 ♀, 17.1; 1 August 1967; dredge; FSBC I 7119. – 1 ♂, 17.2; 5 October 1967; dredge; FSBC I 7118. – 1 ♂, 17.1; 1 ♀, 16.5; 2 November1967; dredge; FSBC I 7120. – HOURGLASS STATION C: 1 damaged postlarva, about 12.3; 20 May 1967; dredge; FSBC I 7121. – 1 ♂, 16.8; 31 August 1967; trawl; FSBC I 7122. – HOURGLASS STATION D: 1 ♂, 14.7; 1 ♀, 22.8; 14 December 1966; from stomach of *Syacium papillosum*; FSBC I 7123. – 1 damaged ♂, about 13.0; 2 August 1966; dredge; FSBC I 7068. - HOURGLASS STATION J: 1 damaged ♂, about 17.3; 1 damaged ♀, 16.3; 21 July 1966; from stomach of *Lutjanus synagris*; FSBC I 7124. – 1 ♀, 17.7; 12 January 1967; trawl; FSBC I 7125. – 1 ♂, 20.7; 30 January 1967; trawl; FSBC I 7126. – 1 damaged ♂, about 13.4; 1 damaged ♀, 14.4; 14 November 1967; dredge; FSBC I 7127. – HOURGLASS STATION K: 1 ♀, 24.8; 6 June 1967; trawl; FSBC I 7128. – HOURGLASS STATION L: 1 ♀, 23.4; 6 July 1967; dredge; FSBC I 7129.

Diagnosis: Four teeth on dactylus of raptorial claw; four epipods present; ventral spines present on fifth thoracic somite; lateral processes of sixth and seventh thoracic somites rounded posteriorly, unarmed; submedian carinae of telson long; denticles 4-7, 8-12, 1.

Discussion: Most specimens agree well with Manning's (1969) account of this species. Only one specimen, however, agrees with the abdominal spine formula he presented (1969:113): submedian, 6; intermediate, 5-6; lateral, 5-6; marginal, (4) 5. All others differ by never having spines on the intermediate and lateral carinae of the fifth somite.

The number of spines on the penultimate segment of the exopod of the uropod has been variously reported as 6 (Lemos de Castro, 1955; Manning, 1961), 5-6 (Manning, 1966), and 6-7

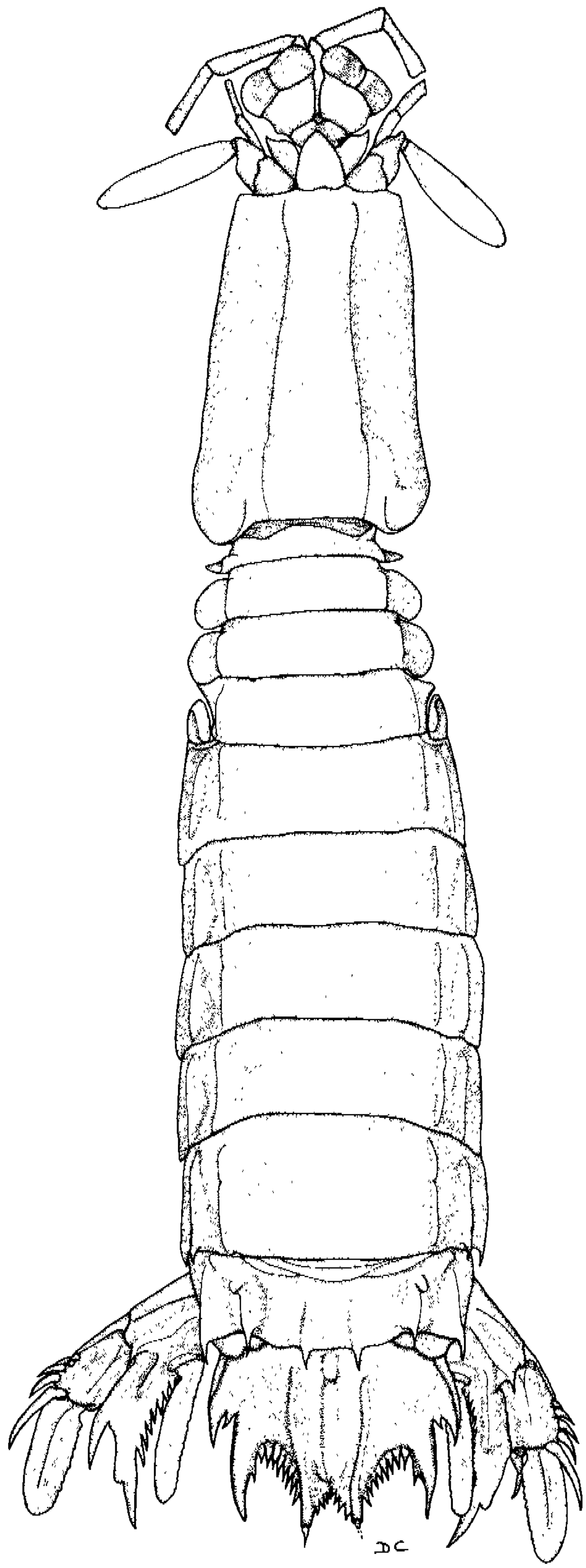


Figure 8. *Meiosquilla schmitti* (Lemos de Castro), adult ♂: CL = 7.6 mm; TL = 29.5 mm; FSBC I 6975. Claws, walking legs, and setae omitted.

(Manning, 1969). Six specimens from the Hourglass material have five such spines, two have five on one side and six on the other, and eleven have six spines on both uropods. None have seven spines.

One specimen (FSBC I 7122) differs from previously published accounts of this species in having twelve spines on the inner margin of the basal prolongation of the uropod, rather than 5-11.

It is with some hesitation that I designate the small specimen (FSBC I 7121) from Station C a postlarval *M. schmitti*. The claws and epipods are missing, and the carapace, though still attached at its anterior margin, is torn away from the thorax. The specimen appears to agree with Calman's (1917:141) report of a postlarval *Squilla* sp. from Rio de Janiero, which Manning (1969:114) later tentatively assigned to *M. schmitti*. It differs from Calman's specimen, however, in having only 20 submedian denticles on the telson (9 on the right, 11 on the left of the midline) rather than 22. It also agrees with Manning's (1966:368) brief diagnosis of a postlarva from Mogiquiçaba. It differs from Manning's specimen, however, in having only nine intermediate denticles on the telson rather than eleven.

A summary of corneal indices is presented in Table 5.

TABLE 5. RANGE AND MEAN OF CORNEAL INDICES (CI) OF 14 SPECIMENS OF *MEIOSQUILLA SCHMITTI* (LEMOS DE CASTRO).

Size Class (CL, mm)	n	CI Range	CI Mean
3.0	1	---	333
3.2	1	---	320
3.5	2	350-364	357
3.7	1	---	336
3.8	2	345-345	345
3.9	1	---	355
4.0	1	---	308
4.7	2	361-362	362
5.5	1	---	366
5.6	2	386-400	393

Remarks: Manning (1969:113), in his description of *M. schmitti*, stated, "Thoracic somites with prominent intermediate and lateral carinae on last three somites . . ." As no *Meiosquilla* has lateral carinae on those somites (Manning, 1969:100), the words "and lateral" should be omitted from that sentence in his description (Manning, personal communication).

Squilla grenadensis Manning, 1969

Figure 9

Squilla grenadensis Manning, 1969, p. 152, text-fig. 42.

Material Examined: HOURGLASS STATION L: 1 damaged ♂, about 42; 22 July 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7855. – 1 ♀ fragment, 22 July 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7133. – 1 fragment; 6 August 1966; from stomach of *Scorpaena* *brasiliensis*; FSBC I 7856. – 1 ♂ fragment, CL 4.4; 6 August 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7272. – 1 ♂, 33.4; 7 December 1967; from stomach of *Scorpaena brasiliensis*; FSBC I 7858. – 1 ♂, 23.7; 12 October 1967; trawl; FSBC I 7273. – 1 damaged ♀, 26.6; 12 October 1967; dredge; FSBC I 7134. – HOURGLASS STATION M: 1 ♂ fragment, about 33; 13 October 1966; from stomach of *Scorpaena dispar*; FSBC I 7857.

Diagnosis: Rostral plate without median carina; median carina of carapace lacking anterior bifurcation; dactylus of raptorial claw with six teeth; mandibular palp and four epipods present; lateral process of fifth thoracic somite an acute, laterally projecting lobe, anterior margin straight or concave, posterior margin convex, or lateral process an anteriorly-curved spine; intermediate carinae of thoracic somites unarmed; telson with numerous longitudinal carinae; denticles 4-5, 8-11, 1; basal prolongation of uropod with mesial spines.

Discussion: Most of these specimens are in poor condition, as six occurred in fish stomach contents. Most characters are sufficiently intact on enough specimens to add to the morphological information on this species which was described from a single specimen (Manning, 1969:152).

One character which distinguishes *S. grenadensis* from the closely related *S. rugosa* is the shape of lateral processes of the fifth thoracic somite. In *S. rugosa*, each process is an acute, laterally-directed lobe, with the anterior margin convex and the posterior margin concave. The holotype of *S. grenadensis* has a sharp spine there, which is curved slightly forward (Manning, 1969:152). Most Hourglass specimens which have this feature intact agree with Manning's description; however, three specimens differ. One male (FSBC I 7272) has these processes barely produced, but is obviously immature, for its carapace length is only 4.4 mm (the abdomen and telson are missing), and it lacks the anterolateral angles of the carapace. Another specimen (FSBC I 7273) differs in having laterally-directed processes with the anterior margins straight, not curved forward, and the posterior margins convex. The third specimen (FSBC I 7858) has this condition on one side, but on the other side the process is curved forward, as on the holotype.

Manning (1969) did not mention whether the holotype has a proximal notch on the inferior margin of the dactyls of the raptorial claws. Each Hourglass specimen still possessing its dactyls does have such a notch.

Manning (1969) also did not mention whether the holotype has tubercles on the ventral surface of the telson, although he did note a postanal carina. *Squilla rugosa* has one tubercle on each side of the postanal carina. All but one of the Hourglass *S. grenadensis* have a tubercle on each side of the anus, anterior to the position in which they are found on *S. rugosa*.

Antennal scales are missing on the holotype of *Squilla grenadensis*. An anterodistal line of chromatophores on antennal scales of *S. rugosa* further distinguishes it from *S. deceptrix* and *S. discors*. Presence of such chromatophores on *S. grenadensis* is variable. Three Hourglass specimens have only one antennal scale remaining; each with chromatophores. Three other specimens have both scales intact, but two have no chromatophores on either scale, and one has color on only one scale. Remaining specimens lack antennal scales.

The number of spined abdominal carinae is increased for *S. grenadensis* through examination of Hourglass material. It is now as follows: submedian, 6; intermediate, 3-6; lateral, 2-6; marginal, 1-5. Range of the number of denticles on the posterior margin of the telson is similarly increased, as

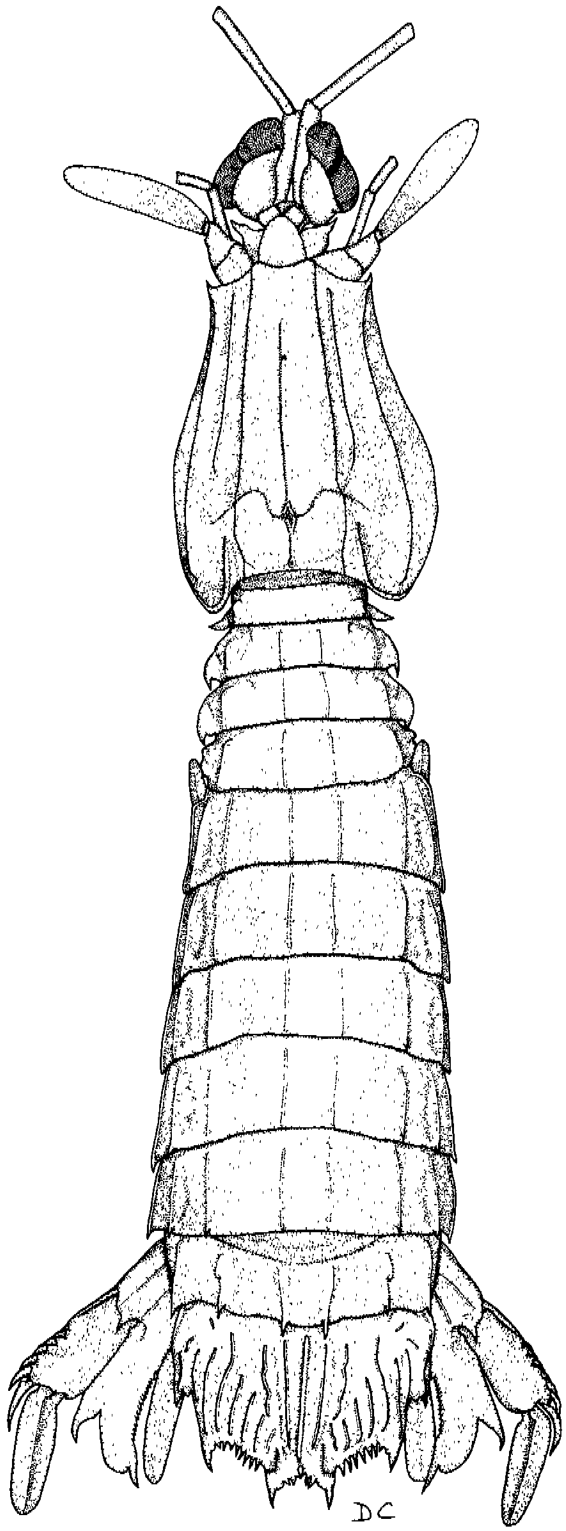


Figure 9. *Squilla grenadensis* Manning, adult ♀: CL = 6.3 mm; TL = 26.6 mm; FSBC I 7134. Claws, walking legs, and setae omitted.

follows: submedian, 4 (5); intermediate, 8-11; lateral, 1. The outermost submedian and intermediate denticle, and the lateral denticle on each side of the midline is rounded, as on the holotype (Manning, 1969:154). In addition, the number of spines on the lateral margins of the uropodal exopod may be six or seven. The holotype has seven such spines, whereas two Hourglass specimens have only six spines on one uropod. All others have seven.

Corneal indices of six Hourglass specimens are given in Table 6.

TABLE 6. CORNEAL INDICES (CI) OF SIX SPECIMENS OF *SQUILLA GRENADENSIS* MANNING.

Size (mm)			
CL	TL	Sex	CI
4.4	---	♂	314
6.2	23.7	♂	310
6.3	26.6	♀	315
7.4	33.4	♂	296
9.6	about 42	♂	290
9.8	---	♂	297

Squilla rugosa Bigelow, 1893

Figure 10

Squilla rugosa Bigelow, 1893, p. 102; Bigelow, 1894, p. 541, text-figs. 23-24; Chace, 1954, p. 449; Springer & Bullis, 1956, p. 23; Manning, 1959, p. 20; Bullis & Thompson, 1965, p. 13; Manning, 1969, p. 155, text-figs. 43-44a.

Material Examined: HOURGLASS STATION B: 1 ♂, 76.8; 8 November 1965; trawl; FSBC I 7137. – 1 ♀ abdomen; 7 February 1966; trawl; FSBC I 7138. – 1 ♂, 49.4; 25 January 1967; trawl; FSBC I 7139. – 1 ♂, 33.3; 2 November 1967; dredge; FSBC I 7140. – HOURGLASS STATION C: 1 ♂, 85.1; 3 ♀, 59.9-108.7; 3 March 1966; trawl; FSBC I 7141. – 1 ♂, 114.7; 2 July 1966; dredge; FSBC I 7142. – 1 ♀, 49.2; 2 July 1966; trawl; FSBC I 7295. – 1 ♀, 87.2; 1 August 1966; trawl; FSBC I 7143. – 1 ♀, 102.9; 19 November 1966; trawl; FSBC I 7144. – 2 ♂, 81.8-102.6; 6 January 1967; trawl; FSBC I 7145. – 1 ♀, 109.7; 5 February 1967; trawl; FSBC I 7146. – 1 ♀, 103.6; 1 July 1967; trawl; FSBC I 7147. – 1 ♂, 75.6; 1 July 1967; dredge; FSBC I 7148. – 1 ♂, 91.6; 25 October 1967; trawl; FSBC I 7149. – 2 ♀, 55.0-101.7; 2 November 1967; trawl; FSBC I 7150. – HOURGLASS STATION J: 1 ♀, 50.4; 12 October 1965; trawl; FSBC I 1231. – 2 ♂, 45.3-64.2; 4 ♀, 58.7-74.6; 12 November 1965; trawl; FSBC I 1165. – 1 damaged ♀, 34.0; 6 December 1965; trawl; FSBC I 1426. – 2 ♂, 74.8-88.7; 14 February 1966; trawl; FSBC I 1985. – 11 ♂, 46.4-72.4; 6 ♀, 40.4-64.7; 21 March 1966; trawl; FSBC I 7151. – 1 ♂, 24.0; 21 July 1966; from stomach of *Scorpaena brasiliensis*; FSBC I 7152. – 1 damaged ♀, about 28.5; 21 July 1966; from stomach of *Diplectrum formosum*; FSBC I 7153. – 1 broken specimen; 21 July 1966; from stomach of *Lutjanus synagris*; FSBC I 7154. – 1 ♀, 25.0; 21 July 1966; from stomach of *Lutjanus synagris*; FSBC I 7176. – 1 ♂, 95.7; 12 October 1966; dredge; FSBC I 7155. – 1 ♂, 49.5; 4 ♀, 46.5-65.6; 12 January 1967; trawl; FSBC I 7156. – 1 ♂, 57.8; 2 ♀, 50.4-66.8; 30 January 1967; trawl; FSBC I 7158. – 1 ♀, 57.2; 15 February 1967; trawl; FSBC I 7157. – 1 ♂, 41.0; 1 juv. ♀, 18.2; 14 November 1967; from stomach of *Syacium papillosum*; FSBC I 7275. – HOURGLASS STATION K: 1 ♂, 26.8; 6 August 1965; trawl; FSBC I 1306. – 1 ♂, 74.2; 1 ♀, 109.7; 13 January 1966; trawl; FSBC I 1664. – 3 ♂, 39.4-85.1; 1 ♀, 80.8; 9 March 1966; trawl; FSBC I 7159. – 1 ♂, 102.2; 21 March 1966; dredge; FSBC I 7160. – 5 ♂, 57.8-75.1; 2 ♀, 79.9-86.9; 11 April 1966; trawl; FSBC I 7161. – 2 ♂, 92.3-108.4; 1 ♀, 93.9; 11 May 1966; trawl; FSBC I 7162. – 2 ♀, 91.2-102.6; 5 July 1966; trawl; FSBC I 7163. – 1 ♀, 70.5; 5 August 1966; trawl; FSBC I 7164. – 1 ♂, 72.4; 4 September 1966; dredge; FSBC I 7165. – 1 fragment; 12 November 1966; from stomach of *Scorpaena calcarata*; FSBC I 7166. – 1 ♂, 66.0; 6 December 1966; trawl; FSBC I 7167. – 1 ♂, 57.5; 12 January 1967; dredge; FSBC I 7168. – 1 damaged ♀, about 61.0; 30 January 1967; trawl; FSBC I 7169. – 1 ♀, 116.1; 15 February 1967; trawl; FSBC I 7170. – 1 ♂, 100.5; 15 February 1967; dredge; FSBC I 7171. – 1 ♀, 18.7; 8 March 1967; trawl; FSBC I 7172. – 1 ♂, 49.6; 1 ♀, 65.7; 7 April 1967; dredge; FSBC I 7173. – 1 ♂, 101.2; 6 June 1967; dredge; FSBC I 7174. – 1 ♀, 98.0; 4 September 1967; trawl; FSBC I 7175.

Diagnosis: Rostral plate lacking median carina; median carina of carapace without anterior bifurcation; dactylus of raptorial claw with six teeth; mandibular palp and five epipods present; lateral process of fifth thoracic somite an acute lobe, anterior margin convex; intermediate carinae of thoracic somites unarmed; fifth and sixth abdominal somites with 0-6 accessory spinules on posterior margin; telson with numerous longitudinal dorsal carinae, prelateral lobes absent, denticles (2-3) 4-6, 7-12 (13), 1; basal prolongation of uropods with mesial spines.

Discussion: Most characters of this species are constant, but several important variations are represented in the present material. One of the more significant is the number of teeth on the dactylus of the raptorial claw. Fifteen specimens have seven teeth on the dactylus of one claw. Of these, fourteen have six teeth, and one has only two teeth on the opposite claw. In all instances, the claw with seven teeth is smaller than the claw with six teeth, indicating that the former may be a regenerated appendage. On the specimen with seven teeth on one claw and two on the other (FSBC I 7158), the latter claw is very small and obviously regenerating. Another specimen (FSBC I 7145) has only five teeth on the dactylus of one claw and six on the other. As in the specimens above, the claw with the unusual number of teeth is smaller than the other. This same phenomenon is also shown by several specimens of *Squilla deceptrix* from Hourglass material. The only species of this genus in the western Atlantic which normally has seven teeth on the dactylus of the claw is *S. heptacantha* (Chace, 1939).

Squilla rugosa is the only species of this genus which has accessory spinules on the posterior margin of the fifth and sixth abdominal somites between the submedian and intermediate carinae (Manning, 1969:160). Although Manning (1969:157) cited the presence of 0-4 spinules for *S. rugosa*, Holthuis (1959:175) listed up to six on each side. The number of these spinules in the present material is 0-6. One specimen (FSBC I 7158) has, in addition to the usual complement of spinules, two extra spinules on each side between the intermediate and lateral carinae. This feature has not been previously reported.

Dorsal carinae of the telson also vary in this material. Manning (1969:158) stated that submedian carinae, which terminate posteriorly under the apex of the median carina, were entire on his specimens. They were entire on only 31 intact specimens from Hourglass material, but were interrupted on 32 specimens. Manning further stated that there were four carinae on each side between carinae of the submedian and intermediate teeth on his specimens. The number of carinae vary considerably in Hourglass specimens: 53 have the usual complement of four, 11 have five, and 24 have only three such carinae. In addition, 65 specimens lacked the usual carina between the carinae of the intermediate and lateral teeth.

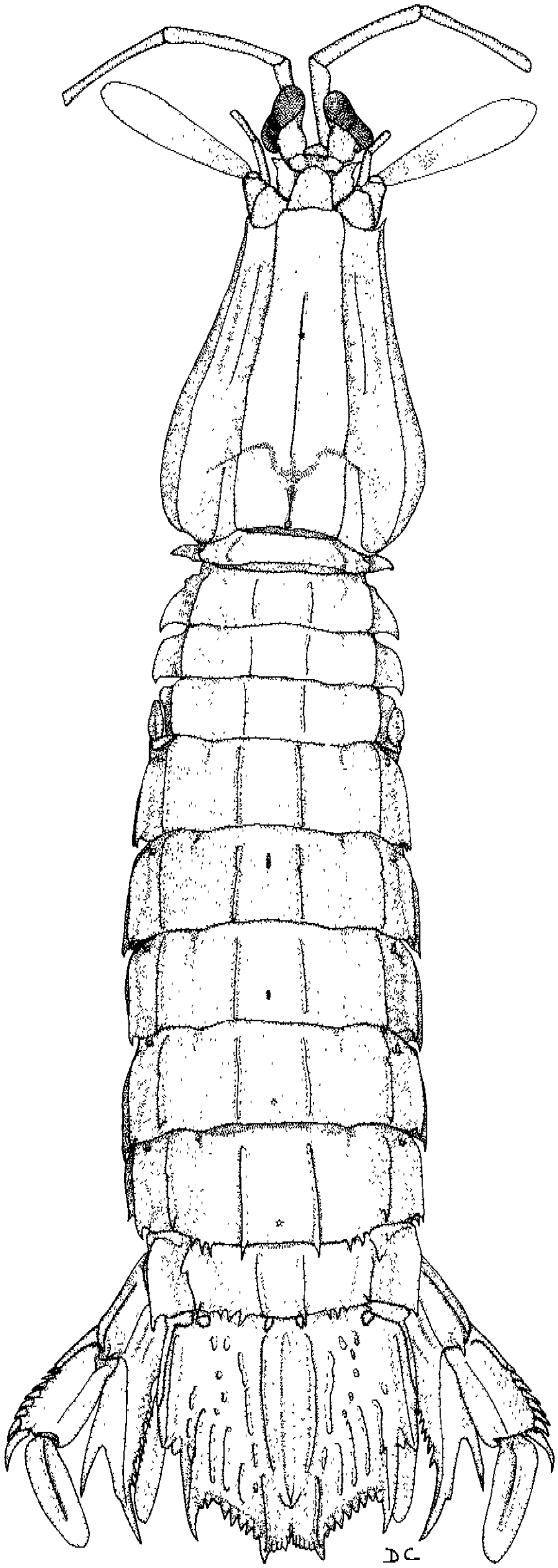


Figure 10. *Squilla rugosa* Bigelow, adult ♀: CL = 24.1 mm; TL = 106.8 mm; FSBC I 7141. Claws, walking legs, and setae omitted.

Most specimens in Hourglass material have the usual denticular formula of 4-6, 7-12, 1. Some specimens, however, have as few as two submedian denticles. One specimen has thirteen intermediate denticles. Holthuis (1959:175) stated that the submedian and intermediate denticles are usually sharp except for the outermost. Manning (1969:159) stated that they are all sharp. Most specimens in Hourglass material have at least the inner and outer denticles rounded, and some have a greater number rounded. One specimen (FSBC I 7151) has four of five submedian denticles on one side rounded, and six of ten intermediate denticles on one side rounded.

Most specimens also have the usual complement of seven or eight spines on the penultimate segment of the exopod of the uropod. Two specimens, however, have as few as six such spines, and thirteen specimens have as many as nine.

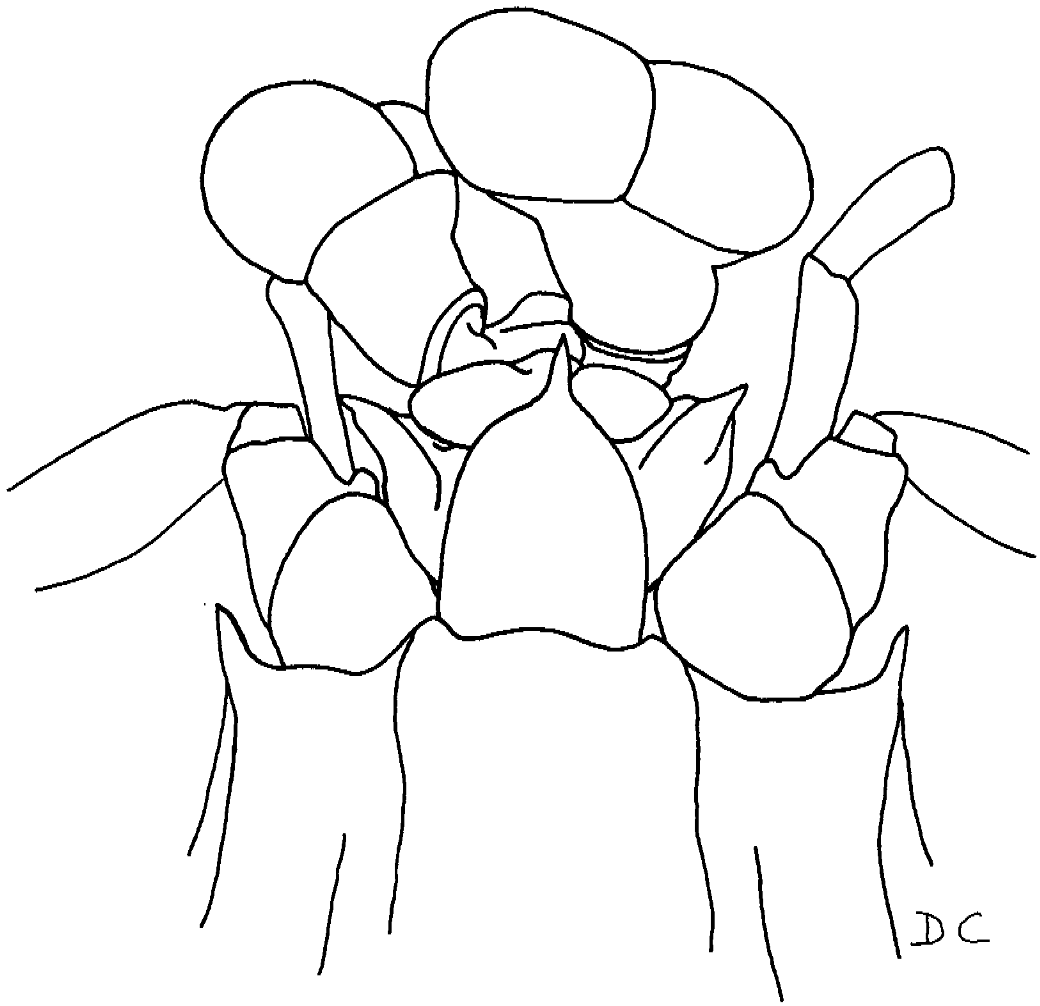


Figure 11. *Squilla rugosa* Bigelow, anterior portion of body illustrating rostral plate: FSBC I 7151. Setae omitted.

All *Squilla* species in the western Atlantic normally have unspined rostral plates. Three specimens from Hourglass Station J, two females (TL 62.6 and 63.8; FSBC I 7151 and 1165 respectively), and one male (TL 72.4; FSBC I 7151), are very unusual in that their rostral plates have long apical spines (Figure 11). Although each differs from most other specimens in other minute details, overall they agree well with descriptive characters of this species, and the spined rostral plate is the only unusual feature shared by all three.

A summary of corneal indices is presented in Table 7.

TABLE 7. RANGE AND MEAN OF CORNEAL INDICES (CI) OF 87 SPECIMENS OF *SQUILLA RUGOSA* BIGELOW.

Size Class (CL, mm)	n	CI Range	CI Mean
3.0- 3.9	1	---	271
6.0- 6.9	1	---	291
7.0- 7.9	1	---	281
8.0- 8.9	2	270-300	285
9.0- 9.9	3	303-321	312
10.0-10.9	5	297-321	312
11.0-11.9	8	311-333	319
12.0-12.9	6	316-339	331
13.0-13.9	6	321-341	331
14.0-14.9	6	322-244	334
15.0-15.9	9	324-373	344
16.0-16.9	7	331-370	349
17.0-17.9	4	359-369	364
18.0-18.9	2	367-380	374
19.0-19.9	5	354-382	371
20.0-20.9	1	---	392
21.0-21.9	3	350-400	380
22.0-22.9	3	391-402	398
23.0-23.9	9	375-418	399
24.0-24.9	4	360-421	385
26.0-26.9	1	---	424

Squilla deceptrix Manning, 1969

Figure 12

Squilla rugosa pinensis: Manning, 1959, p. 20 [part] [not *Chloridella rugosa* var. *pinensis* Lunz, 1937].

Squilla discors Manning, 1962 a, p. 217 [part]; Bullis & Thompson, 1965, p. 13 [part] [not *Squilla discors* Manning, 1962a].

Squilla deceptrix Manning, 1969, p. 165, text-figs. 44b, 46; Camp, 1971, p. 125 [listed].

Material Examined: HOURGLASS STATION C: 1 ♂ 47.6; 6 ♀, 50.4-57.4; 3 March 1966; trawl; FSBC I 7177. – 2 ♂, 37.1-43.8; 4 ♀, 23.6-44.2; 2 July 1966; trawl; FSBC I 7178. – 1 ♂, 42.7; 18 July 1966; trawl; FSBC I 7179. – 2 ♂, 19.4-34.0; 1 August 1966; trawl; FSBC I 7180. – 1 ♀, 39.4; 31 August 1966; trawl; FSBC I 7181. – 1 damaged ♀, about 35.1; 5 February 1967; trawl; FSBC I 7182. – 1 ♀, 43.5; 5 October 1967; trawl; FSBC I 7183. - 1 ♂, 38.8; 1 ♀, 44.8; 2

November 1967; trawl; FSBC I 7184. – HOURGLASS STATION D: 1 ♂, 33.5; 5 October 1965; trawl; FSBC I 7185. – 1 ♂, 36.1; 4 January 1966; trawl; FSBC I 1573. – 2 ♂, 32.9-36.0; 4 March 1966; trawl; FSBC I 7186. 1 ♂, 32.5; 7 April 1966; trawl; FSBC I 7187. – 1 ♀, 38.7; 19 July 1966; trawl; FSBC I 7188. – 1 ♂, 49.6; 25 August 1966; trawl; FSBC I 7189. – 5 ♂, 28.1-42.5; 1 ♀, 27.8; 1 September 1966; trawl; FSBC I 7190. – 2 ♂, 29.8-32.0; 9 September 1966; trawl; FSBC I 7191. – 1 damaged ♀, 59.0; 9 October 1966; trawl; FSBC I 7192. – 1 damaged ♂, 37.1; 6 February 1967; dredge; FSBC I 7193. 1 broken ♀, CL 9.8; 4 April 1967; from stomach of *Scorpaena brasiliensis*; FSBC I 7194. – 1 ♂, 52.9; 3 June 1967; trawl; FSBC I 7195. – 1 ♀, 49.6; 3 June 1967; from stomach of *Scorpaena brasiliensis*; FSBC I 7203. – 1 damaged ♂, 45.1; 2 ♀, 29.0-52.3; 2 July 1967; trawl; FSBC I 7196. – 1 ♂, 57.5; 1 September 1967; trawl; FSBC I 7197. – 2 ♀, 23.8-37.0; 3 November 1967; trawl; FSBC I 7198. – HOURGLASS STATION E: 2 ♂, 27.3-38.3; 4 March 1966; trawl; FSBC I 7199. 2 ♂, 53.0-63.5; 1 ♀, 56.6; 3 July 1966; trawl; FSBC I 7200. 1 ♀, 29.3; 3 July 1966; from stomach of *Lepophidium jeannae*; FSBC I 7201. – 1 damaged ♀, about 27.2; 1 broken ♀, CL 4.2; 2 August 1966; trawl; FSBC I 7202. - 1 broken ♂, CL 7.0; 2 August 1967; from stomach of *Centropristes ocyurus*; FSBC I 7204. – 1 ♂, 45.3; 1 September 1967; trawl; FSBC I 7205. – 1 ♀, 32.0; 6 October 1967; trawl; FSBC I 7206. – 1 ♂, 35.3; 6 October 1967; dredge; FSBC I 7207. – 1 damaged ♂, 31.6; 2 ♀, 47.1-48.2; 3 November 1967; trawl; FSBC I 7208. – HOURGLASS STATION K: 1 ♀, 30.8; 6 August 1965; trawl; FSBC I 6976. – 1 ♂, 40.9; 13 October 1965; trawl; FSBC I 7209. – 1 ♀, 43.5; 12 November 1965; trawl; FSBC I 1178. – 1 ♂, 33.1; 21 March 1966; trawl; FSBC I 7210. – 2 ♀, 38.1-57.6; 11 April 1966; trawl; FSBC I 2540. – 2 ♂, 51.0-51.0; 1 ♀, 47.7; 5 July 1966; trawl; FSBC I 7211. – 1 ♂, 42.8; 5 August 1966; trawl; FSBC I 7112. – 1 ♂, 40.2; 6 June 1967; trawl; FSBC I 7213. – 1 ♂, 49.5; 6 June 1967; dredge; FSBC I 7214. – 1 ♀, 42.1; 7 August 1967; trawl; FSBC I 7215. – HOURGLASS STATION L: 1 ♂, 27.1; 15 February 1966; trawl; FSBC I 2048. – 1 ♀, 25.0; 13 November 1966; dredge; FSBC I 7216. – HOURGLASS STATION M: 1 ♀, 24.4; 6 July 1966; dredge; FSBC I 3209. – 1 ♂, 36.9; 6 July 1966; trawl; FSBC I 7217. – 1 ♂, 33.5; 5 September 1966; trawl; FSBC I 7223. – 10 ♂, 43.9-61.5; 11 ♀, 38.1-68.3; 13 January 1967; trawl; FSBC I 7218. – 1 ♂, 51.6; 13 January 1967; dredge; FSBC I 7219. – 2 ♂, 38.2-52.9; 3 ♀, 42.4-55.9; 16 February 1967; trawl; FSBC I 7220. – 1 ♂, 58.7; 2 ♀, 32.5-56.0; 9 March 1967; trawl; FSBC I 7221. – 2 damaged ♂, 48.0-57.1; 1 ♀, 56.2; 12 October 1967; trawl; FSBC I 7222. – OTHER MATERIAL: 1 ♂, 43.2; 3 ♀, 24.1-40.3; off North Carolina; *Albatross* Sta. 2596; USNM 11260. – 1 ♂ abdomen; South of Cape San Blas, Florida; *Oregon* Sta. 36; USNM 91097. – 1 ♀, 52.1; West of Anclote Keys, Florida; *Oregon* Sta. 920; USNM 96400. - 1 broken ♂, 40.2; 3 ♀, 37.0-56.7; off Charlotte Harbor, Florida; *Albatross* Sta. 2411; USNM 9832. – 3 ♂, 31.9-50.0; 7 ♀, 29.0-53.0; 4 mi off Islamorada, Florida; 73 m; D. de Sylva, et al., 20 August 1961; USNM 119171.

Diagnosis: Rostral plate without median carina; median carina of carapace without anterior bifurcation; dactylus of raptorial claw with six teeth; mandibular palp and five epipods present; lateral process of fifth thoracic somite an anteriorly-curved spine; intermediate carinae of thoracic somites unarmed; telson with numerous dorsal tubercles; denticles (4) 5-7, (7) 8-11, 1; basal prolongation of uropod lacking mesial spines.

Discussion: Manning (1969:170) remarked that there may have been more than one species represented in material he assigned to *S. deceptrix*. His opinion was influenced by more morphological variation occurring throughout his material than is usually encountered in a species of *Squilla*, and he reviewed the major variable characters. Many of the same characters show considerable variation in present material.

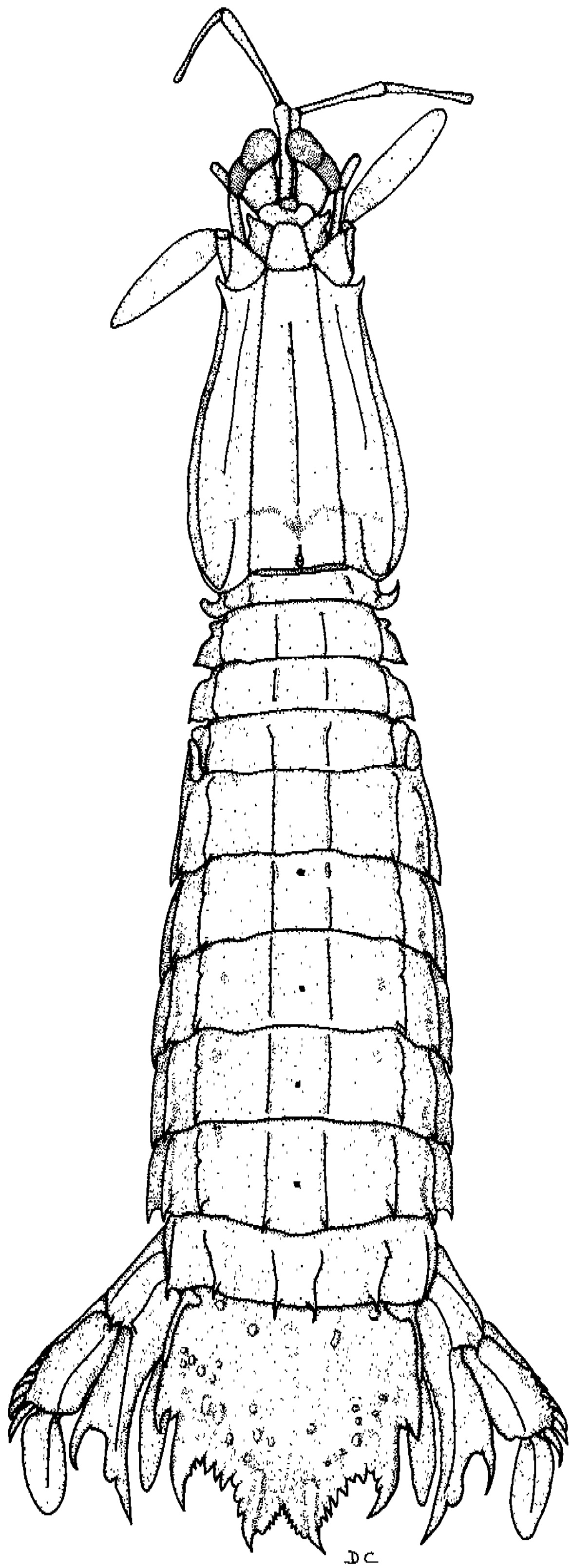


Figure 12. *Squilla deceptrix* Manning, adult ♀: CL = 13.0 mm; TL = 56.4 mm; FSBC I 7218. Claws, walking legs, and setae omitted.

Five Hourglass specimens and the female from *Oregon* Station 920 have seven teeth on the dactylus of one claw. All Hourglass specimens with this feature have six teeth on the opposing claw, and the female from *Oregon* Station 920 has that claw missing. Three other Hourglass specimens also have an unusual number of teeth on one claw: one has eight, another has five, and the third has none. The opposing claw of each has six. In these specimens, the claw with the unusual number of teeth is usually smaller, indicating that it may be regenerated. This same phenomenon has been observed on several specimens of *S. rugosa* from Hourglass material. A regenerated claw does not always have an unusual number of teeth, however; one male *S. deceptrix* (FSBC I 7184) has six teeth on both claws although the right claw is very small and obviously regenerating.

The lateral spine of the fifth thoracic somite may be directed almost laterally rather than anterolaterally. In present material, all specimens greater than TL 42.7 mm have spines curved anterolaterally. Ten of fifty specimens between TL 23.6-42.7 mm have spines directed almost laterally, and the majority of these are smaller specimens, less than TL 27.8 mm. Frequency of laterally-directed spines among small specimens, and absence of the feature in large specimens suggests variation with age.

The anterior lobe of the lateral process of the sixth thoracic somite is rounded on most specimens, seldom irregular, in all size classes. In my opinion, this is a normal variation within the population.

Manning (1969:170) found that most specimens have acute apices on the posterior lobe of the lateral processes of the sixth thoracic somite, whereas those from North Carolina have rounded apices. In Hourglass material, these apices are rounded, subacute, or acute. No specimen greater than CL 7.5 mm has rounded apices on both sides of the body, although five specimens of this size have that condition on one side. The majority of these large specimens have acute apices. Smaller specimens, less than CL 7.5 mm, have a higher frequency of subacute apices, and there are more specimens with rounded apices in this size class than with acute apices. The higher frequency of rounded apices in smaller size classes suggests that this feature also varies with age.

Apices of the lateral process of the seventh thoracic somite are also rounded, subacute, or acute. Again, the rounded condition is more prevalent among smaller specimens. This feature is not always correlated with the shape of the lateral process of the sixth thoracic somite, however. One small male (FSBC I 7208) has unusual processes on the seventh somite. Lateral margins are evenly convex rather than straight or sinuous, and apices are well-rounded. One large female (FSBC I 7222) has similar lateral margins (evenly convex), but apices are acute.

Number of tubercles on the dorsum of the telson varies with size in present material. On specimens with CL 5.0-7.9 mm, CL 8.0-10.9 mm, and CL 11.0-14.5 mm, mean tubercle numbers are 10, 20, and 35, indicating that tubercle number increases as specimens grow larger. This is not true in all instances, however; one large male, TL 61.6 mm (FSBC I 7218) has only five tubercles arranged along the posterior margin of the telson.

The postanal keel on the ventral surface of the telson is variable. It is absent on a small female from Station D (FSBC I 7198) and on another small female from North Carolina (USNM 11260). Manning (1969:170) reported a similar absence on the female from *Oregon* Station 920. However, I observed a low swelling in place of the carina in that specimen. In remaining material, the keel is represented variously as a single small tubercle, a row of tubercles, a short carina with one or two tubercles posterior to it, or as a single long carina. Most specimens smaller than CL 7.0 mm have only a single tubercle.

Manning (1969:170) reported that only one male in his material showed any sexual dimorphism of the telson. In Hourglass material, 33 of 57 intact males show sexual dimorphism by having the intermediate carinae of the telson more swollen than on comparably-sized females. The smallest male exhibiting this condition is about TL 32.5 mm.

All observations on morphological variation reported by Manning (1969) for this species are represented in Hourglass material. Most of these variations are not present among individuals of all size classes, however, but seem restricted to certain classes, suggesting variation with age. In my opinion, all this material now assigned to *S. deceptrix* should be considered conspecific.

Two aberrant specimens were found in Hourglass material. Basal carinae of the lateral spines of the fifth thoracic somite are produced into erect, dorsal processes on two large specimens from Station M (FSBC I 7218 and 7222). A similar condition was noted on one *Meiosquilla quadridens* (Bigelow) from Hourglass material.

A summary of corneal indices is presented in Table 8.

TABLE 8. RANGE AND MEAN OF CORNEAL INDICES (CI) OF 108 SPECIMENS OF *SQUILLA DECEPTRIX* MANNING.

Size Class (CL, mm)	n	CI Range	CI Mean
5.0- 5.9	5	311-353	331
6.0- 6.9	7	319-371	340
7.0- 7.9	16	315-364	337
8.0- 8.9	15	320-382	349
9.0- 9.9	15	336-386	358
10.0-10.9	12	342-371	356
11.0-11.9	13	338-387	371
12.0-12.9	13	355-403	381
13.0-13.9	9	380-394	386
14.0-14.9	2	364-410	387
15.0-15.9	1	---	393

Remarks: Manning's Figure 44c (1969:159) is *Squilla discors*, not *S. deceptrix* (Manning, personal communication).

Squilla neglecta Gibbes, 1850

Figure 13

Squilla neglecta Gibbes, 1850, p. 200; Chace, 1954, p. 449; Springer & Bullis, 1956, p. 23; Manning, 1959, p. 20; Manning, 1969, p. 181, text-figs. 50b, 51; Lyons et al., 1971, p. 27; Godcharles, 1971, pp. 26, 32 [listed].

Chloridella neglecta: Lunz, 1937, p. 10, fig. 3.

Squilla prasinolineata: Manning, 1959, p. 20 [not *Squilla prasinolineata* Dana, 1852].

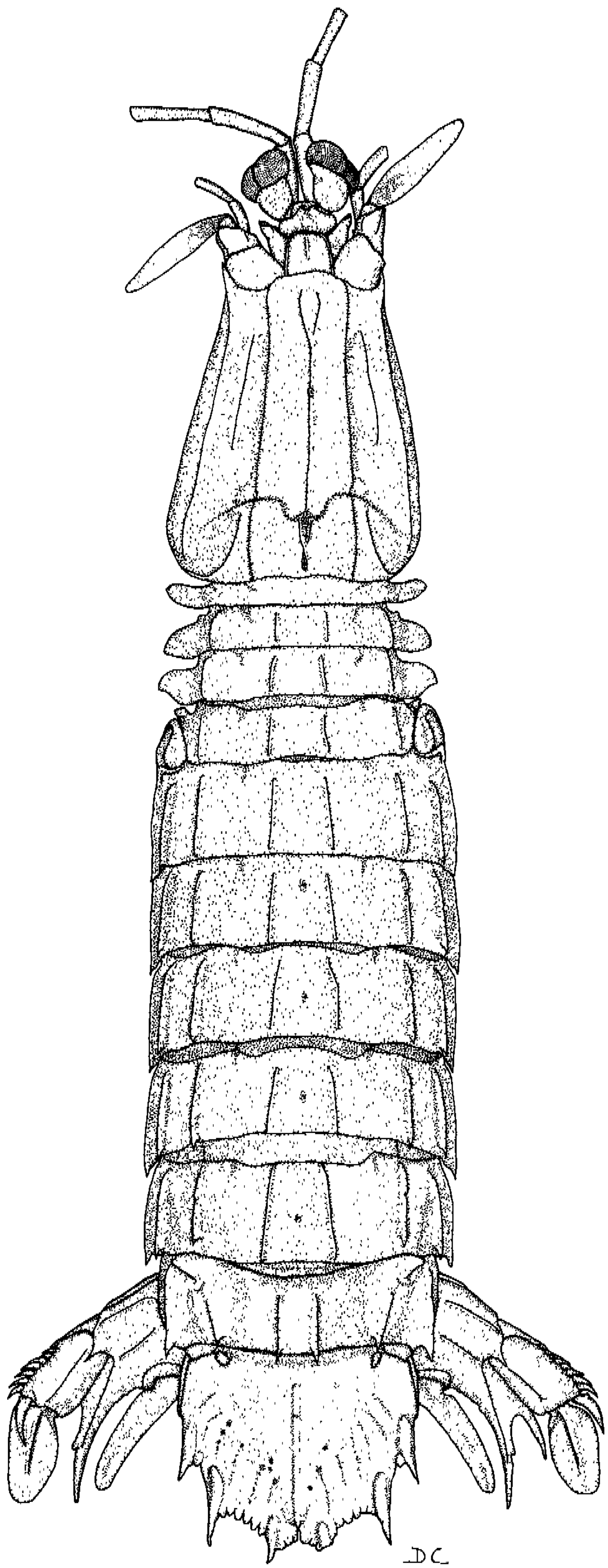


Figure 13. *Squilla neglecta* Gibbes, adult ♂: CL = 18.8 mm; TL = 85.1 mm; FSBC I 1984. Claws, walking legs, and setae omitted.

Material Examined: HOURGLASS STATION A: 1 ♂, 91.6; 6 November 1966; dredge; FSBC I 4857. - HOURGLASS STATION J: 4 ♂, 50.4-100.0; 1 ♀, fragment; 1 ♀, 92.9; 14 February 1966; trawl; FSBC I 1984. – 1 damaged ♀, about 59; 12 January 1967; dredge; FSBC I 7224.

Diagnosis: Rostral plate with median carina; median carina of carapace with anterior bifurcation; dactylus of raptorial claw with five teeth; mandibular palp absent; five epipods present; lateral spine of fifth thoracic somite spatulate, rounded laterally; denticles 2-4, 5-7 (8), 1.

Discussion: All but two specimens in Hourglass material differ slightly from Manning's (1969) account by lacking the dorsal tubercles which replace intermediate carinae on the fifth thoracic somite in this species.

All Hourglass specimens differ from Manning's material in having the ventral median keel on the eighth thoracic somite subtriangular with a subacute apex rather than ovoid with a flattened apex.

Manning (1966:364-365) noted five characters which differed between specimens from Brazil and the upper Gulf of Mexico. Specimens from Hourglass material agree in all respects with those characters which distinguish Gulf forms from Brazilian forms. Manning (1969:184), however, did not consider these differences to be subspecifically significant.

A summary of Corneal Indices is presented in Table 9.

TABLE 9. CORNEAL INDICES (CI) OF 6 SPECIMENS OF *SQUILLA NEGLECTA* GIBBES.

Size (mm)			
CL	TL	Sex	CI
9.6	fragment	♀	369
11.2	50.4	♂	387
18.8	85.0	♂	418
20.9	92.9	♀	445
21.9	91.6	♂	498
23.6	100.0	♂	492

Squilla empusa Say, 1818

Figure 14

Squilla empusa Say, 1818, p. 250; Bigelow, 1893, p. 102; Chace, 1954, p. 449; Menzel, 1956, p. 46; Springer & Bullis, 1956, p. 22; Manning, 1959, p. 19; Tabb & Manning, 1961, p. 594; Tabb, Dubrow, & Manning, 1962, pp. 61, 62; Manning, 1969, p. 201, text-figs. 57a, 58, 59; Rouse, 1969, p. 135; Lyons et al., 1971, p. 27; Godcharles, 1971, pp. 26, 32.

Material Examined: HOURGLASS STATION A: 2 ♂, 32.0-73.3; 1 ♀, 79.2; 1 August 1966; dredge; FSBC I 6969. – 1 ♂ fragment; 6 January 1967; dredge; FSBC I 7225. – 1 ♂, 69.8; 1 ♀, 134.4; 25 January 1967; trawl; FSBC I 6970. – HOURGLASS STATION I: 1 ♂, 71.0; 12 October 1965; trawl; FSBC I 1232. – 1 ♀, 41.2; 9 March 1966; trawl; FSBC I 7226. – HOURGLASS STATION J: 7 ♂, 63.3-103.1; 3 ♀, 101.8-127.5; 14 February 1966; trawl; FSBC I 1983. -- 1 ♂, 94.4; 1 damaged ♀, 114.2; 14 February 1966; dredge; FSBC I 1998. – 1 ♂, 88.7; 9 March 1966; dredge; FSBC I

7227. – 1 ♂, 109.5; 1 damaged ♀, 127.4; 21 March 1966; trawl; FSBC I 7228. – 1 ♀ 123.0; 1 fragment; 12 June 1966; dredge; FSBC I 7229. – 1 ♂, 74.6; 12 January 1967; trawl; FSBC I 7230.

Diagnosis: Rostral plate broader than long, with median carina; median carina of carapace bifid most of distance between dorsal pit and anterior margin of carapace; dactylus of raptorial claw with six teeth, inferior margin sinuous; mandibular palp and five epipods present; lateral spine of fifth thoracic somite sharp, anteriorly curved; lateral processes of sixth and seventh thoracic somites with acute apices; denticles 3-5, 6-9, 1.

Discussion: Hourglass specimens agree well with Manning's (1969) account. One male (FSBC I 6969) differs from his material, having only five teeth on the dactylus of the right claw, whereas the left claw has the usual six. Six other specimens differ in having up to nine spines on the penultimate segment of the uropodal exopod.

Manning (1969:212) discussed differences between North American and South American populations of *S. empusa*, noting that some features are more common in one population than in the other. He cited, as an example, specimens in one lot from Tortugas, Florida, having the anterior margin of the ophthalmic somite flattened, emarginate, or provided with a small spinule. The last feature is found most often on southern forms. In Hourglass material, the anterior margin of the ophthalmic somite is rounded on 11 specimens, emarginate on 10, and flattened on three. None have an anterior spinule.

A summary of Corneal Indices is presented in Table 10.

TABLE 10. CORNEAL INDICES (CI) OF 15 SPECIMENS OF *SQUILLA EMPUSA* SAY.

Size (mm)			
CL	TL	Sex	CI
6.9	32.0	♂	314
9.1	41.2	♀	325
13.8	63.3	♂	354
14.3	69.8	♂	386
15.0	65.8	♂	385
16.9	79.2	♀	393
18.4	83.4	♂	409
19.3	91.7	♂	402
20.4	96.7	♂	425
21.1	99.2	♂	431
22.7	109.5	♂	436
24.0	114.2	♀	428
25.5	127.5	♀	440
26.6	127.4	♀	459
27.4	134.4	♀	481

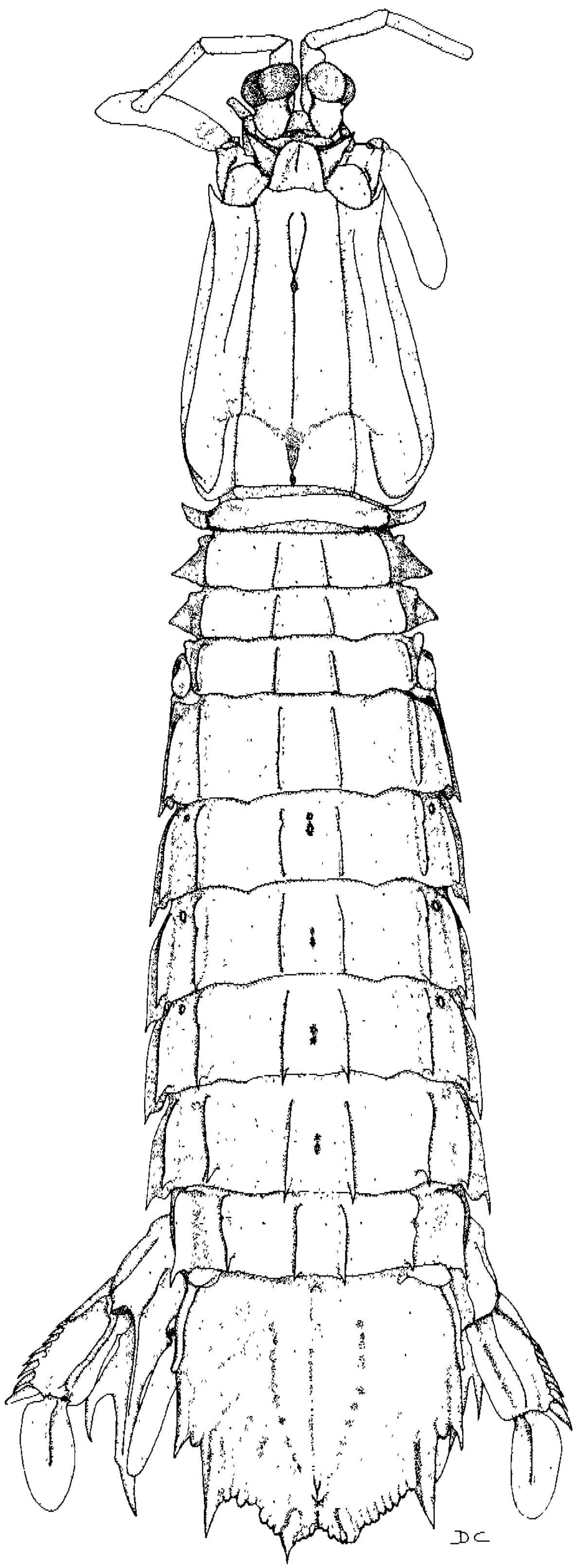


Figure 14. *Squilla empusa* Say, adult ♂: CL = 19.1 mm; TL = 91.1 mm; FSBC I 1983. Claws, walking legs, and setae omitted.

Squilla species

(Postlarva)

Figure 15

Material Examined: HOURGLASS STATION D: 1 ♂ postlarva, 15.8; 11 July 1966; trawl; FSBC I 7859. – HOURGLASS STATION E: 1 ♂ postlarva, 15.9; 2 August 1966; dredge; FSBC I 7860. – HOURGLASS STATION M: 1 ♂ postlarva, 15.2; 5 September 1966; dredge; FSBC I 7861.

Description: Eyes large; cornea bilobed, set almost transversely on stalk, barely wider than stalk. Eyes extend to end of, or just beyond, first segment of antennular peduncle. Ocular scales obliquely truncate. Anterior margin of opthalmic somite evenly rounded.

Antennular peduncle longer than carapace. Antennular processes produced into acute, anterolaterally-directed spines.

Rostral plate subtriangular, wider than long, lateral margins sloping to subacute apex. Median dorsal carina absent.

Anterolateral angles of carapace not spined, almost forming a right angle. Posterolateral margins evenly rounded. Median carina bifurcate posterior to cervical groove, not bifurcate anteriorly. Lateral carinae faintly indicated, not extending to anterior margin. Posterior reflected marginal carinae present.

Raptorial claw elongate. Dactylus with six teeth, inferior margin evenly convex, with faint proximal notch. Fully pectinate propodus with three movable proximal spines, second shortest. Dorsal ridge of carpus undivided.

Mandibular palp inconspicuous, if present. Five epipods present.

Submedian and intermediate carinae of last three exposed thoracic somites unarmed. Lateral process of fifth thoracic somite a short, oblique, compressed lobe, appearing rounded in anterior view; ventral spines short. Lateral processes of sixth thoracic somite faintly bilobed, sloping posteriorly to rounded apex. Lateral processes of seventh somite evenly sloping posteriorly to rounded apex. Median ventral keel of eighth somite short, rounded or subacute, inclined posteriorly.

Abdomen broad, depressed. Anterolateral angles articulated. Submedian, intermediate, lateral and marginal carinae present. Abdominal spine formula: submedian, 6; intermediate, 6; lateral, 6; marginal, 5. Ventral spine on sixth abdominal somite anterior to articulation of uropod minute. Telson almost as long as wide. Dorsal surface with numerous faint, subparallel, longitudinal, gently-curved striations. Median carina faintly notched anteriorly; sharp posterior spine short, not extending to posterior margin. Prelateral lobes absent. Submedian teeth with movable apices. Denticles 6-12 (usually 8-9), 9-11, 1. No postanal carinae on ventral surface.

Basal prolongation of uropod with two spines, mesial longer. Mesial margin of mesial spine finely serrate, not spined. Single, rounded lobe between spines of prolongation broad, extending almost to distal end of mesial spine. Endopod of uropod elongate. Lateral margin of penultimate segment of exopod with 6-8 sharp, graded, movable spines, last extending to midlength of distal segment. Distal segment of exopod ovate, extending posteriorly beyond apices of submedian teeth of telson.

No chromatophores.

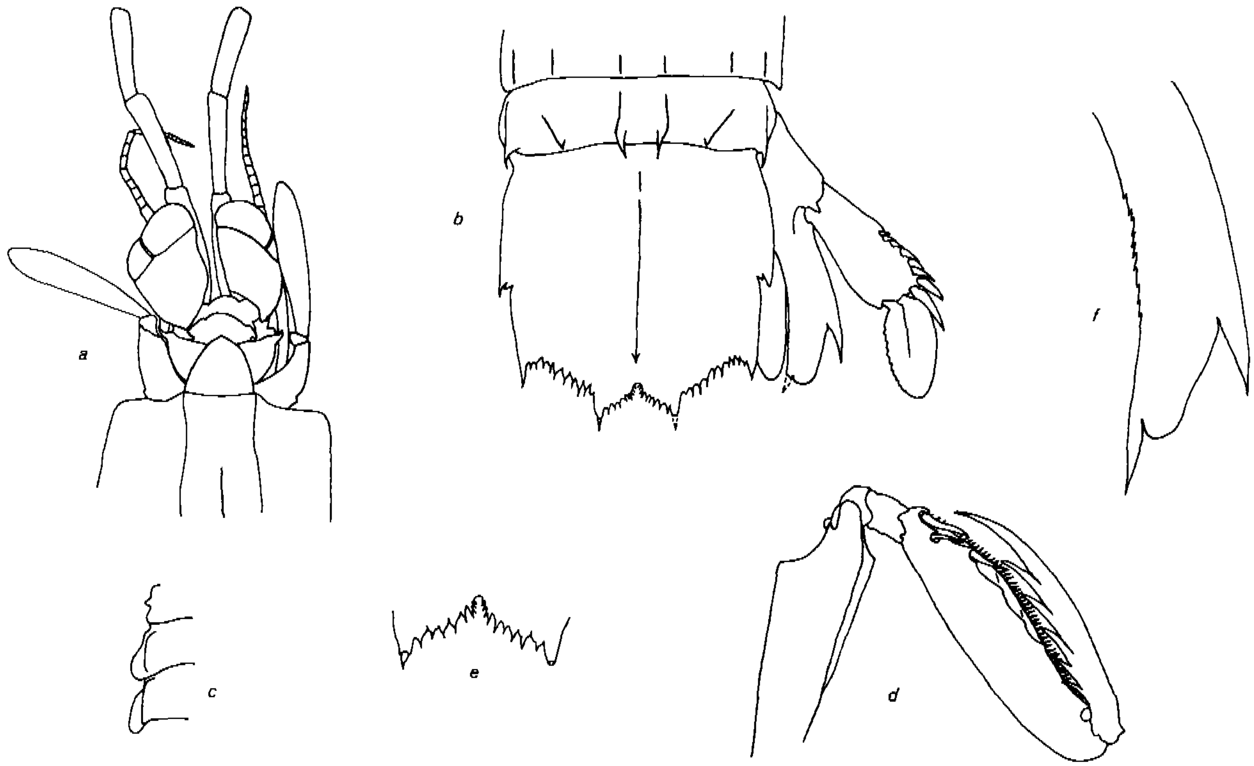


Figure 15. *Squilla* species, postlarva: CL = 3.5 mm; TL = 15.8 mm; FSBC I 7859. *a*, anterior portion of body; *b*, sixth abdominal somite, telson, and uropod; *c*, lateral processes of exposed thoracic somites 5-7; *d*, raptorial claw; *e*, submedian teeth and denticles of telson; *f*, ventral side of basal prolongation of left uropod. Setae omitted.

Discussion: These postlarvae share features with *Squilla rugosa* and *S. deceptrix*. Like *S. rugosa*, the anterior margin of the ophthalmic somite is rounded, prelateral lobes are absent, and low, faintly-indicated striations on the dorsal surface of the telson may be precursors of longitudinal carinae. However, lateral margins of the rostral plate are more sloped as in adults of *S. deceptrix*, not subparallel as in adults of *S. rugosa*. In addition, lateral processes of the sixth and seventh thoracic somites are similar to the smallest *S. deceptrix* examined, and the mesial margin of the inner spine of the basal prolongation of the uropod is serrate, not spined. Based on Hourglass distribution of adults of both species, however, I would tentatively assign the specimens to *S. deceptrix*, since no *S. rugosa* adults were taken at Stations D, E, or M, where *S. deceptrix* occurred frequently.

Measurements and indices are presented in Table 11.

TABLE 11. MEASUREMENTS (mm) AND INDICES OF UNIDENTIFIED *SQUILLA* POSTLARVAE.

Collection Number (FSBC I)	7859	7860	7861
Number of specimens	1	1	1
Total length	15.8	15.9	15.2
Carapace length	3.5	3.6	3.2
Cornea width	1.1	1.3	1.2
Antennular peduncle length	4.0	3.9	4.0
Antennal scale length	1.7	1.9	1.6
Antennal scale width	0.6	0.5	0.5
Abdomen width	about 2.8	3.3	damaged
Telson length	3.1	3.1	2.8
Telson width	3.0	3.3	3.2
Corneal Index	318	276	266

Family Gonodactylidae Giesbrecht, 1910

Eurysquilla plumata (Bigelow, 1901)

Figure 16

Lysiosquilla plumata Bigelow, 1901, p. 156, text-figs. 6-9.

Pseudosquilla plumata: Manning, 1959, p. 18.

Eurysquilla plumata: Manning, 1969, p. 251, text-fig. 70; Camp, 1971, p. 125.

Material Examined: HOURGLASS STATION C: 4 fragments; 18 June 1966; from stomach of *Ancylopsetta quadrocellata*; FSBC I 7232. –1 juv. ♂, 9.9; 21 June 1967; from stomach of *Syacium papillosum*; FSBC I 7231. – HOURGLASS STATION D: 1 ♀, 22.3; 15 March 1967; dredge; FSBC I 7233.

Diagnosis: Cornea subglobular, placed obliquely on stalk; dactylus of raptorial claw with eight to ten teeth; first four abdominal somites not carinate; fifth abdominal somite with unarmed intermediate carinae; telson with median carina, and on either side of that, a tuberculate carina and one uninterrupted, unarmed carina; intermediate denticles of telson rounded; lateral denticles with dorsal tubercle and ventral spinule; basal prolongation of uropod with low lobe on mesial margin of mesial spine, otherwise unarmed.

Discussion: Manning (1969:253-254) remarked that several characters may be difficult to distinguish on some *E. plumata*, including segmentation of endopods of walking legs, presence of longitudinal carinae on the fifth abdominal somite, number of epipods, and presence of ventral papillae on antennal protopods. No Hourglass adult was intact; four were represented by fragments and the other lacked claws. On this last specimen, endopods of walking legs appear unisegmental, longitudinal carinae are distinct on the fifth abdominal somite, five epipods are present, and ventral papillae are present on antennal protopods. Fragments taken from stomach contents of an ocellated flounder, *Ancylopsetta quadrocellata* Gill, were sufficient to nearly reconstruct three specimens,

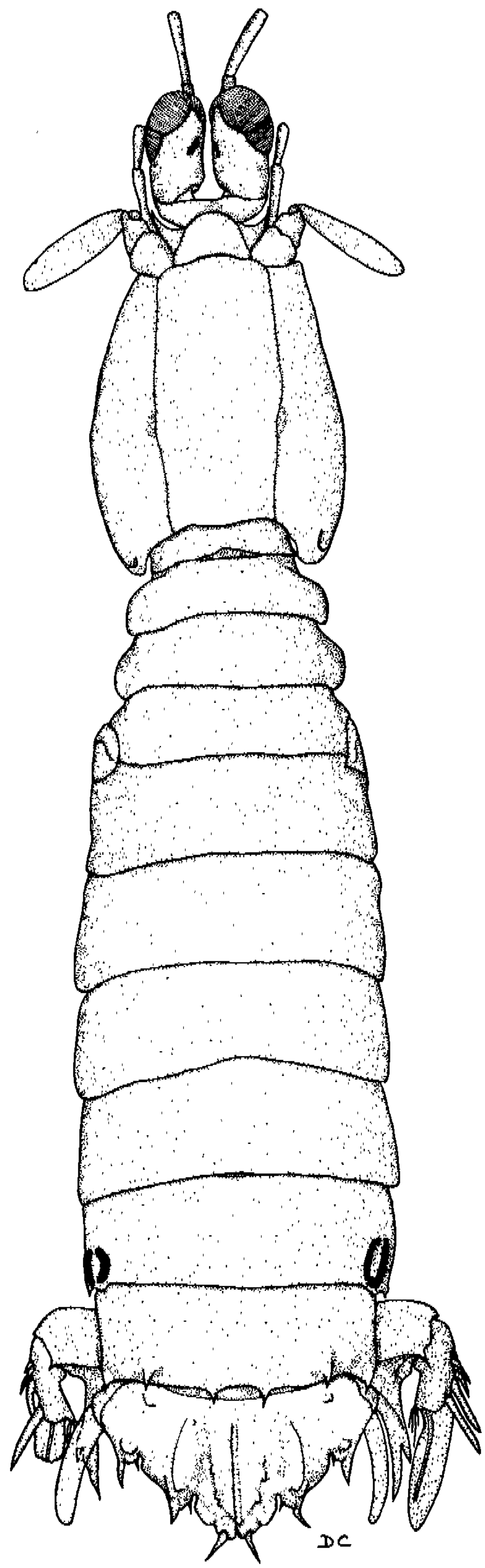


Figure 16. *Eurysquilla plumata* (Bigelow), adult ♀: CL = 4.6 mm; TL = 22.3 mm; FSBC I 7233. Claws, walking legs, and setae omitted.

and anterior appendages of a fourth specimen were present. These specimens also have five epipods and ventral papillae on their antennal protopods. One differs from Manning's (1969:251-253) description of *E. plumata*, having ten teeth on dactyli of its raptorial claws rather than 8-9. Another has ten teeth on one claw and nine on the other.

Juveniles of this species have not been described. The juvenile from stomach contents of a *Syacium papillosum* taken at Station C is in excellent condition and differs from adults in the following characters (Figure 17). Eyes of the juvenile extend almost to the end of the last segment of the antennular peduncle rather than to the end of the second segment. Ocular scales are fused into a broad plate as in adults, but the sides are truncate and do not project as far anterolaterally. The rostral plate is broader than long, with the lateral margins convex and gently sloping to a rounded apex. The plate is not as triangular as in adults. The first five abdominal somites lack swellings or anterolateral depressions on the dorsum. The fifth abdominal somite lacks posterolateral spines. The sixth abdominal somite has six posteriorly-directed spines as in adults, but submedian and intermediate carinae are absent. The telson is not proportionally as broad as on adults. The dorsum of telson lacks convergent, tuberculate carinae on either side of the median carina. The space between the submedian teeth is wide, rather than narrow. Posterior armature on each side of the midline of the telson consists of eight submedian denticles, one rounded submedian tooth with a movable apex, two intermediate denticles, each with a spinule, and one lateral denticle with a spinule. Upturned lobes on inner margins of intermediate and lateral teeth are absent. Measurements and indices of this specimen are presented in Table 12.

TABLE 12. MEASUREMENTS (mm) AND INDICES FOR JUVENILE *EURYSQUILLA PLUMATA* (BIGELOW) (FSBC I 7231).

Total length	10.1
Carapace length	1.9
Cornea width	0.7
Antennular peduncle length	1.8
Antennal scale width	0.3
Antennal scale length	0.9
Abdomen width	2.3
Telson length	1.4
Telson width	2.0
Distance between submedian teeth of telson	0.5
Corneal Index	300
Antennular peduncle, as % CL	86
Antennal scale width, as % scale length	33
Distance between submedian teeth of telson, as % telson width	25

Parasquilla coccinea Manning, 1962

Figure 18

Parasquilla coccinea Manning, 1962, p. 181, fig. 1; Bullis & Thompson, 1965, p. 13; Manning, 1969, p. 279, text-fig. 77; Camp, 1971, p. 125.

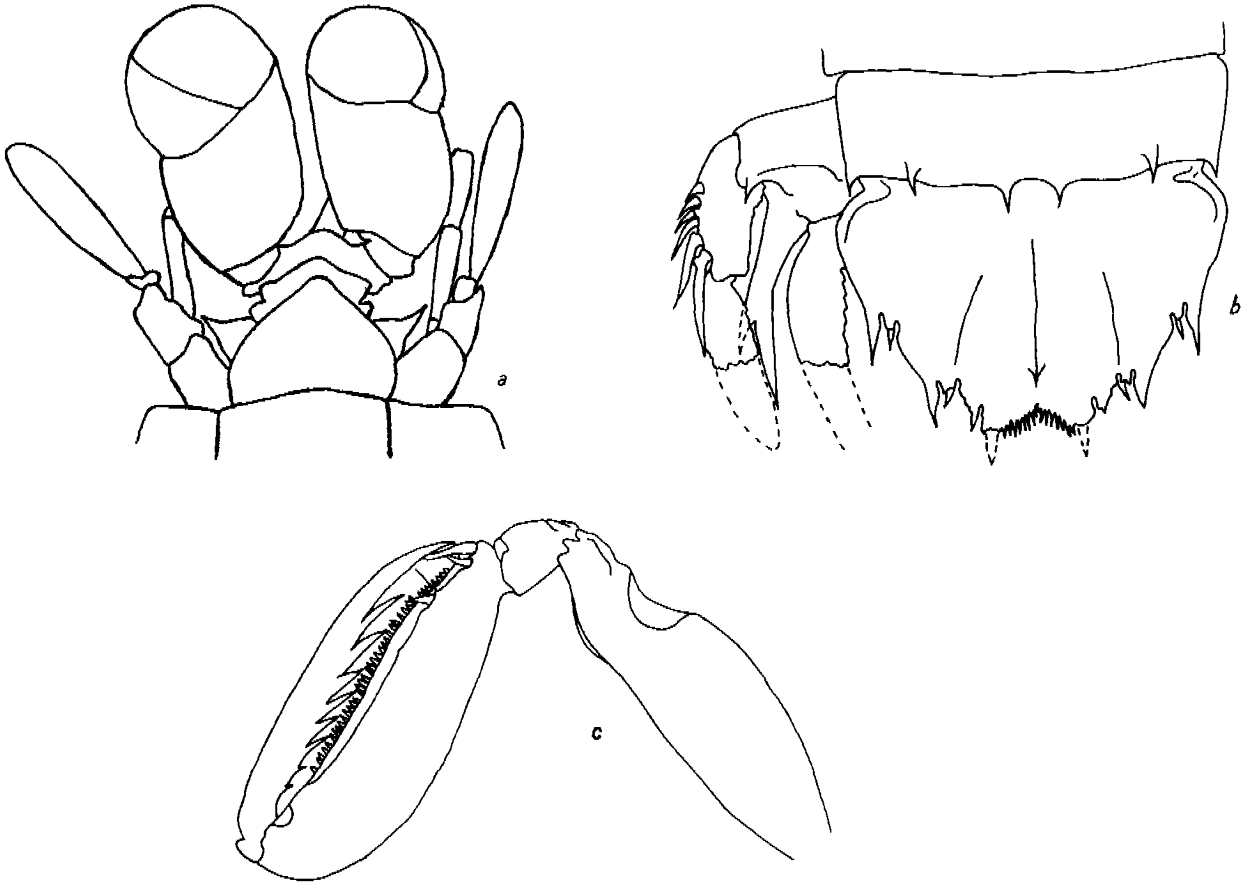


Figure 17. *Eurysquilla plumata* (Bigelow), juvenile ♂: CL = 1.9 mm; TL = 10.1 mm; FSBC I 7231. *a*, anterior portion of body; *b*, sixth abdominal somite, telson, and uropod; *c*, right raptorial claw. Setae omitted.

Material Examined: HOURGLASS STATION D: 1 ♀, 39.0; 6 October 1967; dredge; FSBC I 7235. – HOURGLASS STATION E: 1 ♀, 97.8; 4 December 1965; trawl; FSBC I 1377. - 4 ♂, 70.7-116.9; 4 March 1966; trawl; FSBC I 2216. – 1 broken ♀ juv., CL 5.6; 19 July 1966; from stomach of *Centropristes ocyurus*; FSBC I 7236. – 1 ♂ postlarva, about 20.5; 12 May 1967; from stomach of *Scorpaena agassizi*; FSBC I 7237. – 1 ♂, 99.2; 3 June 1967; trawl; FSBC I 7238. – HOURGLASS STATION I: 1 ♀, 87.9; 4 September 1967; dredge; FSBC I 7239. – HOURGLASS STATION M: 1 postlarva, 20.0; 6 August 1966; trawl; FSBC I 7240. – 1 damaged ♂, 95.1; 13 November 1966; trawl; FSBC I 7241. – 1 ♀, 33.8; 7 December 1966; from stomach of *Scorpaena agassizi*; FSBC I 7242. – 1 ♂, 88.2; 16 February 1967; trawl; FSBC I 7243. - 1 ♂, 100.1; 8 April 1967; trawl; FSBC I 7244. – 2 ♂, 86.1-116.2; 8 April 1967; dredge; FSBC I 7245. – 1 ♂, 58.5; 8 August 1967; trawl; FSBC I 7246. – 1 fragment, CL about 22; 12 October 1967; trawl; FSBC I 7622. – NO DATA: 1 ♂, 46.0; FSBC I 7234.

Diagnosis: Anterolateral angles of rostral plate rarely rounded, usually armed with one or two spines; posterolateral angles of sixth and seventh thoracic somites acute; intermediate carinae of sixth abdominal somite not spined; oblique dorsal carinae or swellings of telson barely visible.

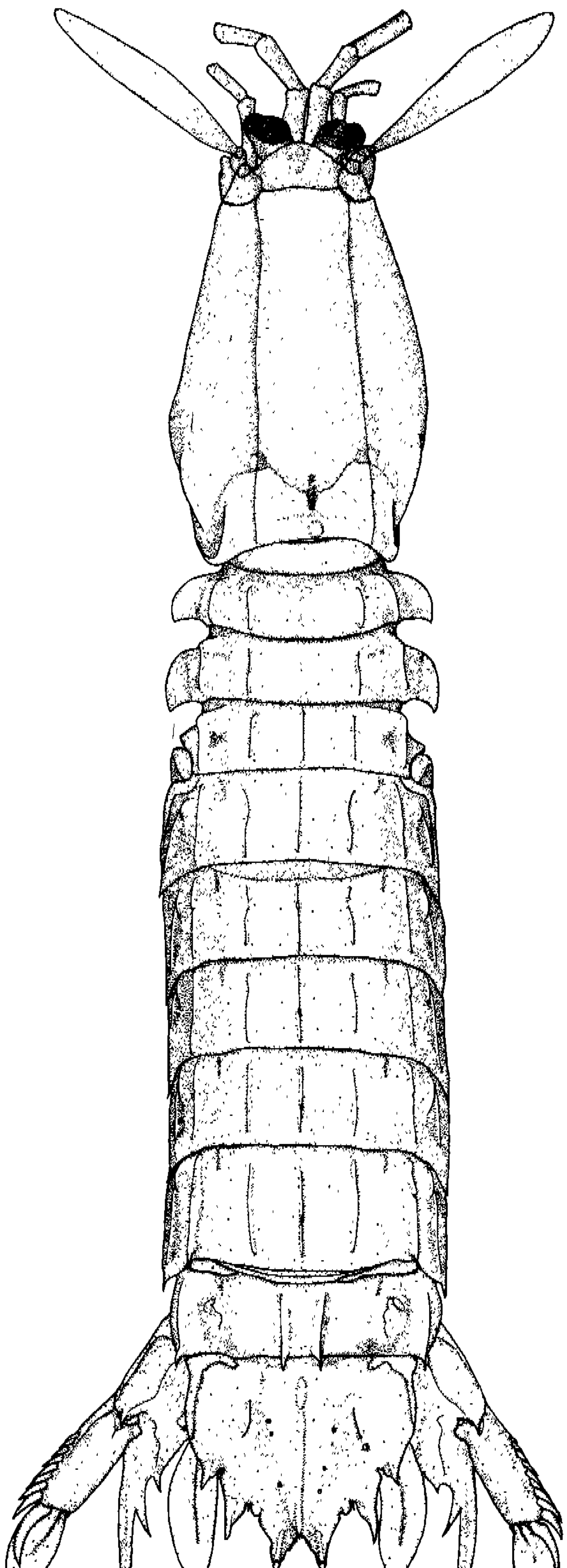


Figure 18. *Parasquilla coccinea* Manning, adult ♂: CL = 25.9 mm; TL = 116.7 mm; FSBC I 2216. Claws, walking legs, and setae omitted.

Postlarva: (Figure 19) Total length, 20.0-20.5 mm.

Eyes large; cornea trilobed, bisected into dorsal and ventral halves, with ventral half again bisected. Eyes extend just beyond distal end of first segment of antennular peduncle or almost to end of second segment.

Rostral plate arcuate, almost twice as broad as long, with shallow median groove on anterior half. Plate extending only to posterior end of eyestalks or almost to cornea.

Ventral papillae of antennal peduncle obscure.

Carapace lacking carinae or tubercles.

Raptorial dactyli with three well-formed teeth; inferior margin evenly convex or barely sinuate, with faint proximal notch. Superior margin of propodus of claw fully pectinate. Dorsal ridge of carpus of claw with two unspined lobes.

Five epipods present, first and second largest, last smallest; mandibular palp short.

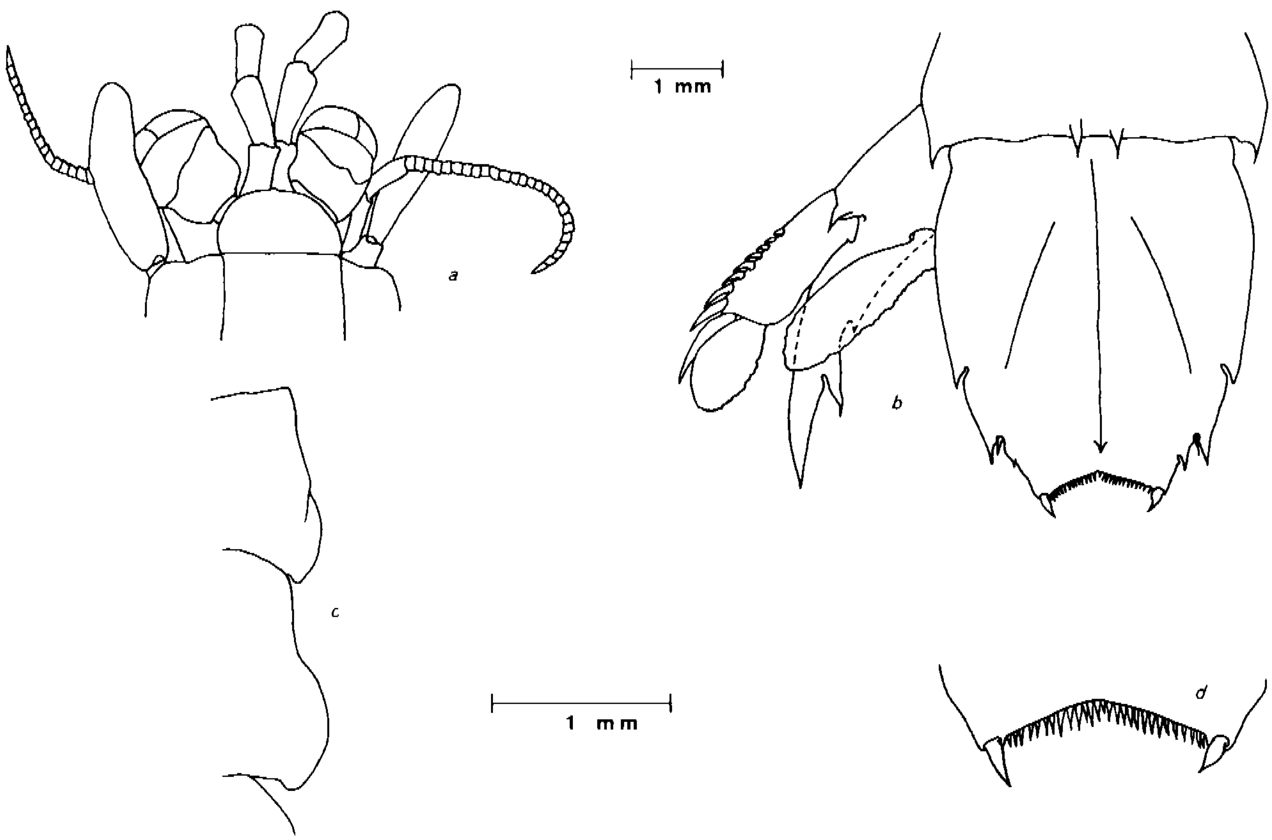


Figure 19. *Parasquilla coccinea* Manning, postlarva: CL = about 4.3 mm; FSBC I 7237. *a*, anterior portion of body; *b*, telson and uropod; *c*, lateral processes of exposed thoracic somites 6 and 7; *d*, submedian teeth and denticles of telson. Setae omitted.

Dorsal surface of exposed thoracic somites lacking carinae. Lateral processes of fifth somite inconspicuous. Lateral processes of sixth and seventh somites with anterior and lateral margins evenly rounded, posterolateral angles truncate, not produced into posteriorly-directed lobes. Ventral median keel of eighth somite a short, sharp process.

First five abdominal somites lacking sharp carinae, but with low, oblique lateral swellings on pleura. Posterolateral angles of first two somites truncate, those of somites 3-5 acute. Sixth abdominal somite with prominent, spined submedian and lateral carinae, without intermediate carinae or tubercles. Ventral spine anterior to articulation of uropod sharp.

Telson as long as or longer than wide. Dorsal median carina lacking anterior notch, armed with short posterior spine. Row of convergent pits on each side of median carina present or indistinguishable. Dorsal surface lacking lateral carinae, anterior tubercles, and short carinae of submedian teeth; low, oblique, inconspicuous swellings present on each side of median carina. Posterior margin with six teeth. Submedian teeth with movable apices; bases of apices widely separated, 33-34% telson width. Fourteen or fifteen submedian denticles on each side of midline.

Basal prolongation of uropod with three mesial spines, distal spine longest, extending to apices of submedian teeth of telson; proximal spine shortest, lacking spinules or serrations on mesial margin. Distal segment of exopod of uropod subcircular, short, about half length of penultimate segment. Lateral margin of penultimate segment of exopod with nine graded, movable spines, last extending to posterior margin of distal segment.

Measurements and indices for these specimens are presented in Table 13.

TABLE 13. MEASUREMENTS (mm) AND INDICES FOR POSTLARVAE AND ONE JUVENILE OF *PARASQUILLA COCCINEA* MANNING.

Collection Number (FSBC I)	7237	7240	7236
Stage	Postlarva	Postlarva	Juvenile
Carapace length	about 4.3	4.4	5.4
Total length	20.5	20.0	about 26.5
Rostral plate length	0.9	0.8	0.9
Rostral plate width	1.4	1.3	1.5
Cornea width	1.0	damaged	1.4
Telson length	3.7	3.3	3.4
Telson width	3.5	3.3	4.1
Distance between submedian teeth of telson	1.2	1.1	1.0
Corneal Index	about 222	---	400
Sex	♀	♀	♀

Juvenile: (Figure 20) Total length about 26.5 mm (specimen broken at seventh thoracic somite).

Eyes large; cornea bilobed; lateral margin of eye longer than mesial margin. Eyes extend to distal end of first segment of antennular peduncle.

Rostral plate with lateral margins rounded, anterolateral angles slightly convex, anterior margins sloping to obtuse apex. Median, anterior groove deeper than that of postlarvae.

Carapace lacking tubercles on lateral plates anterior to cervical groove, posterior median tubercle present. Short lateral carinae on posterior fourth of lateral plates and reflected marginal carinae present as low swellings.

Raptorial dactyli with inferior margin sinuate and prominent proximal notch present. Dorsal ridge of carpus of claw with two sharp, occasionally spined, lobes.

Five epipods present; mandibular palp longer than that of postlarvae.

Dorsal surface of last three exposed thoracic somites with short submedian and intermediate carinae. Eighth somite lacking median carina. Lateral process of fifth thoracic somite inconspicuous, produced ventrally. Lateral processes of sixth and seventh thoracic somites with anterior margin convex, sloping to a rounded lateral margin, with posterior margin concave, producing a subacute, posteriorly-directed lobe. Ventral median keel of eighth somite a short, rounded process.

Dorsal surface of first five abdominal somites with nine short carinae. Intermediate carinae of fifth somite and marginal carinae of somites 3-5 spined. Sixth somite with prominent, spined submedian and lateral carinae; short, unspined, oblique intermediate carinae present. Ventral spine anterior to articulation of uropod sharp.

Figure 20. *Parasquilla coccinea* Manning, juvenile ♀: CL = 5.4 mm; FSBC I 7236. *a*, anterior portion of body; *b*, telson and uropod; *c*, submedian teeth and denticles of telson. Setae omitted.

Telson wider than long. Dorsal median carina lacking anterior notch. Row of pits on each side of median carina. Low, oblique, obscure swellings on each side of median carina. Submedian and lateral carinae present, less prominent than in adults. Posterior margin with six teeth. Submedian teeth with movable apices; bases of apices less widely separated than in postlarvae, more widely separated than in adults, 24 % telson width. Denticles: submedian, 13, intermediate, 2, lateral, 1.

Basal prolongation of uropod with three mesial spines, distal spine longest, extending posteriorly beyond apices of submedian teeth of telson; proximal spine shortest, with mesial margin finely serrate. Distal segment of exopod of uropod ovate, short. Lateral margin of penultimate segment of exopod with nine graded, movable spines, last extending to posterior margin of distal segment of exopod.

Measurements and indices for this specimen are presented in Table 13.

Discussion: Little is known of the ontogeny of *Parasquilla*. Schmitt (1926) identified and figured a postlarva from Africa as *Pseudosquilla ferussaci* (Roux), now called *Parasquilla ferussaci*, but his specimen has since been tentatively referred to *Pseudosquillopsis cerisii* (Roux, 1828) by Manning (1969a). Giesbrecht (1910) figured the larvae of *P. ferussaci* from the Mediterranean Sea. Ontogeny of both western Atlantic species (*P. meridionalis* Manning and *P. coccinea*) was previously unknown.

Postlarval characters are generally constant between present two specimens. Unfortunately, damaged eyes and carapaces prevented comparison of these characters between specimens. Differences between specimens include amount of the eyestalks covered by the rostral plate, amount of the antennular peduncle covered by the eyes, convexity of the inferior margin of the raptorial dactyli, length-width ratios of the telson, and obscureness of the oblique swellings and convergent rows of pits on the dorsum of the telson. These differences are minute, however.

The juvenile differs from postlarvae in the following characters. Eyes are bilobed rather than trilobed, anterior margin of the rostral plate is less rounded, and lateral and reflected marginal carinae and the posterior tubercle of the carapace are present. Dorsal surface of the exposed thoracic somites are carinate, posterolateral angles of the lateral processes of the sixth and seventh thoracic somites are produced into subacute lobes, and the ventral median keel of the eighth thoracic somite is rounded rather than sharp. Dorsal surface of the first five abdominal somites are carinate, the telson is wider than long, lateral and submedian carinae of the telson are present. There are fewer submedian denticles on the telson, distance between the submedian teeth of the telson is less, only about 24% telson width rather than 33-34 %, and the mesial margin of the proximal spine of the basal prolongation of the uropod is serrate rather than entire.

The juvenile differs from the smallest Hourglass adults (total lengths 33.8 mm and 39 mm) in the following characters. Eyes extend to the distal end of the first segment of the antennular peduncle, lateral margins of the rostral plate are convex rather than concave, and lateral and reflected marginal carinae of the carapace are not sharp. Posterolateral angles of lateral processes of sixth and seventh thoracic somites are not as sharp nor produced as far posteriorly as in adults; eighth thoracic somite lacks a median dorsal carina. The dorsal median carina of the telson lacks an anterior notch. There are more submedian denticles on the telson. Furthermore, distance between the submedian teeth of the telson is greater, about 24% telson width rather than 18% (mean distance for all adults in the present material). The mesial margin of the proximal spine of the basal prolongation of the uropod is serrate rather than tuberculate. As more postlarvae and juveniles become available for study, these differences will be refined.

The two small adults (FSBC I 7242 and 7235) differ from larger adults by having lateral margins of the rostral plate short between the posterior margin and the anterolateral angles, and by having rounded anterolateral angles. Only one large adult has such rounded angles, but lateral margins of the plate in that specimen are longer than those of the small adults.

Adults in Hourglass material agree well with Manning's (1962) description. Shape of the anterolateral angles of the rostral plate is variable, however. Manning (1962:184) remarked that the rostral plate is usually provided with two spines at each anterolateral corner, with some specimens having one spine and others having only a rounded lobe. Two adults in Hourglass material have two spines on each side of the rostral plate; three others have two spines on one side and one on the other, and seven have one spine on each side. Number of spined abdominal carinae is constant within adult specimens in Hourglass material. However, none have lateral carinae of the fifth somite spined, whereas Manning (1969:280) found them to be occasionally spined on his material. Two adults have fewer than the usual number of 7-11 submedian denticles on the telson. One has six denticles on each side of the midline and the other has five on one side and nine on the other.

Gonodactylus bredini Manning, 1969

Figure 21

Gonodactylus oerstedi: Menzel, 1956, p. 46 [not *Gonodactylus oerstedii* Hansen, 1895].

Gonodactylus oerstedii: Springer & Bullis, 1956, p. 22; Manning, 1959, p. 16 [part]; Bullis & Thompson, 1965, p. 13 [part] [not *Gonodactylus oerstedii* Hansen, 1895].

Gonodactylus bredini Manning, 1969, p. 315, text-figs. 87-88; Camp, 1971, p. 125 [listed]; Lyons, et al., 1971, p. 27.

Material Examined: HOURGLASS STATION A: 1 ♂, 14.0; 2 ♀, 11.5-33.2; 1 August 1966; trawl; FSBC I 6965. 1 ♂, 36.1; 1 August 1966; dredge; FSBC I 6964. – 1 juv. ♀, 9.3; 31 August 1966; dredge; FSBC I 6966. – HOURGLASS STATION B: 1 ♀, 15.9; 3 August 1965; dredge; FSBC I 2144. – 1 ♂, 15.1; 1 juv. ♀, 8.1; 30 August 1965; dredge; FSBC I 7304. - 1 ♀, 33.0; 4 October 1965; trawl; FSBC I 7305. - 1 ♀, 23.1; 20 October 1965; trawl; FSBC I 7306. – 2 ♀, 19.6-32.5; 20 October 1965; dredge; FSBC I 7307. – 1 ♂, 26.4; 8 November 1965; trawl; FSBC I 7308. – 1 ♂, 13.1; 1 ♀, 18.0; 8 November 1965; dredge; FSBC I 7309. – 1 ♂, 23.4; 19 November 1965; trawl; FSBC I 7310. – 3 ♂, 12.3-22.5; 4 ♀, 13.2-41.8; 19 November 1965; dredge; FSBC I 1209. 3 ♂, 22.2-23.5; 3 December 1965; trawl; FSBC I 1342. - 3 ♀, 18.3-38.3; 3 December 1965; dredge; FSBC I 1348. - 1 ♀, 24.4; 19 January 1966; trawl; FSBC I 1686. - 2 ♀, 23.7-25.7; 19 January 1966; dredge; FSBC I 1691. – 2 ♂, 25.5-31.6; 7 February 1966; trawl; FSBC I 1888. – 2 ♀, 16.5-19.0; 7 February 1966; dredge; FSBC I 1916. – 1 ♂, 24.4; 1 ♀, 25.2; 20 February 1966; trawl; FSBC I 2089. – 2 ♂, 14.7-21.0; 3 ♀, 19.6-32.6; 20 February 1966; dredge; FSBC I 2098. – 2 ♂, 13.0-14.4; 2 ♀, 17.4-19.9; 3 March 1966; trawl; FSBC I 7311. - 1 ♂, 22.5; 1 ♀, 23.5; 3 March 1966; dredge; FSBC I 7312. - 5 ♂, 16.2-36.8; 3 ♀, 14.2-25.5; 26 March 1966; dredge; FSBC I 7313. - 1 ♂, 29.3; 4 ♀, 16.4-31.9; 15 April 1966; dredge; FSBC I 7314. – 2 ♂, 22.7; 2 May 1966; dredge; FSBC I 7315. – 2 ♂, 25.6-37.6; 2 ♀, 28.0-28.3; 18 May 1966; dredge; FSBC I 7316. – 1 ♂, 23.0; 1 ♀, 29.1; 6 June 1966; trawl; FSBC I 7317. - 2 ♀, 26.6-37.4; 6 June 1966; dredge; FSBC I 7318. – 3 ♂, 9.0-25.1; 3 ♀, 8.0-21.8; 17 June 1966; trawl; FSBC I 7319. - 1 ♀, 12.9; 18 July 1966; trawl; FSBC I 7320. - 2 ♂, 18.2-21.4; 7 ♀, 13.9-43.8; 1 August 1966; dredge; FSBC I 7322. – 1 ♀, 37.4;

10 August 1966; dredge; FSBC I 7323. – 1 ♂, 13.8; 31 August 1966; trawl; FSBC I 7321. – 1 ♂, 20.7; 5 ♀, 9.7-34.4; 31 August 1966; dredge; FSBC I 7324. – 1 ♀, 28.2; 8 September 1966; trawl; FSBC I 7325. – 7 ♂, 10.2-38.8; 3 ♀, 13.4-25.8; 8 September 1966; dredge; FSBC I 7326. – 3 ♂, 10.4-15.4; 1 ♀, 33.6; 8 October 1966; dredge; FSBC I 7327. – 1 ♀, 15.0; 18 October 1966; trawl; FSBC I 7328. – 6 ♂, 14.2-20.2; 2 ♀, 31.7-37.2; 18 October 1966; dredge; FSBC I 7329. – 1 ♀, 28.8; 19 November 1966; trawl; FSBC I 7330. – 1 ♂, 29.1; 3 ♀, 16.4-30.1; 19 November 1966; dredge; FSBC I 7331. – 2 ♂, 24.5-27.3; 1 ♀, 18.9; 1 December 1966; trawl; FSBC I 7332. – 1 ♀, 15.4; 1 December 1966; dredge; FSBC I 7333. – 1 ♂, 19.4; 2 ♀, 19.9-43.9; 13 December 1966; trawl; FSBC I 7334. – 2 ♂, 25.2-30.7; 2 ♀, 24.2-24.5; 18 December 1966; dredge; FSBC I 7335. – 1 ♂, 31.8; 6 January 1967; trawl; FSBC I 7336. – 1 ♂, 26.6; 1 ♀, 13.3; 6 January 1967; dredge; FSBC I 7337. – 1 ♂, 32.7; 20 January 1967; trawl; FSBC I 7338. – 1 ♂, 15.6; 1 ♀, 17.2; 20 January 1967; dredge; FSBC I 7339. - 1 ♂, 32.6; 1 ♀, 40.0; 25 January 1967; trawl; FSBC I 7340. - 2 ♂ 20.4-24.0; 1 ♀, 39.0; 5 February 1967; trawl; FSBC I 7341. – 1 ♂, 23.8, 5 February 1967; dredge; FSBC I 7342. – 1 ♂, 19.3; 1 ♀, 27.7; 27 February 1967; dredge; FSBC I 7343. – 2 ♂, 24.3-32.8; 3 ♀, 15.1-23.0; 2 March 1967; dredge; FSBC I 7344. – 3 ♂, 20.8-25.8; 2 ♀, 20.5-30.0; 14 March 1967; dredge; FSBC I 7345. 3 ♀, 14.3-30.4; 3 April 1967; trawl; FSBC I 7346. – 3 ♂, 20.2-25.3; 9 ♀, 14.3-24.4; 3 April 1967; dredge; FSBC I 7347. – 2 ♀, 18.2-20.5; 11 April 1967; trawl; FSBC I 7348. 2 ♂, 19.5-22.5; 3 ♀, 17.7-28.2; 11 April 1967; dredge; FSBC I 7349. - 1 ♂, 8.3; 11 May 1967; trawl; FSBC I 7350. – 3 ♂, 16.9-33.7; 3 ♀, 8.4-33.7; 11 May 1967; dredge; FSBC I 7351. – 7 ♀, 7.8-25.2; 20 May 1967; dredge; FSBC I 7352. – 2 ♀, 8.8-34.8; 2 June 1967; trawl; FSBC I 7353. - 2 ♂, 10.5-29.0; 4 ♀, 8.5-23.2; 2 June 1967; dredge; FSBC I 7354. – 1 ♂, 8.7; 2 ♀, 9.3-32.6; 20 June 1967; trawl; FSBC I 7355. – 2 ♂, 23.4-31.7; 1 ♀, 26.7; 20 June 1967; dredge; FSBC I 7356. – 5 ♂, 9.5-13.8; 6 ♀, 7.6-42.4; 1 July 1967; dredge; FSBC I 7357. – 5 ♂, 8.5-17.0; 8 ♀, 8.8-29.9; 11 July 1967; dredge; FSBC I 7358. - 9 ♂, 9.4-27.2; 8 ♀, 11.4-37.0; 1 August 1967; dredge; FSBC I 7360. – 13 ♂, 10.9-14.6; 5 ♀, 9.8-16.0; 11 August 1967; dredge; FSBC I 7361. – 16 ♂, 9.4-24.5; 13 ♀, 11.9-22.4; 31 August 1967; dredge; FSBC I 7359. – 3 ♂, 13.0-18.2; 2 ♀, 20.2-35.7; 11 September 1967; trawl; FSBC I 7362. – 8 ♂, 12.6-33.7; 1 broken ♂, CL 2.2; 8 ♀, 12.8-45.3; 11 September 1967; dredge; FSBC I 7363. 1 ♂, 19.7; 2 ♀, 9.6-16.8; 5 October 1967; trawl; FSBC I 7364. – 9 ♂, 12.2-32.6; 8 ♀, 13.5-27.1; 5 October 1967; dredge; FSBC I 7365. – 1 ♂, 16.9; 25 October 1967; trawl; FSBC I 7366. 2 ♂, 20.8-31.4; 3 ♀, 19.1-39.4; 25 October 1967; dredge; FSBC I 7367. – 28 ♂, 12.5-27.0; 33 ♀, 10.9-25.5; 2 November 1967; dredge; FSBC I 7368. – 1 ♂, 16.5; 2 ♀, 14.0-17.6; 20 November 1967; trawl; FSBC I 7369. – 2 ♂, 19.4-23.8; 5 ♀, 15.0-21.7; 20 November 1967; dredge; FSBC I 7370. – HOURGLASS STATION C: 2 ♂, 15.1-19.5; 1 ♀, 28.2; 31 August 1965; dredge; FSBC I 7371. - 1 ♂, 31.0; 8 November 1965; trawl; FSBC I 7372. - 1 ♂, 29.4; 3 December 1965; trawl; FSBC I 1359. – 1 ♂, 36.9; 2 ♀, 31.8-45.4; 3 December 1965; dredge; FSBC I 1363. – 1 ♂, 11.6; 1 ♀, 19.3; 3 January 1966; trawl FSBC I 1550. – 3 ♂, 20.3-26.9; 4 ♀, 27.7-32.2; 3 January 1966; dredge; FSBC I 1559. 2 ♂, 10.8-15.0; 1 ♀, 38.6; 7 February 1966; dredge; FSBC I 1926. - 1 ♂, 20.0; 4 ♀, 21.5-25.6; 20 February 1966; dredge; FSBC I 2108. – 1 ♂, 11.5; 4 ♀, 14.8-29.3; 27 March 1966; dredge; FSBC I 7373. - 1 ♂, 26.9; 6 April 1966; trawl; FSBC I 7374. 1 ♂, 13.3; 1 ♀, 18.0; 6 April 1966; dredge; FSBC I 7375. – 2 ♂, 15.9 and broken; 3 ♀, 23.5-27.1; 16 April 1966; dredge; FSBC I 7376. 2 ♂, 26.3 and broken; 2 May 1966; trawl; FSBC I 7377. – 1 ♀, 27.4; 2 May 1966; dredge; FSBC I 7466. – 2 ♀, 16.5-25.2; 19 May 1966; trawl; FSBC I 7378. – 2 ♂, 18.1-35.3; 3 ♀, 17.8-30.5; 19 May 1966; FSBC I 7379. – 1 ♂, 20.0; 2 July 1966; trawl; FSBC I 7380. – 2 ♂, 25.7-29.9; 2 ♀, 19.2 and broken; 2 July 1966; dredge; FSBC I 7381. – 1 ♀, 29.4; 11 July 1966; trawl; FSBC I 7382. – 3 ♂, 17.5-32.9; 1 ♀, 8.7; 11 July 1966; dredge; FSBC I 7383. 1 damaged ♂, about 10.0; 1 August 1966; trawl; FSBC I 7384. – 3 ♂, 20.2-28.8; 1 ♀, 29.9; 1 August 1966; dredge; FSBC I 7385. - 3 ♂, 18.7-22.0; 1 ♀, 25.3; 11 August 1966; dredge; FSBC I 7386. – 1 ♂, 21.7; 31 August 1966; trawl; FSBC I 7387. – 1 ♂, 22.9; 8 September 1966; dredge; FSBC I 7388. –

3 ♂, 13.0-33.8; 5 ♀, 9.7-41.0; 8 October 1966; dredge; FSBC I 7389. – 1 ♂, 11.9; 6 November 1966; dredge; FSBC I 7390. – 1 ♂, 29.9; 2 ♀, 17.6-26.9; 19 November 1966; trawl; FSBC I 7391. – 4 ♂, 11.0-37.2; 6 ♀, 12.0-33.3; 19 November 1966; dredge; FSBC I 7392. – 3 ♀, 11.9-15.4; 1 December 1966; dredge; FSBC I 7393. – 1 ♂, 12.5; 1 ♀, 17.7; 13 December 1966; trawl; FSBC I 7394. – 2 ♂, 15.7-33.7; 3 ♀, 13.0-31.6; 13 December 1966; dredge; FSBC I 7395. – 2 ♂, 13.4-34.9; 2 ♀, 18.0-38.3; 6 January 1967; dredge; FSBC I 7396. – 4 ♂, 13.4-33.9; 3 ♀, 25.5-41.3; 20 January 1967; dredge; FSBC I 7397. – 1 ♀, 35.5; 25 January 1967; trawl; FSBC I 7398. – 1 ♀, 35.1; 5 February 1967; trawl; FSBC I 7399. – 5 ♂, 30.5-36.8; 1 ♀, 27.1; 5 February 1967; dredge; FSBC I 7400. – 2 ♂, 15.5-21.0; 2 ♀, 14.5-30.8; 27 February 1967; trawl; FSBC I 7401. – 3 ♂, 10.8-28.9; 3 ♀, 19.9-33.1; 2 March 1967; dredge; FSBC I 7402. – 1 ♀, 13.7; 12 April 1967; trawl; FSBC I 7404. – 1 ♀, 38.6; 20 May 1967; dredge; FSBC I 7405. – 2 ♂, 20.0-33.2; 1 broken ♀; 2 June 1967; dredge; FSBC I 7406. – 1 ♂, 21.9; 21 June 1967; dredge; FSBC I 7407. – 1 ♂, 24.8; 1 ♀, 38.5; 1 July 1967; trawl; FSBC I 7408. – 2 ♂, 32.9-40.4; 1 ♀, 12.2; 11 July 1967; dredge; FSBC I 7409. – 1 ♀, 35.2; 1 August 1967; trawl; FSBC I 7410. – 1 ♀, 7.3; 1 August 1967; dredge; FSBC I 7411. – 1 ♂, 29.7; 1 ♀, 35.3; 11 August 1967; trawl; FSBC I 7412. – 2 ♂, 35.5-37.0; 11 August 1967; dredge; FSBC I 7413. – 1 ♀, 42.9; 11 September 1967; trawl; FSBC I 7414. – 4 ♂, 27.0-46.5; 5 ♀, 24.6-32.8; 11 September 1967; dredge; FSBC I 7415. – 1 ♂, 10.7; 5 October 1967; trawl; FSBC I 7416. – 1 ♀, 30.0; 5 October 1967; dredge; FSBC I 7417. – 1 ♀, 12.2; 2 November 1967; trawl; FSBC I 7418. – 4 ♂, 8.5-41.9; 1 ♀, 28.9; 1 fragment; 21 November 1967; dredge; FSBC I 7419. – HOURGLASS STATION D: 1 ♀, 26.5; 16 April 1966; trawl; FSBC I 7420. – HOURGLASS STATION E: 1 ♀, 13.0; 7 June 1966; dredge; FSBC I 7421. – HOURGLASS STATION I: 1 ♂, 12.6; 14 February 1966; dredge; FSBC I 2028. – HOURGLASS STATION J: 1 ♂, 33.8; 1 ♀, 40.1; 14 February 1966; dredge; FSBC I 1658. – 1 ♂, 25.8; 9 March 1966; trawl; FSBC I 7422. – 1 ♂, 23.3; 1 ♀, 30.6; 9 March 1966; dredge; FSBC I 7423. – 1 ♀, 30.1; 11 April 1966; dredge; FSBC I 7424. – 2 ♂, 24.5-34.9; 2 ♀, 37.0 and fragment; 11 May 1966; trawl; FSBC I 7425. – 2 ♂, 24.8-30.5; 12 June 1966; dredge; FSBC I 7426. – 2 ♀, 24.3-31.8; 21 July 1966; trawl; FSBC I 7427. – 2 ♂, 9.9-10.5; 3 ♀, 8.1-27.8; 12 October 1966; dredge; FSBC I 7428. – 3 ♀, 17.2-29.2; 12 November 1966; FSBC I 7429. – 2 ♀, 16.6-17.9; 6 December 1966; dredge; FSBC I 7430. – 1 ♀, 26.5; 15 February 1967; dredge; FSBC I 7431. – 1 ♀, 15.1; 8 March 1967; dredge; FSBC I 7432. – 1 ♀, 25.2; 7 April 1967; trawl; FSBC I 7433. – 2 ♂, 17.5-28.7; 7 April 1967; dredge; FSBC I 7434. – 1 ♂, 24.0; 1 ♀, 29.2; 15 April 1967; dredge; FSBC I 7435. – 1 ♂, 38.3; 1 ♀, 27.6; 6 June 1967; trawl; FSBC I 7436. – 1 ♂, 38.8; 1 ♀, 9.1; 6 June 1967; dredge; FSBC I 7437. – 2 ♀, 7.6-14.5; 5 July 1967; dredge; FSBC I 7438. – 1 ♀, 15.8; 11 October 1967; trawl; FSBC I 7439. – 2 ♂, 16.8-20.5; 11 October 1967; dredge; FSBC I 7440. – 1 ♀, 15.8; 11 October 1967; from stomach of *Syacium papillosum*; FSBC I 7439. – 2 ♀, 18.3-22.7; 14 November 1967; trawl; FSBC I 7441. – 29 ♂, 12.8-31.3; 38 ♀, 9.0-33.5; 1 fragment; 14 November 1967; dredge; FSBC I 7442. – HOURGLASS STATION K: 1 ♂, 23.6; 7 December 1965; dredge; FSBC I 7443. – 1 ♂, 15.4; 13 January 1966; trawl; FSBC I 1663. – 1 ♂, 34.1; 1 ♀, 31.1; 14 February 1966; dredge; FSBC I 2039. – 2 ♀, 23.0-25.5; 5 July 1966; dredge; FSBC I 7444. – 1 ♂, 10.9; 22 July 1966; trawl; FSBC I 7445. – 1 ♀, 33.4; 5 August 1966; trawl; FSBC I 7446. – 1 ♂, 24.4; 1 ♀, 12.4; 5 August 1966; dredge; FSBC I 7447. – 1 ♀, 32.5; 4 September 1966; trawl; FSBC I 7448. – 1 ♂, 9.4; 1 ♀, 9.5; 4 September 1966; dredge; FSBC I 7449. – 1 ♂, 29.6; 2 ♀, 12.3-21.9; 12 October 1966; dredge; FSBC I 7450. – 1 ♂, 17.2; 12 November 1966; trawl; FSBC I 7451. – 1 ♂, 25.4; 2 ♀, 12.5-28.0; 12 November 1966; dredge; FSBC I 7452. – 1 ♀, 20.6; 12 January 1967; dredge; FSBC I 7453. – 1 ♀, 22.6; 8 March 1967; trawl; FSBC I 7454. – 3 ♂, 14.9-37.0; 2 ♀, 17.5-18.7; 8 March 1967; dredge; FSBC I 7455. – 2 ♀, 13.1-17.6; 7 April 1967; trawl; FSBC I 7456. – 1 ♂, 17.0; 7 April 1967; dredge; FSBC I 7457. – 1 ♀, 25.8; 6 June 1967; dredge; FSBC I 7458. – 1 ♂, 12.6; 2 ♀, 22.3-23.8; 5 July 1967; dredge; FSBC I 7459. – 1 ♀, 30.7; 4 September 1967; dredge; FSBC I 7461. – 1 ♂, 17.8; 1 ♀, 8.5; 11 October 1967; dredge; FSBC I 7462.

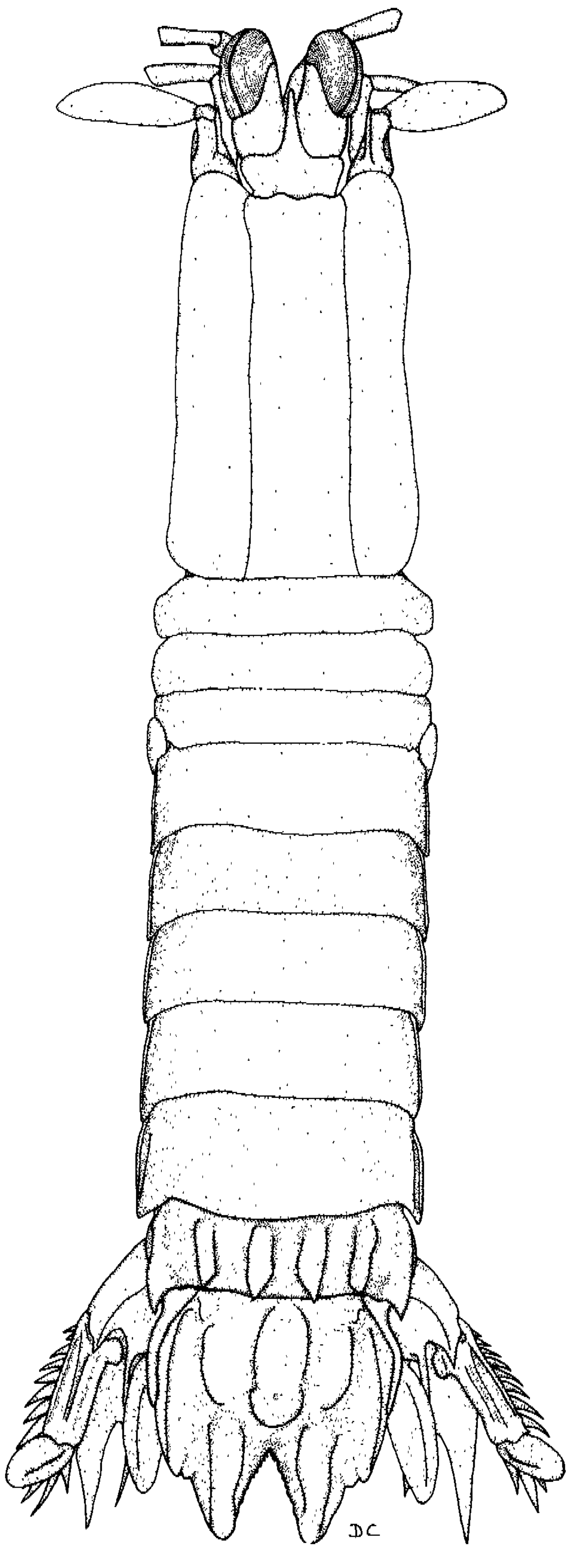


Figure 21. *Gonodactylus bredini* Manning, adult ♂: CL = 9.5 mm; TL = 37.8 mm; FSBC I 7436. Claws, walking legs, and setae omitted.

Diagnosis: Dactylus of raptorial claw usually pink; fifth abdominal somite angled or rounded posterolaterally, unarmed; telson broader than long, lacking dorsal spinules; median and anterior submedian carinae of telson lacking apical spines; dorsal surface of submedian carinae of telson at most pitted, never longitudinally sulcate; movable apices of submedian teeth of telson absent; longitudinal axes of submedian and intermediate teeth of telson convergent posteriorly, teeth not widely separated; apices of intermediate denticles of telson rounded, situated posterior to or at level of apices of intermediate teeth, never recessed by as much as their own width; lateral carinae of telson closely appressed to intermediate teeth; uropodal endopod not noticeably tapered distally.

Discussion: Manning (1969:295-298) presented an excellent discussion of characters used to distinguish species of *Gonodactylus*, and concluded that the most important ones are subjective features of telson morphology. He revised Schmitt's (1940) concept of congeners having "Atlantic" and "Pacific" types of telsons, and divided species into two new groups (1969:293-294). One contains eight species in the western Atlantic, and has what Manning designated an Oerstedii-type telson, characterized by features best seen in *G. oerstedii*. The other group, containing only *G. lacunatus* and *G. bredini* in the western Atlantic, has a Bredini-type telson, characterized by features best seen in the latter species. The present diagnosis best distinguishes only large specimens of *G. bredini*, since a great amount of age variation occurs in this species and is evident in Hourglass material. Telsons of small specimens differ from those of larger adults and have some features of the Oerstedii-type.

Manning (1969:293-294) states that species with Oerstedii-type telsons always have movable apices on submedian teeth, whereas large specimens of species with Bredini-type telsons never have them. Juveniles in Hourglass material always have movable apices on submedian teeth (Figure 25). As specimens get larger, relative lengths of these apices decrease, until only remnants remain. Eventually, these disappear altogether. Their disappearance probably does not occur in one or two molts, since the following conditions were observed on intermediate-sized specimens: a long movable apex on one submedian tooth and a short remnant on the other; short remnants on both submedian teeth; and a short remnant on one submedian tooth and none on the other. One specimen (FSBC I 7456) with remnants of movable apices also has such remnants on the developing integument discernible through the existing exoskelton. Figure 22 shows distribution of these conditions through different size classes. The largest specimen with long movable apices on both teeth is CL 4.6 mm (TL about 20.9 mm), and the largest specimen with remnants still visible on both submedian teeth is CL 7.9 mm (TL about 35.3 mm). The smallest specimen with no movable apices nor remnants is CL 2.7 mm (TL about 12.2 mm), however, showing that these apices disappear on some specimens at a very small size.

Shape of submedian teeth of the telson is another important feature. They are usually sharp in all sizes of *G. oerstedii* and *G. curacaoensis*, but they are rounded in *G. bredini* (Manning 1969:296). In Hourglass material, only six of 129 intact specimens less than CL 3.0 mm have rounded teeth, 237 of 308 specimens between CL 3.0-4.4 mm have rounded teeth, and all specimens greater than 4.4 mm have rounded teeth. Sharp submedian teeth are usually associated with the presence of movable apices, but on specimens where only remnants remain, they may be either rounded or sharp.

Manning (1969:296) further states that species with Oerstedii-type telsons have two intermediate denticles on each side of the telson, both usually with sharp apices, whereas adults with Bredini-type telsons have only one rounded denticle on each side. Many specimens in Hourglass material have two denticles on each side. On juveniles, the larger, mesial denticle tapers to

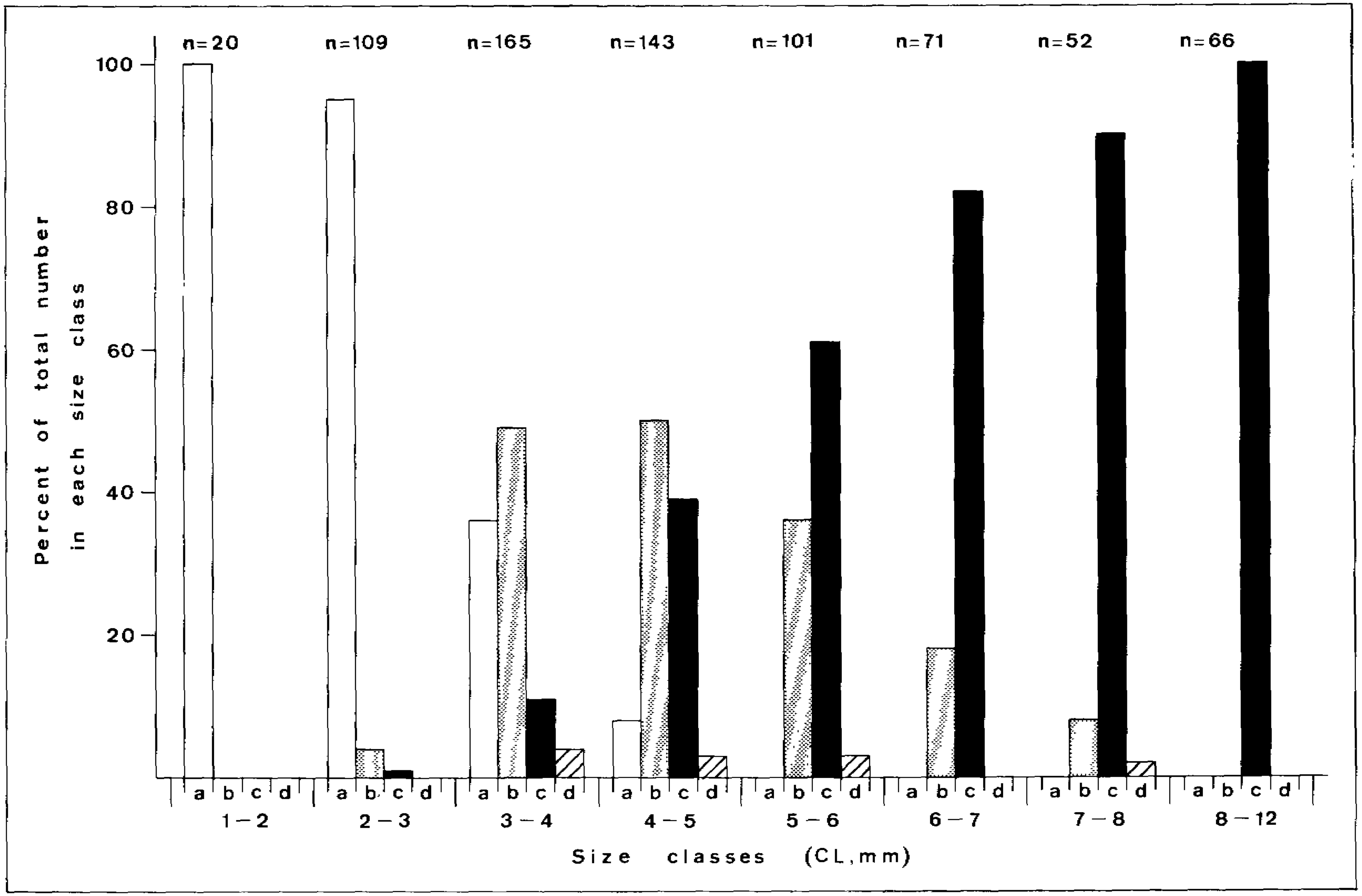


Figure 22. Morphological conditions of apices of submedian teeth on intact telsons of *Gonodactylus bredini* Manning in each size class. Last four size classes are combined. a = movable apex present on each submedian tooth; b = short remnant of movable apex present on each tooth; c = no movable apex on either tooth; d = some other condition, such as a movable apex on one tooth and a remnant on the opposing tooth, or a remnant on one tooth and no movable apex on the opposing tooth.

a sharp apex, and the smaller, lateral denticle is always very prominent. On larger specimens, the mesial denticle becomes more rounded and relative size of the lateral denticle becomes smaller until it disappears. Loss of the second denticle probably does not occur simultaneously on both sides of the telson since several specimens had two denticles on one side and one on the other. Two denticles persist on each side of the telson on a few specimens as large as CL 9.2 mm (TL 38.8 mm), but at this size the lateral denticle is usually just a minute tubercle, and the mesial denticle is well-rounded. All large specimens (CL greater than 9.3 mm, TL greater than about 40 mm) have only one rounded denticle on each side. Figure 23 shows distribution of these conditions through different size classes.

Another unusual condition of the intermediate denticles is seen in this material. Twelve specimens in the small and intermediate size classes (CL 2.2-7.6 mm) have no denticles on one side, but have one or two on the other side. None completely lack intermediate denticles. There is no evidence of injury.

Position of the apex of an intermediate denticle relative to the apex of the adjacent intermediate marginal tooth of the telson is also an important character used to distinguish telson types in *Gonodactylus*. Species with Oerstedii-type telsons have the intermediate denticles deeply recessed anteriorly from the apex of the intermediate tooth, whereas species with Bredini-type telsons never have them recessed more than their own width (Manning, 1969:293-294). This proved to be the most constant distinguishing character in the present material, even on smallest juveniles. Only six of several hundred intact specimens had denticles recessed even slightly, but never on both sides of the telson, and never as much as their own width.

Manning (1969:296) also points out that in most species of western Atlantic *Gonodactylus* posterolateral angles of the fifth abdominal somite are rounded and unarmed, whereas in all *G. curacaoensis* and some small *G. torus* they are spined. Spination of these somites is also evident in some small *G. bredini* in Hourglass material. Posterolateral angles of the fourth and fifth somites are spined on most specimens between CL 1.5-1.9 mm, but only the fifth somite is spined on most specimens between CL 2.0-3.1 mm. The largest specimen showing this condition is about CL 3.1 mm (TL 13.6 mm). Specimens greater than CL 3.1 mm usually have only an acute posterolateral angle on the fifth somite, and largest specimens have the typically rounded angle.

Separation of dwarf species of *Gonodactylus* from juveniles of larger congeners is difficult. Manning (1969:294) first recognized the existence of these dwarf species in the western Atlantic when he noted several male specimens which exhibited well-developed secondary sexual modifications at a much smaller size (TL 25-30 mm) than usual. Copulatory tubes of *Gonodactylus* males begin as small buds at the base of the last pair of walking legs, growing longer as the animal matures. Males of the dwarf species *G. torus*, for instance, have copulatory tubes as well-developed at TL 20 mm as *G. oerstedii* have at TL 40 mm. They also have greatly swollen median and anterior submedian carinae of the telson at TL 25 mm (Manning, 1969:337). Evidence that *G. torus* is a dwarf species was strengthened when a female of TL 18.7 mm was collected with eggs (Manning, 1969:338). All intact males in Hourglass material were examined for the presence of well-developed copulatory tubes to investigate the possibility of an undescribed dwarf species occurring in material assigned to *G. bredini*. When copulatory tube length equaled 78% of the length of the propodite of the adjacent walking leg (the ratio in the largest Hourglass male), the copulatory tube was considered well developed. All males less than TL 12.5 mm had under-developed copulatory tubes. Between TL 12.6-17.4 mm, approximately half were judged well developed. All males TL 17.5 mm

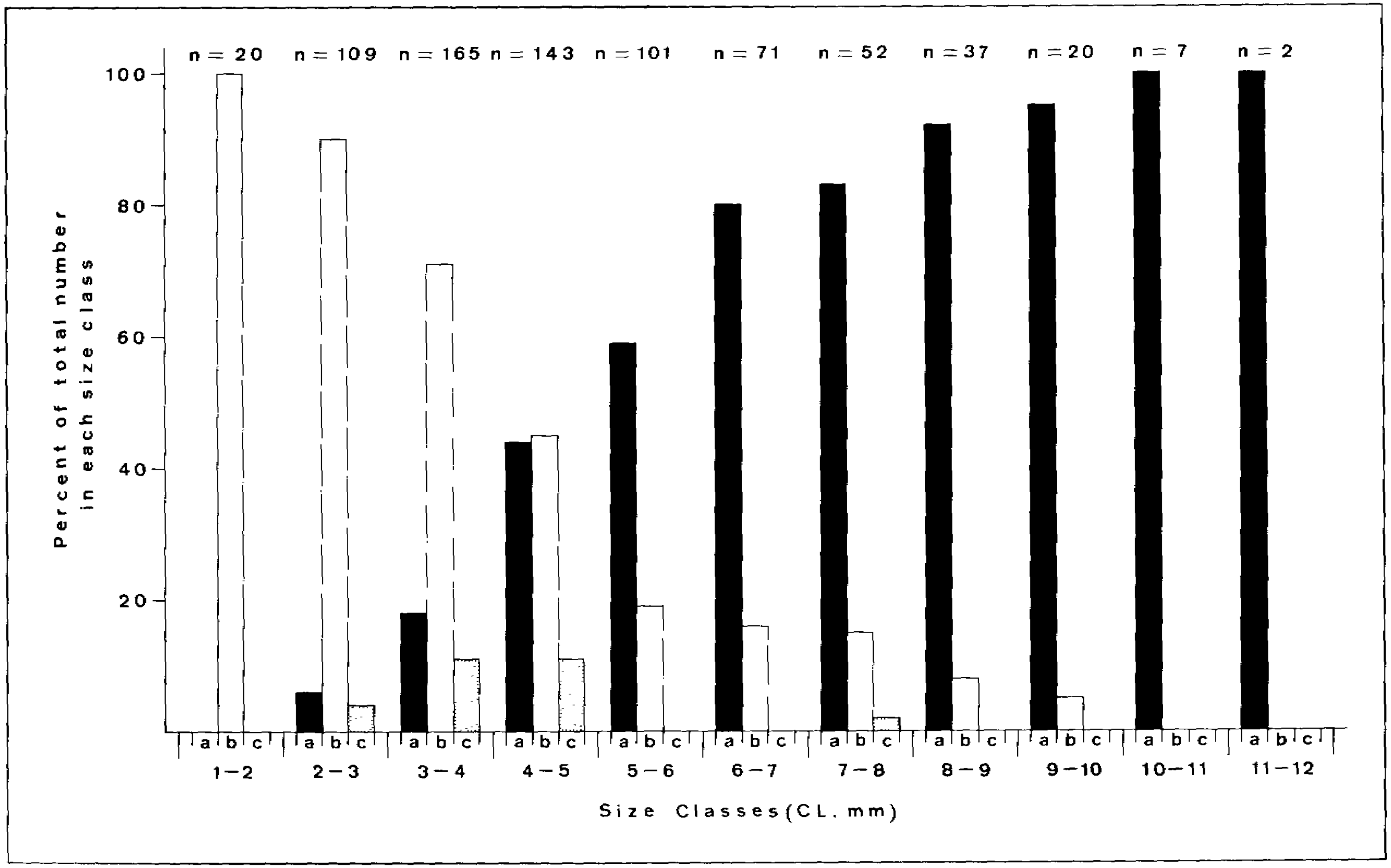


Figure 23. Number of intermediate denticles on intact telsons of *Gonodactylus bredini* Manning in each size class. a = one intermediate denticle on each side of telson; b = two denticles on each side; c = some other condition, such as one denticle on one side and two on opposing side.

or greater were well developed. None of the smaller males with well developed copulatory tubes had unusually swollen telson carinae, but they were often swollen on larger adults. Small males with well developed copulatory tubes do not differ in other aspects of telson morphology from comparably sized males with under-developed tubes.

Another feature which helps distinguish dwarf species in the western Atlantic is the relative slenderness of the abdomen, indicated by the Abdominal Width/Carapace Length Index (AWCLI) (Manning, 1969:296). Although ranges of this index occasionally overlap in certain size classes, dwarf species generally possess more slender abdomens than other species (Manning, 1969, 1970).

TABLE 14. *GONODACTYLUS BREDINI* MANNING. AWCLI RANGE AND MEAN OF MALES WITH UNDER-DEVELOPED COPULATORY TUBES COMPARED WITH AWCLI OF MALES WITH WELL-DEVELOPED COPULATORY TUBES.

Size Class (CL, mm)	Under-developed AWCLI Range	Under-developed n	Under-developed AWCLI Mean	Well-developed AWCLI Range	Well-developed n	Well-developed AWCLI Mean
2.0-2.9	727-909	44	844	821-926	8	862
3.0-3.9	789-871	14	832	781-969	51	844

The AWCLI of all intact males in Hourglass material was analyzed to determine if numerous small males (TL less than 20 mm) with well developed copulatory tubes have narrower abdomens than comparably-sized males with under-developed tubes. Table 14 shows the AWCLI range and mean of males with well developed and with under-developed copulatory tubes in the two size classes where both conditions occur. Figure 24 shows the distribution of this index for all intact males. The AWCLI range in each size class is very large, probably because of inherent variability and experimental error. The range overlaps greatly in each size class between the two conditions. Moreover, the mean AWCLI of males with well developed copulatory tubes in each size class is greater than that of comparably-sized males which lack them. This evidence opposes what one would expect if a dwarf species were present in the material, and if all dwarf species always have narrower abdomens than their non-dwarf congeners.

Other characters showing striking ontogenetic variation in this material are the rostral plate, raptorial dactylus, and raptorial propodus. Gurney (1946:156, fig. 14) showed these characters in his illustration of a postlarval *G. bredini* (as *G. oerstedii*) from Bermuda, and postlarvae from Hourglass material agree with this illustration. The rostral plate is subtriangular in the smallest specimens (TL about 7.5-8.3 mm). Its lateral margins are broadly convex posteriorly, concave anteriorly, sloping to an acute apex. In slightly larger specimens (TL about 8.5-9.8 mm) posterolateral margins are longer and less convex, and anterolateral angles are broadly rounded. Specimens greater than TL 9.8 mm have the typical subquadrate adult rostrum, with more sharply rounded anterolateral angles and a long apical spine. Figure 25 illustrates stages in the ontogeny of the rostral plate. All postlarvae less than about TL 9.5 mm have a notch on the proximal inferior margin of the raptorial dactylus. The notch is deeply excavated in the smallest specimens examined, and gradually diminshes in depth in larger juveniles until it is no longer evident. All juvenile *G. bredini* examined have one spine on the inner proximal margin of the raptorial propodus, and the longitudinal groove of the propodus is not deeply excavate. At this stage of development, the

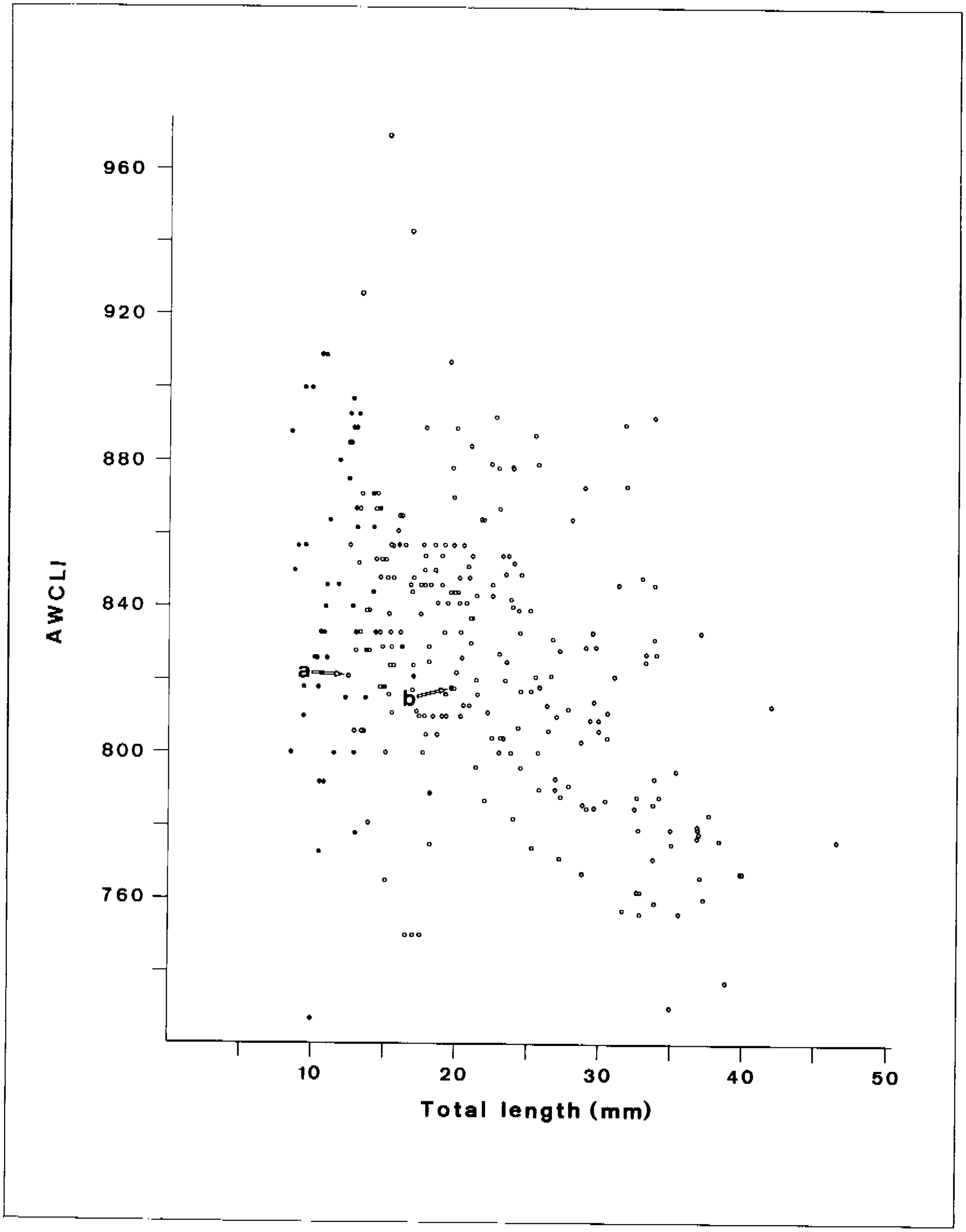


Figure 24. Abdominal Width/Carapace Length Index plotted against Total Length of all intact *Gonodactylus bredini* males. Solid circles are males with well-developed copulatory tubes; open circles are those with underdeveloped tubes. a = smallest male with well-developed tubes; b = largest male with underdeveloped tubes.

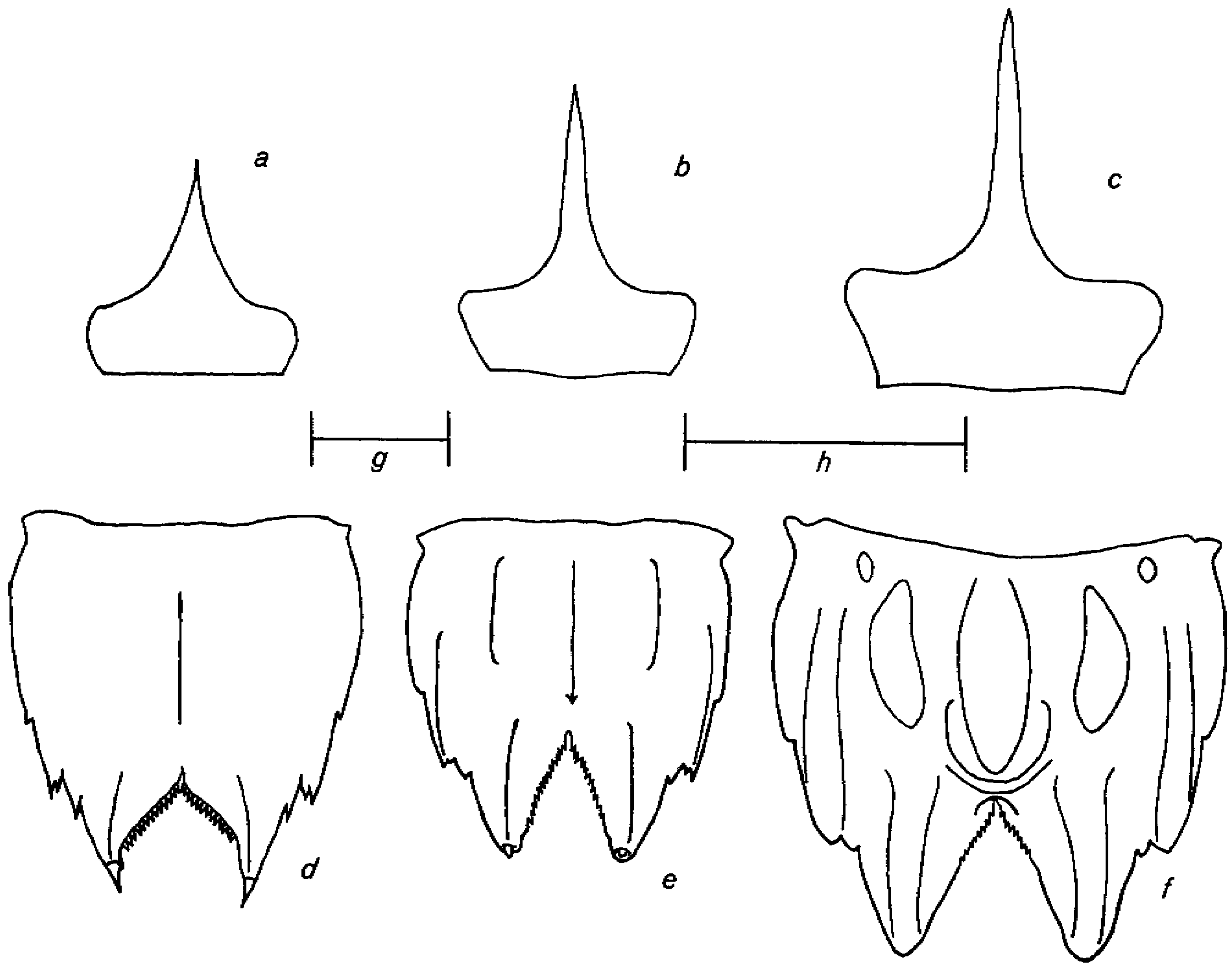


Figure 25. Developmental stages of the rostral plate and telson of *Gonodactylus bredini* Manning. *a-c* are rostral plates; *d-f* are telsons. Measurements (mm) and collection numbers of these specimens are as follows: *a* and *d*, CL = 1.5, TL = 7.3 (FSBC I 7411); *b*, CL = 1.9, TL = 9.1 (FSBC I 7437); *c*, CL = 2.8, TL = 13.1 (FSBC I 7456); *e*, CL = 3.3, TL = 14.7 (FSBC I 2098); *f*, CL = 4.4, TL = 19.6 (FSBC I 2098). One mm scale *g* applies to figures *e* and *f*; 1 mm scale *h* applies to all others.

shallow groove affords little protection to the distal end of the folded raptorial dactylus. Margins of the groove are more produced in larger specimens, causing it to deepen; the proximal spine appears more mesially located within the groove, and is proportionately smaller. Margins of the groove eventually grow over the proximal end of the spine, making it difficult to detect. Finally, the spine disappears, and the margins of the longitudinal groove completely cover the distal end of the folded dactylus. The propodal spine, apparently a juvenile character, persists on Hourglass specimens as large as 34 mm. Maximum reported size of the three western Atlantic dwarf species is 33.7 mm (Manning, 1969, 1970). However, Manning did not include the raptorial propodi in his descriptions of these dwarf species, but stated (1969:291) that these propodi are unarmed proximally in all *Gonodactylus*. If the raptorial propodi of adult dwarf species are unarmed, this may be another character distinguishing small *G. bredini* (which possess certain features of Oerstedii-type telsons) from adults of their dwarf congeners.

Manning (1969:322-325) described five morphologically distinct populations of *G. bredini* from the Caribbean Sea, from Bermuda, from the Carolinas, northeast Florida and the Gulf of Mexico, from south Florida, and from moderate depths off Puerto Rico. The length-width ratio of the body is a major distinguishing character. Specimens from the Gulf of Mexico are short and broad, whereas the type series from the Caribbean are elongate and slender (Manning, 1969:323).

TABLE 15. *GONODACTYLUS BREDINI* MANNING. NUMBER OF SPECIMENS AND RANGE OF TOTAL LENGTH IN EACH 1.0 mm CARAPACE LENGTH SIZE CLASS.

Size Class (CL, mm)	n	Total Length Range (mm)
1.0- 1.9	21	7.3- 9.1
2.0- 2.9	107	8.5-15.0
3.0- 3.9	162	12.9-19.9
4.0- 4.9	141	15.8-25.8
5.0- 5.9	97	20.3-29.3
6.0- 6.9	70	24.5-31.6
7.0- 7.9	52	27.2-37.0
8.0- 8.9	37	31.7-40.4
9.0- 9.9	20	35.5-42.9
10.0-10.9	7	39.9-45.4
11.0-11.9	2	42.4-46.5
Fragments	23	---

This is further demonstrated by Hourglass material. Maximum size reported for the species is TL 74.6 mm, but the largest specimen from Hourglass material is only TL 46.5 mm. Table 15 lists numbers of specimens in several size classes, showing that the majority are small. Lyons (1970:51) also found the maximum carapace lengths of *Scyllarus americanus* (Smith, 1869) (Decapoda, Scyllaridae) collected during Project Hourglass were smaller than sizes regularly seen from other Florida locations. Broadness of the abdomen of Hourglass *G. bredini* is shown by the Abdominal Width/Carapace Length Index, given in Table 16. Mean AWCLI of Hourglass specimens is greater than that reported for an unspecified series by Manning (1969:320) in all but two size classes, although the ranges overlap in all classes.

Another character distinguishing Gulf of Mexico *G. bredini* from those of the Caribbean type-series is the inflation of telson carinae (Manning, 1969:323). He stated that in Caribbean forms, the median and anterior submedian carinae are not usually inflated, whereas in Gulf forms they are often inflated. In addition, inflation of the median carina usually obscures the knob in Gulf forms, but not on Caribbean forms. Although large specimens in Hourglass material often have inflated carinae, only on 19 was the knob completely obscured, perhaps due to the small average size of *G. bredini* collected. Large specimens usually have telson carinae inflated more than those of small specimens.

TABLE 16. *GONODACTYLUS BREDINI* MANNING. AWCLI RANGE AND MEAN, UNDAMAGED SPECIMENS ONLY.

Size Class (CL, mm)	n	AWCLI Mean	AWCLI Range
1.5- 1.9	12	838	684-933
2.0- 2.9	97	845	727-926
3.0- 3.9	138	845	763-969
4.0- 4.9	124	841	750-980
5.0- 5.9	74	834	782-927
6.0- 6.9	62	822	774-873
7.0- 7.9	46	821	757-911
8.0- 8.9	34	801	756-892
9.0- 9.9	18	783	737-833
10.0-10.9	6	796	767-813
11.0-11.9	2	805	776-835

Manning (1969:323-324) also mentioned movable apices of submedian teeth as a character differing significantly between the several "populations" of *G. bredini*. He stated that they are never present on specimens from the Caribbean type-series and from the Gulf of Mexico, nor even on small (less than TL 20 mm) specimens from Puerto Rico, but they are present on small specimens (TL less than 25 mm) (Manning, personal communication) from south Florida. High incidence of movable apices on Hourglass juveniles discussed previously indicates that Manning's south Florida "population" is, as he speculated, comprised of juveniles of the Gulf form. Submedian teeth of Hourglass juveniles differ from those of juveniles taken off Puerto Rico, however. This feature may prove to be a significant distinguishing character when more is learned about geographical variation.

Color of *G. bredini* is variable, differing not only between specimens from different areas, but also between specimens from the same sample. Manning (1969:322-323) stated that specimens from the Caribbean are characteristically green with black circles of chromatophores on the dorsum, whereas Florida forms may be light green (with darker pigment along the posterior margins of the somites), dark blue, or mottled pink. Dingle (1964) found six basic colors among 86 specimens collected at Bermuda; although some were merely different shades of the same hue, each was supplemented by white "flecks and blotches," or paired white spots on some somites.

Color of live specimens from Hourglass collections was not recorded, and all hues have faded in preserved material. Black chromatophore patterns of these specimens were noted, however, and a summary of basic patterns and variations of each is outlined in Table 17. Most specimens have

TABLE 17. *GONODACTYLUS BREDINI* MANNING. OUTLINE OF CHROMATOPHORE PATTERNS OBSERVED ON DORSUM OF PRESERVED SPECIMENS.

Basic Patterns		Secondary Additions to Basic Pattern		Additions to Secondary Pattern
I.	Median patches on sixth thoracic and first abdominal somites (2 ♂)			
		A.	plus submedian patches on telson (1 ♂)	
		or B.	plus median patch on fifth abdominal somite and lateral patches on sixth thoracic somite (15 ♂, 6 ♀)	
				1. plus submedian patches on fourth abdominal somite and lateral patches on all abdominal somites (1 ♀)
				or 2. plus scattered dots over remainder of dorsum (3 ♂)
				or 3. plus submedian patches on telson (3 ♂, 1 ♀)
		or C.	plus lateral patches on sixth thoracic somite	
				1. plus lateral patches on second abdominal somite (1 ♀)
				or 2. plus scattered dots over entire dorsum and submedian patches on telson (1 ♀)
II.	Median patches on sixth thoracic, and fourth and fifth abdominal somites, and lateral patches on all exposed thoracic and first five abdominal somites (1 ♂)			
III.	Submedian solid circular patches on sixth thoracic and first abdominal somites (1 ♀)			
		A.	plus submedian circles on fifth abdominal somite, and lateral circles on sixth thoracic somite (1 ♂, 1 ♀)	
		or B.	plus submedian patches on fifth abdominal somite, and lateral patches on first five abdominal somites (2 ♂)	
IV.	Submedian open circular patches on first abdominal somite, and random dots over remainder of dorsum (1 ♀)			
		A.	plus open circles on sixth thoracic somite (1 ♀)	
				1. with dots more dense at posterior margin of each somite (1 ♀)
V.	Scattered dots over entire dorsum with no discernible pattern (7 ♂, 10 ♀)			
VI.	Median patch on carapace (1 ♀)			
VII.	Median patches at posterior margin of each exposed thoracic and abdominal somite, and lateral patches on sixth thoracic somite (1 ♂)			

chromatophores only on the distal superior margin of the merus of each raptorial claw, concentrated as very dark spots which are displayed during aggressive behavior (Dingle and Caldwell, 1969:118-119). Other specimens may have additional chromatophores on the body, on lateral surfaces of raptorial meri, or on both. Manning (1969) pointed out that Caribbean forms lack bars of dark pigment on the merus, whereas specimens from the Gulf of Mexico may have them. When present, lateral meral chromatophores are randomly scattered dots on Hourglass specimens. Only a few have a definite chromatophore pattern on the merus; the pattern is not sexually dimorphic (Table 17), nor is it related to particular patterns on the remainder of the body. The most prevalent pattern on the dorsum of the body is a median patch on the sixth thoracic and first abdominal somites. This is similar to patterns on preserved specimens of *G. spinulosus*, but that species differs in having paired submedian black circles on the remaining abdominal somites as well (Manning, 1969:298;303). The variation in this and other basic patterns (Table 17) may reflect different manifestations of the same pattern produced by reaction of each specimen to the preservative. It is doubtful that there are as many different chromatophore patterns in live animals as there are indicated in Table 17.

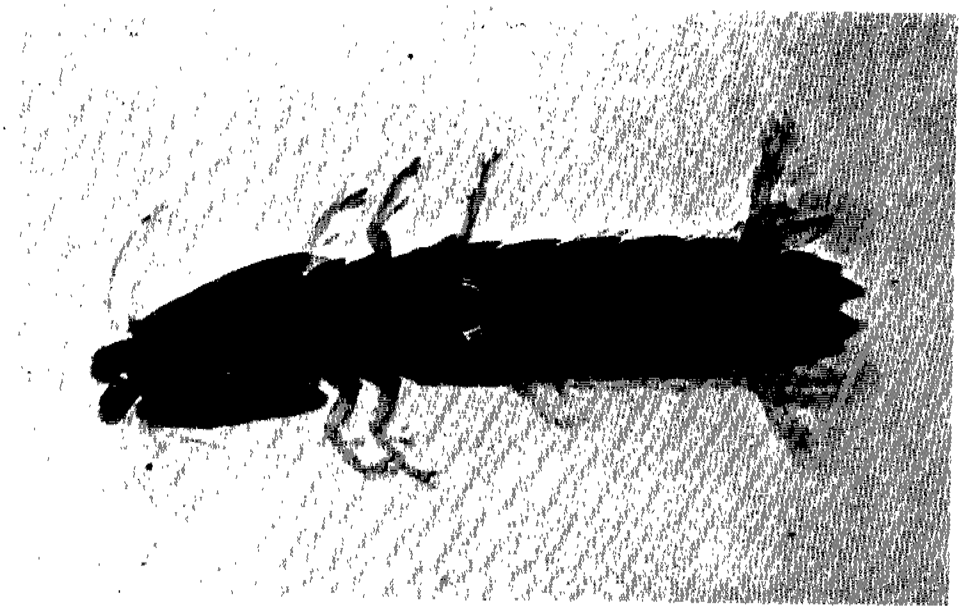
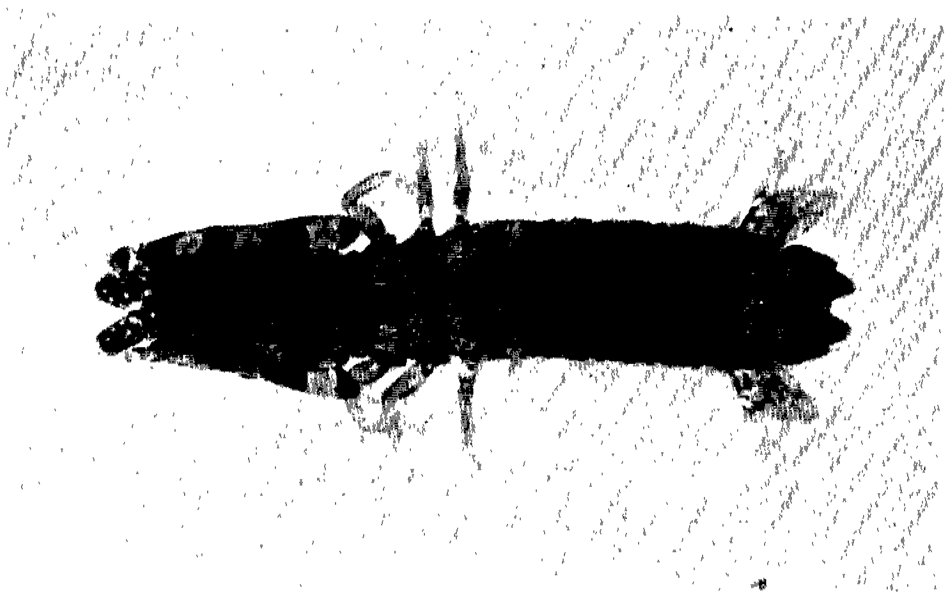
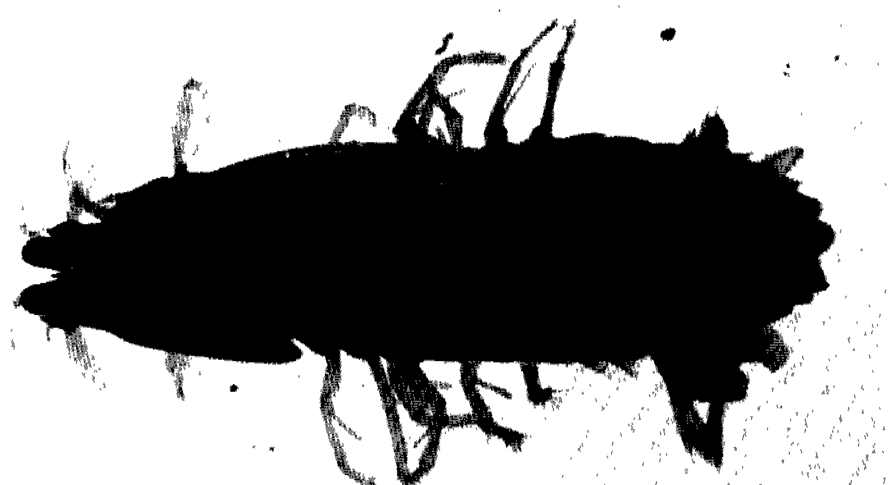
To elucidate color in living animals, the R/V *Hernan Cortez* revisited Hourglass Stations B and C during December, 1970. Live specimens from these collections exhibited considerable color variation. Three basic forms were found, each with considerable variation. They are as follows (Plate 1):

Uniformly colored. – The dorsum of these forms are not mottled nor speckled, but exhibit an overall even background coloration. Background color may vary considerably, however, from dark blue-green (almost black), through brownish-green, and yellowish-orange, to bright orangish-red. Each of these shares a distinctive pattern of small, submedian, dorsal white spots on the carapace and various numbers of exposed thoracic and abdominal somites. Antennae, antennal scales, maxillipeds (other than claws), walking legs, and uropods of blue-green, brownish-green, and yellowish-orange forms are orange, but on orangish-red forms they are pink. Larger specimens of the yellowish-orange form have conspicuous dark green posterior margins of the carapace, exposed thoracic and all abdominal somites, as well as dark green carinae on the telson, uropods and certain areas of the carpus of the claw. Dark blue-green forms have faint maroon bars at the proximal end, the midpoint, and just posterior to the distal end of the lateral surface of the merus of the raptorial claw. Meri of orangish-red forms also have three bars in these locations, but they are the same color as the rest of the body and are separated by narrow bands of white spots. Meri of brownish-green forms are often speckled with random grey spots over the entire lateral surface.

Highly mottled. – These forms exhibit the characteristic pattern illustrated by Manning (1969:324, Figure 88d). Mottling is usually reddish or maroon, and may appear on several background hues including grey-green, dark green, light tan, or grey. Dark green forms seem to be the most abundant in our study area. Their antennae, antennal scales, maxillipeds (other than the claw), walking legs and uropods are orange. Setae on antennal scales, pleopods and uropods are violet. Posterior margins of the somites, and carinae of the telson and sixth abdominal somite of all highly mottled forms are green. Meri of the claws are banded as in some uniformly colored types.

Secondarily mottled. – These have a more uniform overall coloration than the highly mottled forms, but the dorsum exhibits a mottled effect caused by the presence of paired submedian white "blotches" on the carapace and on most thoracic and abdominal somites. Background hues may be orangish-red or greenish-brown, appearing deeper on some areas of the body than on others. The

Plate I. Three basic color patterns of *Gonodactylus bredini* Manning on specimens from Hourglass stations.

mottled pattern is nearly identical to the highly mottled forms, but is less distinct. Meri of the claws may be barred as on previous forms, but these bars are less pronounced.

All observed colors were present on both males and females of all sizes, indicating that for this population, color variation is not limited to sex or size. Blue forms, listed for the Florida population by Manning (1969:323), were not captured.

Size structure of the population: *Gonodactylus bredini* was the only species sufficiently abundant in Hourglass collections to be analyzed for seasonal size structure of the population. The species was most abundant at Station B. To avoid possible bias by including animals responding to differing physical parameters, only the Station B material was so analyzed. Monthly catches from December 1965 through November 1967 were combined for analysis (Figure 26). Although sample sizes in some months are low, certain trends are discernible.

Two year classes appear to be present in the samples. Only one specimen less than CL 3.0 mm, the approximate size at which most copulatory tubes on males attain full development, was taken between December and April, suggesting a predominantly adult population during these months. However, it is not certain that females reach sexual maturity at the same size, nor that attainment of such organs indicates sexual maturity in males.

Recruitment of smallest animals (CL 1.0-1.9 mm) occurred during May through July. Additional recruitment from August through November is suggested by appearance of numerous juveniles (CL 2.0-2.9 mm). However, no smaller specimens were obtained in that period, although sample sizes were generally large. Growth is indicated by modal shifts toward larger size classes from May through January, and appears to be slow (approximately 0.5 mm CL/month).

Initiation of spawning could not be determined, since small sample sizes prevented analysis of temporal ovarian development. Neither can it be determined by considering larval duration. Number of larval stages of *Gonodactylus bredini* is unknown; larval duration and number of larval stages of any stomatopod species can only be estimated (Manning and Provenzano, 1963:484). Larval duration longer than one month, however, is not an unreasonable estimate for some species. Manning and Provenzano (1963) showed that larvae of *Gonodactylus oerstedii* held in the laboratory at 26-29° C took about two weeks to attain intermolt Stage IV, which far precedes metamorphosis. Alikunhi (1967) later showed that the interval between successive molts, after metamorphosis, lengthens with age and hypothesized that larval duration of some species could be as long as three months.

In view of the broad geographic distribution of *Gonodactylus bredini*, a larval life longer than one month would not be unexpected. This estimate can be correlated with bottom water temperatures at Hourglass Station B. Sudden rise in temperature often initiates spawning in some crustaceans, such as penaeid shrimps (Pérez Farante, 1969), whereas others do not spawn until temperature reaches a yearly maximum. Nothing is known of spawning response to temperature by *Gonodactylus bredini*, but spawning at Station B could have been initiated by a temperature rise. Bottom temperature was lowest (13.9° C) during February 1966, and rose to 20.0° C by March (Figure 27); it was lowest (16.5° C) during February and March 1967, and rose to 20.0° C by April. If spawning was initiated during these periods, and if larval duration was longer than one month, then juveniles would enter the benthic population during May through July.

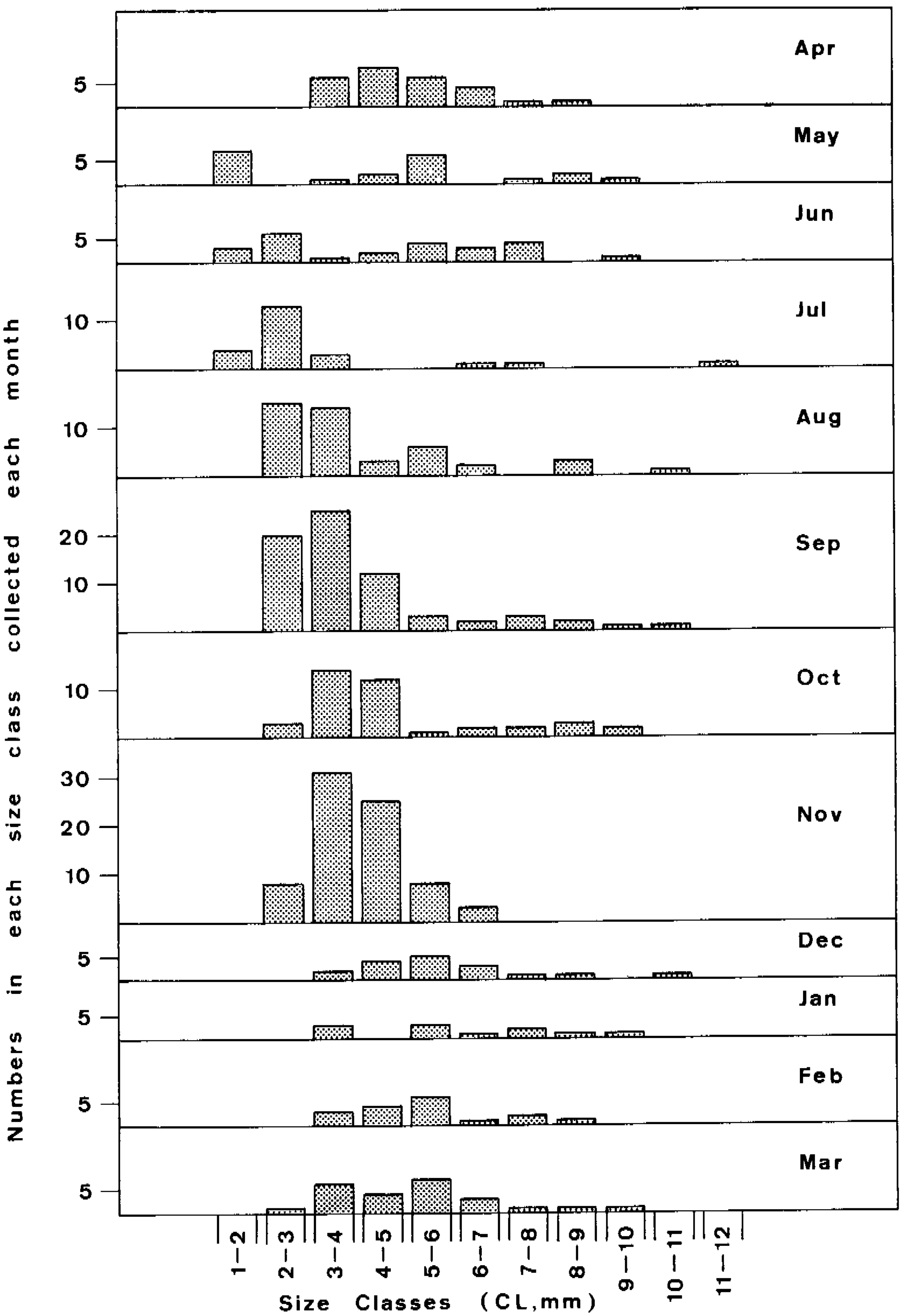


Figure 26. Size structure of the population of *Gonodactylus bredini* Manning at Station B during last 24 months of sampling.

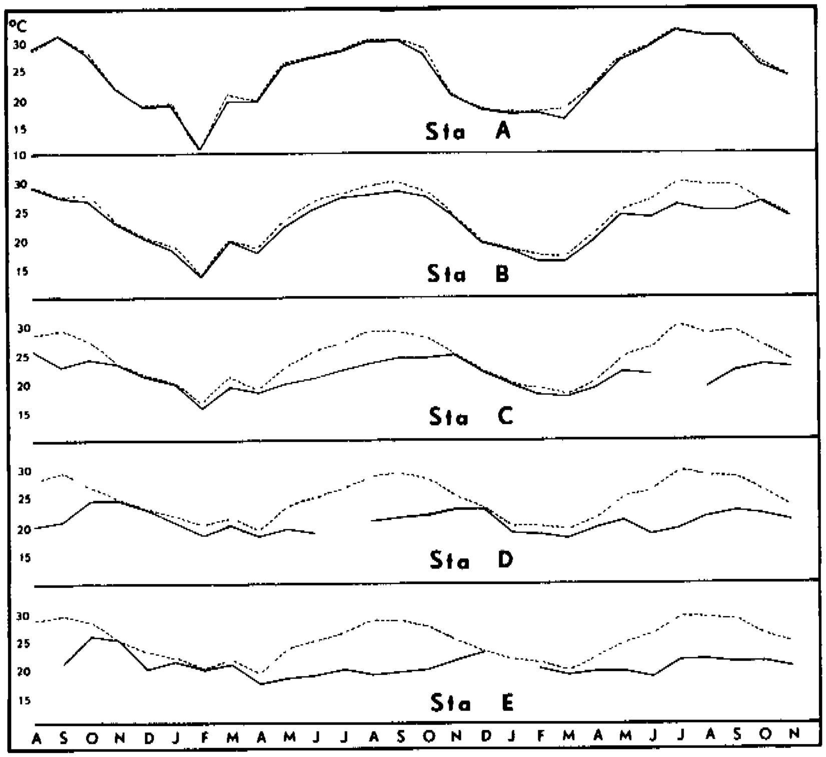


Figure 27a. Variation of monthly surface (---) and bottom (–) temperatures at Hourglass Stations A-E. (After Lyons, 1970.)

DISCUSSION

DIEL ACTIVITY

Hourglass Stations B, C and D were sampled during daylight and night each month to determine diel activity. This analysis was affected primarily by two factors, gear selectivity and habitats of the fauna. Burrowing species that seek food by leaving their burrow and foraging, as do some stomatopods, are susceptible to capture by dredge while in their burrows, and thus may not necessarily be active at the time of capture. Inactive stomatopods inhabiting burrows in hard substrates, such as rocks, are probably captured more often by dredge than by trawl. Similarly, inactive individuals in soft substrates, such as sponges or coralline algae, may occasionally be captured by trawls. Consequently, dredge samples are omitted here because it is felt that trawl collections allow a more accurate analysis of diel activity.

Only three species, *Gonodactylus bredini*, *Squilla deceptrix* and *S. rugosa*, were sufficiently abundant at Stations B, C and D to be analyzed for diel activity. Table 18 shows that 93% of *S. deceptrix* and 94% of *S. rugosa* were captured at night, indicating that both probably exhibit nocturnal behavior patterns. Differences in diel activity help increase reproductive isolation among sympatric species, but frequently some closely related species do not show divergence of such diel rhythms (Allee et al., 1949). This is apparently true for these two stomatopods, suggesting that

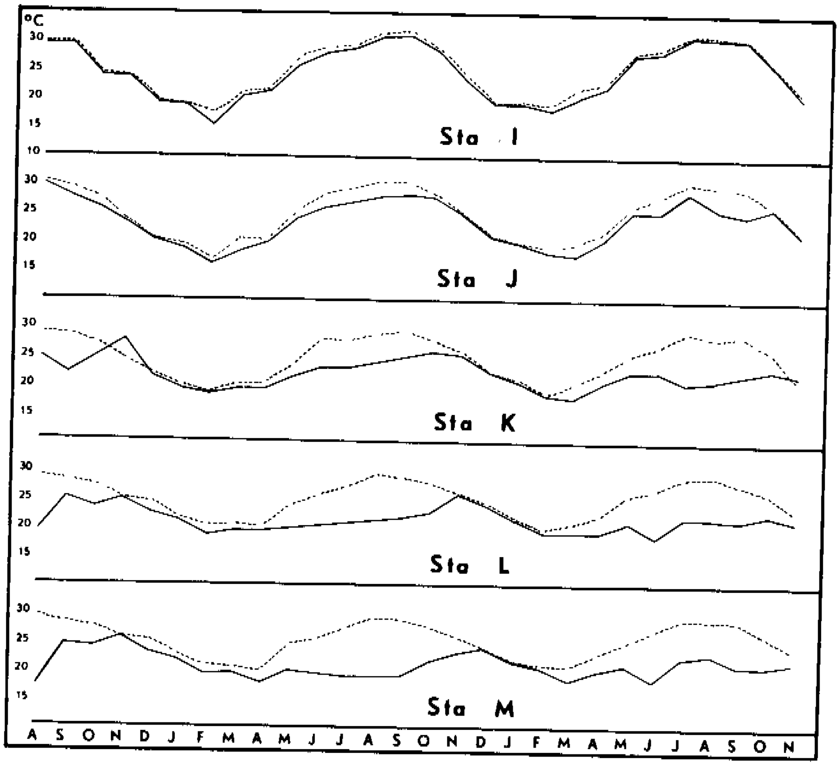


Figure 27b. Variation of monthly surface (---) and bottom (-) temperatures at Hourglass Stations I-M. (After Lyons, 1970.)

TABLE 18. DAY AND NIGHT CATCHES OF THREE STOMATOPOD SPECIES FROM TRAWL SAMPLES AT HOURGLASS STATIONS B, C AND D.

Species	Numbers: Night (77 samples)	Numbers: Day (77 samples)
Squilla deceptrix	43	3
Squilla rugosa	16	1
Gonodactylus bredini	50	49

other factors, such as habitat or physiological isolation, allow coexistence. Catches of *G. bredini* were about equal in day and night samples (Table 18), suggesting that this species does not conform to strict diurnal or nocturnal patterns in our study area. However, these results may be biased by *G. bredini* inhabiting sponges, thereby making them susceptible to trawl capture while not active. Dingle and Caldwell (1969) reported that *G. bredini* at Bermuda were active during the day, entering their burrows at dusk and closing the entrances with shells and other debris. Closer observation of the west Florida population may reveal a similar pattern. Analyses of their feeding habits tend to support this.

STOMACH CONTENTS

Stomatopods have long been recognized as carnivores, feeding primarily on crustaceans (Balss, 1938:109; Schmitt, 1965:81), but other items are regularly included. Senta et al. (1969) examined stomach contents of over 1000 *Squilla oratoria* from Japan and found that crustaceans were the predominant food item, followed in order by bivalves, fish, and cephalopods.

Stomachs from 105 of the largest adults of eight species were examined in this study (Table 19).

TABLE 19. FREQUENCY OF DIET ITEMS IN THE HOURGLASS STOMATOPOD STOMACH CONTENTS.

Species	Large Crustaceans	Small Crustaceans	Polychaetes	Echinoderms	Fishes	Mollusks	Unidentifiable Animal Tissues	Plant Materials	Sediments	Empty	Total Specimens
Gonodactylus bredini	5		1				1		3	13	20
Meiosquilla quadridens	9	1								10	20
Meiosquilla schmitti	1									4	5
Parasquilla coccinea	3			2			1		3		5
Squilla deceptrix	6	1	1				1		7	10	18
Squilla rugosa	7				2		7		11	6	20
Squilla neglecta	5	3	8			1	1	1	7		8
Squilla empusa	2		2		2		2		4	3	9
Total	38	5	12	2	4	1	13	1	55	46	105

Only the largest adults of species well represented in Hourglass collections were selected for stomach content analysis (Table 19). Two categories of crustaceans from stomachs were recorded, following Hall's (1962:46-47) criterion: "small" – those which could be ingested whole, and "large" – those which could not. The former were represented entirely by amphipods, while the latter were often represented only by flagellae or other appendages and bits of tissue with attached chitin. Empty stomach incidence was generally low, but high for certain species, possibly influenced by regurgitation during capture. Large crustaceans were generally the predominant food item, but polychaetes were predominant in one species. Polychaetes were represented by body fragments or by parapodial setae, and ten families of errantiate and sedentariate forms were identified (Table 20). Small crustaceans and fish occurred in about equal amounts. Echinoderms were represented only by ophiuroids, and mollusks by a single bivalve.

Individual food items for several species were judged predominant when they formed the bulk of the food material, residual when they did not (Table 20). Very often, certain items were always predominant, such as polychaetes which occurred in all *S. neglecta* examined. Large crustaceans

TABLE 20. IMPORTANCE OF DIET ITEMS TO SEVERAL SPECIES OF HOURGLASS STOMATOPODS.

Species	Food Category and Major Identifiable Components	Predominant	Residual	Total
Gonodactylus bredini	Large crustaceans (Majidae, Parthenopidae)	5	-	5
	Polychaetes (Nereidae)	1	-	1
Meiosquilla quadridens	Large crustaceans (Majidae, *Leptochela* sp.)	9	-	9
	Small crustaceans (Amphipoda)	1	-	1
Meiosquilla schmitti	Large crustaceans (unidentifiable)	1	-	1
Parasquilla coccinea	Large crustaceans (Majidae, *Metoporhaphis calcarata*)	3	-	3
	Echinoderms (Ophiuroidea)	1	1	2
Squilla deceptrix	Large crustaceans (Stomatopoda, Penaeidae, Parthenopidae)	6	-	6
	Small crustaceans (Amphipoda)	1	-	1
	Polychaetes (Sigalionidae)	1	-	1
Squilla empusa	Large crustaceans (Hippidae, Majidae)	2	-	2
	Polychaetes (Nereidae, Maldanidae, Arabellidae)	2	-	2
	Fishes	1	1	2
Squilla neglecta	Polychaetes (Spionidae, Polynoidae, Nephtyidae, Flabelligeridae, Terrebellidae, Sigalionidae, Syllidae, Nereidae, Arabellidae)	8	-	8
	Large crustaceans (Stomatopoda, *Leptochela* sp.)	-	5	5
	Small crustaceans (Amphipoda)	-	3	3
	Mollusks (*Tellina sybaritica*)	-	1	1
Squilla rugosa	Large crustaceans	5	2	7
	Fishes	2	-	2

were predominant in every species except *S. neglecta*, where they occurred only residually. Small crustaceans were predominant only in single specimens of *M. quadridens* and *S. deceptrix*. Fish, represented by fin rays and scales attached to minute bits of tissue, were eaten only by *S. empusa* and *S. rugosa* and were predominant both times they occurred in *S. rugosa*. Stomatopod appendages (a uropodal exopod and a thoracic walking leg) in stomach contents of *S. deceptrix* and *S. neglecta* introduce the possibility of cannibalism in these species. Cannibalism is well documented for stomatopods (Schmitt, 1965; Senta et al., 1969; Dingle and Caldwell, 1969).

Based on the wide range of occasional food items, it is felt that scavenging may be utilized to augment normal food supplies obtained through predation. Many other predators are euryphagous, eating whatever is available (Allee et al., 1949).

Diel variation in feeding habits was analyzed for *G. bredini*, the only species in which an equal number (10) from day and night samples were selected. Results indicate that *G. bredini* on the west coast of Florida have diurnal feeding habits, since 71% of those with food were collected during the day. Conversely, 62% of those with empty stomachs were collected at night. Regurgitation during capture could have biased these results.

PREDATION

Stomatopods are a well-known constituent of carnivorous fish diets. Reintjes and King (1953) found that larvae and postlarvae of at least five genera of stomatopods contributed 4.6% (by volume) to the diet of the Pacific yellowfin tuna, *Neothunnus macropterus* (Temminck and Schlegel), whereas other crustaceans contributed only one-half that amount. Dragovich (1970) found larval stomatopods prominent in the stomach contents of Atlantic skipjack tuna, *Euthynnus pelamis* (Linné) (reported as *Katsuwonus pelamis*), and yellowfin tuna *Thunnus albacares* (Bonnaterre), and also in the stomachs of fishes which these tuna had ingested.

Adult stomatopods found in fish stomachs have been reported, but few were identified to species, and few of these records were from Florida. In an intensive study of diets of reef fishes at Puerto Rico, Randall (1967) found adult stomatopods in stomachs of 44 fish species, and larvae in stomachs of another 11 species. Stomatopods contributed more than 5% to the volume of the stomach contents of 21 fishes he examined, and 50% to the volume of two lane snappers, *Lutjanus synagris* (Linné). He was able to identify only four stomatopod species, however: *Gonodactylus curacaoensis*, *G. oerstedii*, *Pseudosquilla ciliata*, and *Lysiosquilla glabriuscula*. In Florida, Longley and Hildebrand (1941) reported small stomatopods as part of the diet of red grouper, *Epinephelus morio* (Cuvier and Valenciennes), at Tortugas, and Croker (1962) found two stomatopods in the contents of 146 stomachs of the gray snapper, *Lutjanus griseus* (Linné), taken at Everglades National Park. Neither of these records include the identity of the stomatopods. Fraser (1971) was able to identify *Squilla, Meiosquilla* and *Eurysquilla*, finding them the second most important food items in the diet of the flatfish, *Syacium papillosum* (Linné), from off southeast Florida. Manning (1969) examined 21 specimens of 17 stomatopod species taken from fish stomachs. Six of these records, *Nannosquilla schmitti* ["fish stomach"; Tortugas], *Meiosquilla quadridens* ["fish stomach"; Tortugas], *Squilla rugosa* ["grouper stomach"; Madeira Beach; *Sciacyon* (sic) *micrurum*; Tortugas], *S. neglecta* ["fish stomach"; Pensacola], and *Gonodactylus curacaoensis* [*Hypoplectrus unicolor*; Alligator Reef Light], were from Florida.

Not all of Hourglass fishes have had their stomach contents examined. Table 21 lists eight stomatopod species found in stomachs of 72 specimens of 15 Hourglass fish species. Stomatopods were often the only items in stomachs of several individual fish, notably *Scorpaena brasiliensis* Cuvier. Net feeding during capture may account for this in some instances. Most fishes listed belong to families which are generalized carnivores (Randall, 1967).

Meiosquilla quadridens is the most heavily preyed upon stomatopod in these samples, occurring 34 times in stomachs of nine fish species. Although *Gonodactylus bredini* was the most abundant stomatopod in this survey, it occurs only once in fish stomach contents.

Lyons (1970:62) showed that bathymetric separation of *Scyllarus* species (Decapoda: Scyllaridae) taken in Hourglass samples was further verified by examination of fish stomach contents. Bathymetric and station distribution of two Hourglass stomatopods was expanded by examination of fish stomach contents. Most species listed in Table 21 were taken only at stations where they were also trawled or dredged. *Squilla grenadensis*, however, was taken in regular samples only from Station L, but was taken from the stomach of a *Scorpaena dispar* Longley and Hildebrand from Station M. Similarly, *Eurysquilla plumata* was taken in regular samples only from Station D, but was taken from stomachs of dusky flounders, *Syacium papillosum* (Linné) (and from stomachs of rock shrimp, *Sicyonia brevirostris* Stimpson) from Station C.

Meiosquilla quadridens was never taken in regular samples from Stations B and J, where *M. schmitti* occurred most frequently. Thus, unidentifiable fragments listed in Table 21 as *Meiosquilla* sp. from the stomachs of *Diplectrum formosum* (Linné) from Station J, and *Orthopristis chrysoptera* (Linné) from Station B are probably *M. schmitti. Meiosquilla schmitti* was never taken at Station E and M, whereas *M. quadridens* occurred there regularly. The former was eaten by *Scorpaena brasiliensis* at Station B, and the latter was eaten by the same species at Stations E and M, suggesting that although one food item (Stomatopoda) of *S. brasiliensis* is the same at different locations, species composition of that item may differ.

Figures presented in Table 18 suggest that *Squilla deceptrix* and *S. rugosa* are probably nocturnal. Most fish which ate these stomatopods, however, belong to families which are primarily diurnal (Randall, 1967). Presence of apparently nocturnal species in stomachs of reportedly diurnal predators could result from feeding by the latter at dawn or dusk.

TABLE 21. STOMATOPODS FROM HOURGLASS FISH STOMACH CONTENTS.

Numbers and Species of Stomatopods	Fish Species	Hourglass Station	Depth (meters)	Date
4 *Eurysquilla plumata*	*Ancylopsetta quadrocellata* Gill	C	37	6/21/66
1 *Eurysquilla plumata*	*Syacium papillosum* (Linné)	C	37	6/21/67
1 *Gonodactylus bredini*	*Syacium papillosum* (Linné)	J	18	10/11/67
1 *Meiosquilla quadridens*	*Holocentrus bullisi* Woods	E	73	7/19/66
1 *Meiosquilla quadridens*	*Lepophidium jeannae* Fowler	D	55	11/ 6/66
2 *Meiosquilla quadridens*	*Lepophidium jeannae* Fowler	L	55	10/12/67
1 *Meiosquilla quadridens*	*Lepophidium jeannae* Fowler	L	55	10/12/67
1 *Meiosquilla quadridens*	*Lepophidium jeannae* Fowler	M	73	12/ 7/66
1 *Meiosquilla quadridens*	*Prionotus alatus* Goode & Bean	E	73	12/ 2/66
1 *Meiosquilla quadridens*	*Scorpaena agassizi* Goode & Bean	E	73	5/12/67
1 *Meiosquilla quadridens*	*Scorpaena agassizi* Goode & Bean	M	73	11/13/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	D	55	7/ 3/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	D	55	7/ 3/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	D	55	8/ 2/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	D	55	8/ 2/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	D	55	8/ 2/67
3 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	L	55	8/ 6/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	L	55	8/ 6/66
2 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	L	55	9/ 5/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	L	55	11/13/66
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	L	55	9/ 5/67
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	L	55	10/12/67
1 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	E	73	7/19/66
4 *Meiosquilla quadridens*	*Scorpaena brasiliensis* Cuvier	M	73	1/31/67
1 *Meiosquilla quadridens*	*Scorpaena calcarata* Goode & Bean	D	55	12/ 2/66

TABLE 21. STOMATOPODS FROM HOURGLASS FISH STOMACH CONTENTS (Cont.).

Numbers and Species of Stomatopods	Fish Species	Hourglass Station	Depth (meters)	Date
1 *Meiosquilla quadridens*	*Syacium papillosum* (Linné)	D	55	11/20/66
1 *Meiosquilla quadridens*	*Synodus intermedius* (Agassiz)	M	73	7/22/66
1 *Meiosquilla quadridens*	*Urophycis regius* (Walbaum)	E	73	4/ 4/67
1 *Meiosquilla quadridens*	*Urophycis regius* (Walbaum)	M	73	11/13/66
1 *Meiosquilla ?quadridens*	*Scorpaena calcarata* Goode & Bean	K	37	10/11/67
1 *Meiosquilla schmitti*	*Lutjanus synagris* (Linné)	J	18	7/21/66
1 *Meiosquilla schmitti*	*Scorpaena brasiliensis* Cuvier	B	18	7/18/66
1 *Meiosquilla schmitti*	*Scorpaena brasiliensis* Cuvier	B	18	12/ 1/66
2 *Meiosquilla schmitti*	*Scorpaena calcarata* Goode & Bean	B	18	12/ 1/66
1 *Meiosquilla schmitti*	*Scorpaena calcarata* Goode & Bean	B	18	1/25/67
1 *Meiosquilla schmitti*	*Scorpaena calcarata* Goode & Bean	J	18	1/30/67
2 *Meiosquilla schmitti*	*Syacium papillosum* (Linné)	D	55	12/14/66
1 *Meiosquilla* sp.	*Diplectrum formosum* (Linné)	J	18	7/21/66
1 *Meiosquilla* sp.	*Orthopristis chrysoptera* (Linné)	B	18	12/ 1/66
1 *Meiosquilla* sp.	*Scorpaena brasiliensis* Cuvier	L	55	8/ 6/66
1 *Meiosquilla* sp.	*Scorpaena brasiliensis* Cuvier	L	55	8/ 6/66
1 *Parasquilla coccinea*	*Centropristis ocyurus* (Jordan & Evermann)	E	73	7/19/66
1 *Parasquilla coccinea*	*Scorpaena agassizi* Goode & Bean	E	73	11/ 9/66
1 *Parasquilla coccinea*	*Scorpaena agassizi* Goode & Bean	E	73	5/12/67
1 *Parasquilla coccinea*	*Scorpaena agassizi* Goode & Bean	M	73	12/ 7/66
1 *Parasquilla coccinea*	*Scorpaena brasiliensis* Cuvier	E	73	5/12/67
1 *Parasquilla coccinea*	*Scorpaena dispar* Longley & Hildebrand	M	73	9/ 5/67
1 *Squilla deceptrix*	*Centropristis ocyurus* (Jordan & Evermann)	E	73	8/ 2/67
1 *Squilla deceptrix*	*Lepophidium jeannae* Fowler	E	73	7/ 3/66
2 *Squilla deceptrix*	*Scorpaena agassizi* Goode & Bean	E	73	9/ 1/66
1 *Squilla deceptrix*	*Scorpaena brasiliensis* Cuvier	D	55	2/ 6/67
1 *Squilla deceptrix*	*Scorpaena brasiliensis* Cuvier	D	55	4/ 4/67
1 *Squilla deceptrix*	*Scorpaena brasiliensis* Cuvier	D	55	6/ 3/67
1 *Squilla deceptrix*	*Scorpaena calcarata* Goode & Bean	C	37	7/18/66
1 *Squilla deceptrix*	*Scorpaena calcarata* Goode & Bean	C	37	7/18/66
1 *Squilla deceptrix*	*Scorpaena calcarata* Goode & Bean	C	37	11/ 2/67
1 *Squilla deceptrix*	*Scorpaena calcarata* Goode & Bean	K	37	7/22/66
1 *Squilla ?deceptrix*	*Scorpaena agassizi* Goode & Bean	E	73	1/26/67
1 *Squilla ?deceptrix*	*Scorpaena brasiliensis* Cuvier	D	55	7/ 3/66
1 *Squilla ?deceptrix*	*Scorpaena brasiliensis* Cuvier	D	55	7/ 3/66
1 *Squilla grenadensis*	*Scorpaena brasiliensis* Cuvier	L	55	7/22/66
1 *Squilla grenadensis*	*Scorpaena brasiliensis* Cuvier	L	55	7/22/66
1 *Squilla grenadensis*	*Scorpaena brasiliensis* Cuvier	L	55	12/ 7/66
1 *Squilla grenadensis*	*Scorpaena brasiliensis* Cuvier	L	55	8/ 6/66
1 *Squilla grenadensis*	*Scorpaena dispar* Longley & Hildebrand	M	73	10/13/66
1 *Squilla rugosa*	*Diplectrum formosum* (Linné)	J	18	7/21/66
1 *Squilla rugosa*	*Lutjanus synagris* (Linné)	J	18	7/21/66
1 *Squilla rugosa*	*Lutjanus synagris* (Linné)	J	18	7/21/66
1 *Squilla rugosa*	*Scorpaena brasiliensis* Cuvier	J	18	7/21/66
1 *Squilla rugosa*	*Scorpaena calcarata* Goode & Bean	K	37	11/12/66
1 *Squilla* sp.	*Scorpaena brasiliensis* Cuvier	L	55	10/13/66
1 Squillidae	*Symphurus diomedianus* (Goode & Bean)	E	73	7/19/66

DISTRIBUTION AND HABITAT PREFERENCE

Faunal elements of the Carolinian and West Indian marine zoogeographic provinces occur in the Gulf of Mexico. Most zoogeographic discussions of the Gulf have been made by specialists considering only one group of organisms, usually mollusks or fish (Rehder, 1954; Rivas, 1954). Several geographical reference points on the Florida west coast have been proposed for demarking limits of the characteristic fauna of these provinces. Hedgpeth (1957), however, warned of the difficulties inherent in attempting establishment of provincial limits based only on considerations of single groups, and Work (1969) questioned the validity of equating such geographic reference points to zoogeographic boundaries. Thus, intensive studies of the entire fauna at several locations on the west Florida shelf are needed to gain greater knowledge of the limits and affinities of faunal assemblages in this region. Completion of analyses of all faunal groups collected during Project Hourglass will contribute greatly to this knowledge. This report, however, will not make definite zoogeographic conclusions about the stomatopods but will present considerations on their distribution and local habitat preference for use in future discussions.

Based on Manning's (1969) and this Laboratory's records, Table 22 summarizes known western Atlantic, Florida and Gulf latitudinal and bathymetric distributions of Gulf of Mexico stomatopods. These species are arranged in four categories based on their reported western Atlantic distributions. Eight are widely distributed from the Carolinas to various latitudes off Central and South America. Only *Squilla empusa*, occurring as far north as Maine, exceeds this range. *Squilla neglecta* is also included in this category although its distribution is very disjunct, being reported from the Carolinas, Florida, Texas, and Brazil but not from the Caribbean Sea (Manning, 1969:184). Such widely distributed species can not be considered endemic to one zoogeographic province. Only one species, *Coronis excavatrix*, appears endemic to the Carolinian province. It is known only from North Carolina and the northern Gulf off Alabama, Mississippi, Louisiana, and Texas. It is not known from Florida. Five species, including three which have been reported only from the Gulf, have a more limited distribution in the western Atlantic, making their provincial analyses difficult. Fourteen Gulf species do not occur north of Florida, ranging southward to various latitudes off Central and South America and apparently represent components of West Indian fauna at the northern limit of their range. Only three of these fourteen species occur in the northern Gulf, and one (*Lysiosquilla scabricauda*) apparently withstands wide environmental fluctuations, being commonly found in bays and lagoons along the entire Gulf coast. None of the fourteen are known from northeast Florida, but all, except the rare species *Acanthosquilla biminiensis* and *Squilla grenadensis*, are known from Mexico, southeast Florida, or the Florida Keys.

Distributions of Hourglass species indicate that none can be considered strictly Carolinian, two have very limited distributions, five are widespread in the western Atlantic, and six are probably West Indian species at the northern limit of their range. Of these West Indian species, *Eurysquilla plumata* and *Squilla grenadensis* occur most frequently at offshore stations (37-73 m), representing a deep-water West Indian element. *Squilla rugosa*, *Meiosquilla schmitti* and *Acanthosquilla biminiensis*, are most abundant at inshore 18 m stations. Each of these three also inhabit shallow waters throughout the Caribbean (Manning, 1969). Occurrence of *Lysiosquilla scabricauda* at Hourglass stations is questionable, but it occurs in Tampa Bay.

Such latitudinal surveys of species distributions are helpful in gaining a general overview of zoogeographic affinities, but are not sufficient to explain more exact distributional patterns. Cerame-Vivas and Gray (1966) demonstrated that several biogeographic assemblages may occur in a

TABLE 22. FLORIDA, GULF, AND WESTERN ATLANTIC DISTRIBUTIONS OF ALL STOMATOPODS KNOWN TO OCCUR IN THE GULF OF MEXICO. HOURGLASS SPECIES NOTED WITH ASTERISK.

Species	Known Bathymetric Range	Northeast Florida	Alabama, Miss. and/or Louisiana	Northwest/Central Florida	Central/Southwest Florida	Texas	Southeast Florida	Florida Keys	Mexico	North of Carolinas to South America	Carolinas to South America	Carolinas and Northern Gulf of Mexico	East Florida and Gulf of Mexico only	Gulf of Mexico only	Southeast Florida, Gulf of Mexico and Bahamas	Yucatan, West Indies to South America	East Florida, Gulf of Mexico to South America	Distributional Category
*Squilla empusa**	Sublittoral, to 154 m (usually less than 40 m)	X	X	X	X	X	X	X	X	X								Widely distributed
*Gonodactylus bredini**	Sublittoral, to 73 m	X		X	X	X	X	X			X							
Lysiosquilla glabriuscula	Sublittoral, to 64 m			?	?		X	X	X		X							
Gonodactylus torus	10-364 m (usually less than 50 m)			X			X	X	X		X							
*Squilla neglecta**	Littoral to 64 m	X		X	X	X					X							
*Meiosquilla quadridens**	Littoral to 137 m			X	X		X	X			X							
*Squilla deceptrix**	37-346 m	X		X	X		X	X			X							
Squilla edentata	55-319 m (usually less than 200 m)		X	X		X	X				X							
Coronis excavatrix	"Shallow"		X			X						X						Carolinian affinities
Squilla chydaea	24-366 m		X	X		X	X	X	X				X					Limited distribution
*Platysquilla horologii**	51-73 m				X									X				
Nannosquilla taylori	1.8 m				X									X				
Lysiosquilla campechiensis	62-66 m								X					X				
*Parasquilla coccinea**	55-382 m		X	X			X		X						X			

Gonodactylus lacunatus	Sublittoral, to 50 m							X	X		
*Lysiosquilla scabricauda**	Sublittoral, to 55 m	X	X	X	X	X	X	X		X	
*Squilla rugosa**	Littoral, to 71 m		X	X		X	X	X		X	
Odontodactylus brevirostris	?-309 m			X			X	X		X	
*Meiosquilla schmitti**	Sublittoral, to 55 m			X	X	X	X			X	
*Acanthosquilla biminiensis**	Sublittoral, to 24 m		X	X	X					X	
Pseudosquilla ciliata	Sublittoral, to 110 m					X	X	X		X	West Indian affinities
*Eurysquilla plumata**	Sublittoral, to 55 m			X		X	X			X	
*Squilla grenadensis**	55-311 m (usually less than 73 m)			X						X	
Squilla prasinolineata	"Shallow"			X		X	X	X		X	
Nannosquilla schmitti	Sublittoral, to 4 m					X	X			X	
Gonodactylus spinulosus	Sublittoral, to 10 m					X	X			X	
Gonodactylus oerstedii	Sublittoral, to 29 m					X	X			X	
Alima hyalina	Sublittoral, to about 46 m					X	X	X		X	

relatively small geographic area, and that exact delimitation of these assemblages must be known to adequately define a provincial boundary or transition zone. Moreover, local current patterns, climatology, bottom type, and microhabitat preferences of each species affect their local distributional patterns (Thorson, 1957).

Hourglass stomatopods exhibit well-defined distribution patterns within the survey area. No evidence of interstation migration is afforded in the present data. Species assemblages are similar at latitudinally separated stations of the same depth but differ at bathymetrically separated stations on the same transect. Monthly catches of each species at each station by trawl and dredge are presented in Appendix I. These data are summarized as depth-occurrence frequency histograms for the most abundant species (Figure 28). Day-time samples at Stations B, C and D are not included. Bathymetric separation of centers of highest abundance of certain congeners within our study area is evident. *Meiosquilla schmitti*, for instance, is most abundant at 18 m stations, occurs less frequently at 37 and 55 m stations, and is not present at 73 m stations. Conversely, *M. quadridens*, a deep water species (Table 22), is not present at 18 m stations and is most abundant at 73 m stations. *Squilla* populations also show a change in species composition with changing depth. *Squilla neglecta* and *S. empusa* are the only congeners collected at 6 m stations; both are most abundant at 18 m stations. *Squilla rugosa* is the only other congener occurring at 18 m, but it is most abundant at 37 m where its range overlaps that of *S. deceptrix*. The latter species, however, is most abundant at 73 m where *S. rugosa* does not occur. *Squilla grenadensis* also occurs at 55 and 73 m stations but is probably more abundant in greater depths; this is the first record of its occurrence since the holotype was collected off Grenada, Lesser Antilles, at a depth of 311 m (Manning, 1969:155).

Locality preferences were exhibited by several other Hourglass species. Seventy-three percent of all *Gonodactylus bredini* were collected at 18 m stations, most from Station B. Similarly, *Acanthosquilla biminiensis* was collected only at 18 m stations. In deeper water, *Parasquilla coccinea* and *Platysquilla horologii* were most abundant at 73 m. The single *P. coccinea* reported above from Station I (6 m) probably results from an erroneous transcription of data accompanying this specimen, since those collected at 55 m Hourglass stations represent bathymetric range extensions shallower than previously reported 82 m (Manning, 1969:283).

Only two species reported from this study area were not collected during Project Hourglass. A single *Odontodactylus brevirostris* was reported from off Charlotte Harbor, Florida but was probably collected in depths exceeding those of Hourglass stations since this species inhabits depths to 309 m (Manning, 1969:291). The only known specimen of *Nannosquilla taylori* was collected in shallow water off Egmont Key, less than five miles from Hourglass Station A. Its absence from Hourglass samples illustrates the difficulty in collecting certain stomatopods, probably because of their cryptic habits or non-random distribution within an area. Such difficulty often results in seemingly unusual distribution patterns.

Physiological responses of larvae, postlarvae and adults to fluctuations in temperature, salinity, light penetration, and other water mass characteristics probably affect species composition between nearshore and offshore stations. Two water masses occur in the study area (Cobb et al., in press). A body of green, turbid coastal water extends from shore to a point between the 18 and 37 m stations, and a body of blue, clear shelf water extends from that point to beyond the 73 m stations. Turbidity differences are reflected in mean daytime Secchi disk readings (Joyce and Williams, 1969) which are 13 m at Station B, 20 m at Station C and 23 m at Station D. Part of the increased nearshore turbidity is probably caused by tidal currents which move unconsolidated sediments

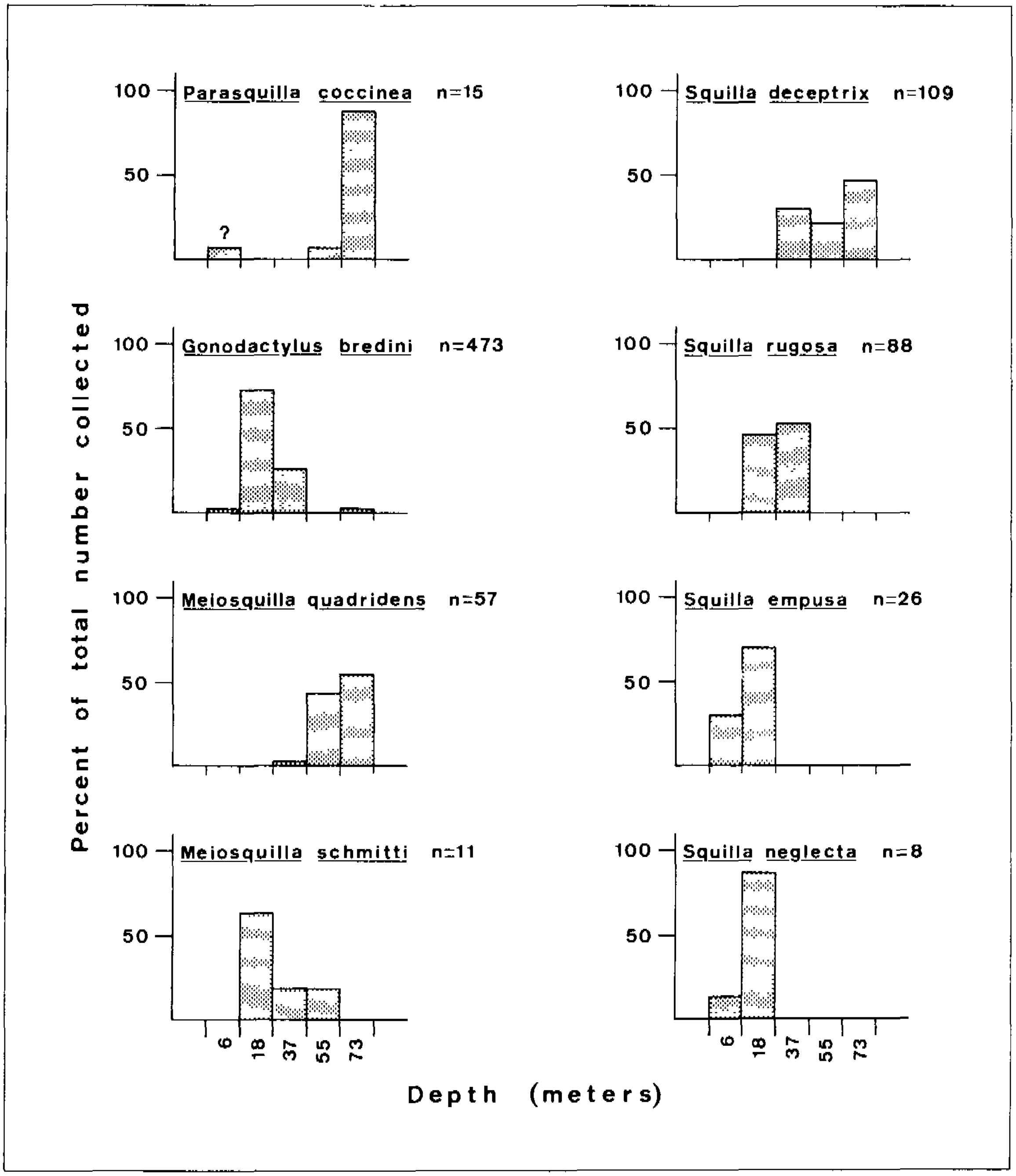


Figure 28. Percentages of total number of specimens collected at each depth for eight selected species.

offshore from the entrances of Tampa Bay and Charlotte Harbor (Gould and Stewart, 1956:11). Inshore waters are green because of increased numbers of phytoplankters. Saunders and Glenn (1969:7) pointed out that yearly mean numbers of all diatom cells at inshore Stations H and P (Figure 1) was 128 times greater than numbers at offshore Stations F/N. Similarly, Steidinger and Williams (1970:65) found that dinoflagellate densities were highest at inshore stations and lowest at offshore stations, but pointed out that such densities may not reflect differences in biomass since small species predominated inshore while larger species predominated at offshore stations. Such differences in phytoplankton numbers could also cause differences in the distribution of certain stomatopod larvae. Laboratory-held pelagic larvae of *G. bredini* are positively phototactic (Dingle, 1969). Dingle (1962) also found that unspecified stomatopod larvae change their horizontal swimming activity to a hop and sink motion in response to spectral shifts in penetrating light and speculated that a similar response would be elicited by increased abundance of phytoplankton in overhead waters. He hypothesized that such activity could lead larval crustaceans (both herbivorous and carnivorous) to more abundant sources of food. This behavior, combined with prevailing current patterns, could affect the distribution of species in this area.

Bottom temperature and salinity fluctuations are greater nearshore than offshore. Minimum and maximum temperatures throughout Project Hourglass differed by 15.5° C at Station A and 15.1° C at Station B, but differed by only 8.3° C at Station C and 6.5° C at Station D (Figure 27). Salinity extremes showed similar trends, differing by as much as 4.05‰ at Station I, but only by 0.56‰ at Station M (Joyce and Williams, 1969). Pelagic larvae of numerous benthic invertebrates have the ability to maintain themselves in water masses with optimum environments for survival (Thorson, 1957). Differences in larval environmental requirements of each species could confine certain stomatopod larvae to a particular water mass in the study area, thus affecting observed adult distributional differences. Such separation of larvae is highly conjectural, however, since little is known of stomatopod larval requirements.

Relationship of sediment types to substrate preference of each species is also important in determining distributions, since most populations of sublittoral benthos are closely related to the sediments and their physical-chemical characters (Thorson, 1957). Gould and Stewart (1956) characterized sediments on the west Florida shelf, and Joyce and Williams (1969) characterized the bottom at each Hourglass station. Their observations are summarized here to compare the relationship between distributions of certain stomatopods and sediment types within the study area. Lithified sediments in the area consist of cemented lime in the form of limestone, coral, or coralline algae. From a depth of 4 m, where beachrock stops, to about 50 m, there are six varieties of limestone: 1) soft, marly, 2) sandy, 3) dense, fine grained, 4) phosphatic, conglomeratic, 5) oolitic, and 6) foraminiferal, with types 1 and 4 predominating. Corals and calcareous algae are attached to the limestone in this depth zone. Calcareous algae are scattered at these depths, but between 50 and 90 m form a continuous blanket over the bottom, often forming algal reef-like structures which may rise as high as 12 m above surrounding bottom. *Lithothamnion* species are the characteristic calcareous algae of offshore Hourglass stations.

Unconsolidated sediments in the study area are of four types, arranged in strips roughly paralleling the coast (Gould and Stewart, 1956). Such arrangement probably contributes to the similarity of species composition of bathymetrically similar Hourglass stations, and to changes in species composition between stations of differing depth on each transect. Dominant unconsolidated sediments at Hourglass stations, plotted from Gould and Stewart's sediment distribution map, (1956:5, Figure 2) are: quartz-shell sand (greater than 50% quartz) (Stations A and J); quartz-shell sand (less than 50% quartz) (Stations B, I and K); shell sand (Station C); algal sand (Stations D, E, L and M). However, unconsolidated sediments do not cover the bottom in a continuous blanket, but form a thin veneer in some areas and leave lithified bedrock bare in others.

Stations A and I are lithologically similar to portions of nearby estuarine areas, and stomatopods at these stations are frequently collected at other nearshore localities in west Florida (Rouse, 1969; Lyons et al., 1971). Stations B and J are abundantly dotted with limestone outcroppings which often rise as high as one meter above surrounding bottom, creating a Gulf reef community (Joyce and Williams, 1969). Three species (*Meiosquilla schmitti*, *Squilla rugosa* and *Gonodactylus bredini*) are predominant at these stations. *G. bredini* is primarily a reef dweller inhabiting burrows in the limestone outcroppings or attached sponges. *Squilla rugosa*, a sand-shell inhabitant (Manning, 1969:160), is probably confined to the sandy interspaces between such outcroppings. Stations C and K have fewer limestone reefs and larger expanses of open shell bottom. Decrease in numbers of *Gonodactylus bredini* and increase in numbers of *Squilla rugosa* at Stations C and K (Figure 28) could reflect the lithological differences between these stations and Stations B and J. A similar decrease in numbers of *Meiosquilla schmitti* at Stations C and K suggests its affinities to limestone reefs, but its exact substrate preferences are unknown. Six species of stomatopods were either most abundant or apparently confined to farthest offshore stations (D, E, L and M), where calcareous algae blanket the bottom.

ASSOCIATED STOMATOPODS AND GEAR SELECTIVITY

Camp (1971:125) assumed that all species collected at the same station during the program were associated, reporting five stomatopods as associates of *Platysquilla horologii*. Station locations, however, especially farther offshore, could vary as much as one mile on each cruise (Joyce and Williams, 1969:12). Therefore, stomatopod associations are here restricted to species collected in the same sample (Table 23). Only 50 out of over 700 samples yielded two or more stomatopod species. Possible explanations include apparent scarcity of certain species within the study area, gear selectivity upon different species which occur together, and possible differences in species diel activity; all may result in differences of availability to capture.

Gear selectivity was an important parameter in this analysis. *Gonodactylus bredini* and *Squilla rugosa* occurred regularly at 18 m and 37 m stations (Figure 28), but were taken together only 19 times in 339 collections at these depths (Table 23). However, 83% of all *Gonodactylus bredini* were collected by dredge and 88% of all *Squilla rugosa* were collected by trawl. Similarly, *Meiosquilla quadridens* and *Squilla deceptrix* occurred most frequently at 55 and 73 m stations, but appeared together only 7 times; 94% of all *S. deceptrix* were captured by trawl and 69% of all *Meiosquilla quadridens* were captured by dredge.

Change in species composition with changing depth is illustrated in Table 23. Inshore, *Gonodactylus bredini*, *Squilla rugosa*, *S. empusa* and *Meiosquilla schmitti* were collected together most often, whereas offshore, *M quadridens*, *Squilla deceptrix* and *Parasquilla coccinea* were most frequently associated. Determination of actual associations is difficult, however, for each collection probably covered several micro-habitats and micro-communities.

TABLE 23. ASSOCIATED HOURGLASS STOMATOPODS. SPECIES COLLECTED TOGETHER IN SINGLE SAMPLES.

Depth (meters)	6	18								37						55					73			
Association number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Squilla neglecta								X																
Acanthosquilla biminiensis					X		X																	
Squilla empusa	X					X	X	X	X															
Meiosquilla schmitti			X	X	X				X				X		X					X				
Squilla rugosa		X	X				X	X	X	X	X			X										
Gonodactylus bredini	X	X	X	X	X	X	X			X	X	X	X											
Squilla deceptrix											X	X		X	X	X	X					X		X
Meiosquilla quadridens																X	X	X	X	X	X	X	X	
Parasquilla coccinea																			X		X			X
Squilla grenadensis																		X						
Platysquilla horologii																	X						X	
Number of times association occurred at each depth	1	2	1	2	1	2	1	1	1	9	6	2	1	4	1	2	1	2	1	1	1	4	2	1

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APPENDIX I

Monthly catches of all stomatopod species at Hourglass stations. Subscripts 1, 2, and sp represent regular (night), post (day) and supplementary cruises.

Acanthosquilla biminiensis

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																											1				1
B_2																															
C_1																															
C_2																															
D_1																															
D_2																															
E																															
I																															
J										1																					1
K																															
L																															
M																															
TOT										1																	1				2

Eurysquilla plumata

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1																															
D_2																						1									1
E																															
I																															
J																															
K																															
L																															
M																															
TOT																						1									1

Gonodactylus bredini

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A														4	1																5
B_1	1	2	1	3	6		4	6		2	4		1	9	7	4		4	3	2	4	5	15	7	8	11	17	29	20	61	236
B_2			3	8		3	7	8	5	4	6			1	11	9	5	7	3		2	5	7	7	6	13	18	22	6	10	176
C_1		3		1	4	9	3		3	3		5		5	1	8	1	4	4	1	7	6	6		3	2	2		2	1	84
C_2							5	5	5	7		5		4	1		13	7	7		4		1	1	1	3	4	10		6	89
D_1																															
D_2									1																						1
E											1																				1
I							1																								1
J						2		3	1	4	2		2			5	3	2			1	1	3	2	4	2			2	70	109
K					1	1	2					2	1	3	3	3	4		1			6	3		1	3		1	2		37
L																															
M																															
TOT	1	5	4	12	11	15	22	22	15	20	13	12	4	26	24	29	26	24	18	3	18	23	35	17	23	34	41	62	32	148	739

Lysiosquilla scabricauda

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1																															
D_2																					1										1
E																															
I																															
J																															
K																															
L																															
M																															
TOT																					1										1

Meiosquilla quadridens

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1											1				1	4									1		2	3	1	1	14
D_2																										1					1
E													1	4				2				1					1			1	10
I																															
J																															
K		1																													1
L														2	4								1	1		1			2		11
M														2	9		2		1	1			1			1		2		2	21
TOT		1									1		1	8	14	4	2	2	1	1		1	2	1	1	3	3	5	3	4	58

Meiosquilla schmitti

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																											1		1	2	4
B_2																															
C_1																												1			1
C_2																								1							1
D_1														1																	1
D_2																															
E																															
I																															
J																			1											2	3
K																									1						1
L																										1					1
M																															
TOT														1					1					1	1	1	1	1		4	12

Parasquilla coccinea

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1																													1		1
D_2																															
E					1			4																	1						6
I																												1			1
J																															
K																															
L																															
M																	1				1		3				1		1		7
TOT					1			4									1				1		3		1		1	1	2		15

Platysquilla horologii

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1															1																1
D_2																															
E														1								1									2
I																															
J																															
K																															
L																															
M																															
TOT														1	1							1									3

Squilla deceptrix

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1										7		6	1	3							1								1	2	21
C_2																															
D_1			1			1		2	1				1		6	1					1		1		2	3		1		2	23
D_2														1	2																3
E								2				4		1													1	1	2	3	14
I																															
J																															
K	1		1	1				1	2			3		1											2		1				13
L							1										1														2
M												2			1				22		5	3							3		36
TOT	1		2	1		1	1	5	3	7		15	2	6	9	1	1		22		7	3	1		4	3	2	2	6	7	112

Squilla empusa

STA	1965					1966													1967												TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A														3					1	2											6
B_1																															
B_2																															
C_1																															
C_2																															
D_1																															
D_2																															
E																															
I			1					1																							2
J							12	3			2								1												18
K																															
L																															
M																															
TOT			1				12	4			2			3					2	2											26

Squilla grenadensis

STA	1965					1966													1967													TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																															
B_1																															
B_2																															
C_1																															
C_2																															
D_1																															
D_2																															
E																															
I																															
J																															
K																															
L																												2			2
M																															
TOT																												2			2

Squilla neglecta

STA	1965					1966													1967													TOT
	A	S	O	N	D	J	F	M	A	M	J	J	J sp	A	S	O	N	D	J	J sp	F	M	A	M	J	J	A	S	O	N	
A																1															1
B_1																															
B_2																															
C_1																															
C_2																															
D_1																															
D_2																															
E																															
I																															
J							6												1												7
K																															
L																															
M																															
TOT							6									1			1												8

Squilla rugosa

STA	1965 A	S	O	N	D	1966 J	F	M	A	M	J	J	J sp	A	S	O	N	D	1967 J	J sp	F	M	A	M	J	J	A	S	O	N	TOT
A																															
B₁				1			1													1										1	4
B₂																															
C₁								4				2		1					2		1					2			1	2	15
C₂																	1														1
D₁																															
D₂																															
E																															
I																															
J			1	6	1		2	17								1			5	3	1										37
K	1					2		5	7	3		2		1	1			1	1	1	2	1	2		1			1			32
L																															
M																															
TOT	1		1	7	1	2	3	26	7	3		4		2	1	1	1	1	8	5	4	1	2		1	2		1	1	3	89