

GH
1
B4X
NH

No. 10, pp. 147-184

25 June 1976

PROCEEDINGS
OF THE
BIOLOGICAL SOCIETY OF WASHINGTON

STUDIES ON STOMATOPOD CRUSTACEA FROM THE
INDIAN RIVER REGION OF FLORIDA. II.
AN ANNOTATED CHECK LIST OF THE
MANTIS SHRIMPS OF THE CENTRAL
EASTERN FLORIDA COAST¹

BY ROBERT H. GORE AND LINDA J. BECKER
Smithsonian Institution,
Ft. Pierce Bureau, Ft. Pierce, Florida 33450

INTRODUCTION

The stomatopod crustaceans, or mantis shrimps, are a large, variable, and distinctive component in the tropical western Atlantic fauna. Although published records indicate that at least 20 species may occur along the central eastern Florida coast (e.g., Manning, 1969), there has been, as yet, no comprehensive survey of stomatopod crustaceans in the region. This area has long been of interest to zoogeographers, many of whom consider it to be a transitional zone between the tropical West Indian faunal subprovince to the south, and the warm temperate Carolinian faunal subprovince to the north (see e.g., Bayer, 1961; Work, 1969; Briggs, 1974). The Indian River is a long, relatively narrow, estuarine lagoon bordered by barrier islands offshore. The lagoon extends for its entire length along this transitional zone and constitutes a major physiographic feature for the region. A 3-year period, sampling in both the Indian River, and in waters to slightly greater than 200 m depth on the adjacent Atlantic continental shelf, provided 17 species of stomatopod crustaceans, in 9 genera and 3 families. Total material consisted of 341 speci-

¹ Scientific Contribution No. 56, from the Smithsonian Institution—Harbor Branch Foundation, Inc. Science Laboratories.

mens in 172 lots. Although no new species were found, the material filled several gaps in previous distributional records for this region, as well as providing one notable range extension for *Heterosquilla armata* (Smith, 1881), a species previously recorded only from boreal waters off the northeastern United States (Gore and Becker, 1975). Minor range extensions or first records for the Indian River area are also noted for the following 11 species previously known from north or southeastern Florida: *Meiosquilla quadridens*, *M. schmitti*, *M. tricarinata*, *Cloridopsis dubia*, *Squilla rugosa*, *S. neglecta*, *Pseudosquilla ciliata*, *Parasquilla coccinea*, *Gonodactylus oerstedii*, *G. spinulosus* and *Eurysquilla plumata* (Fig. 16).

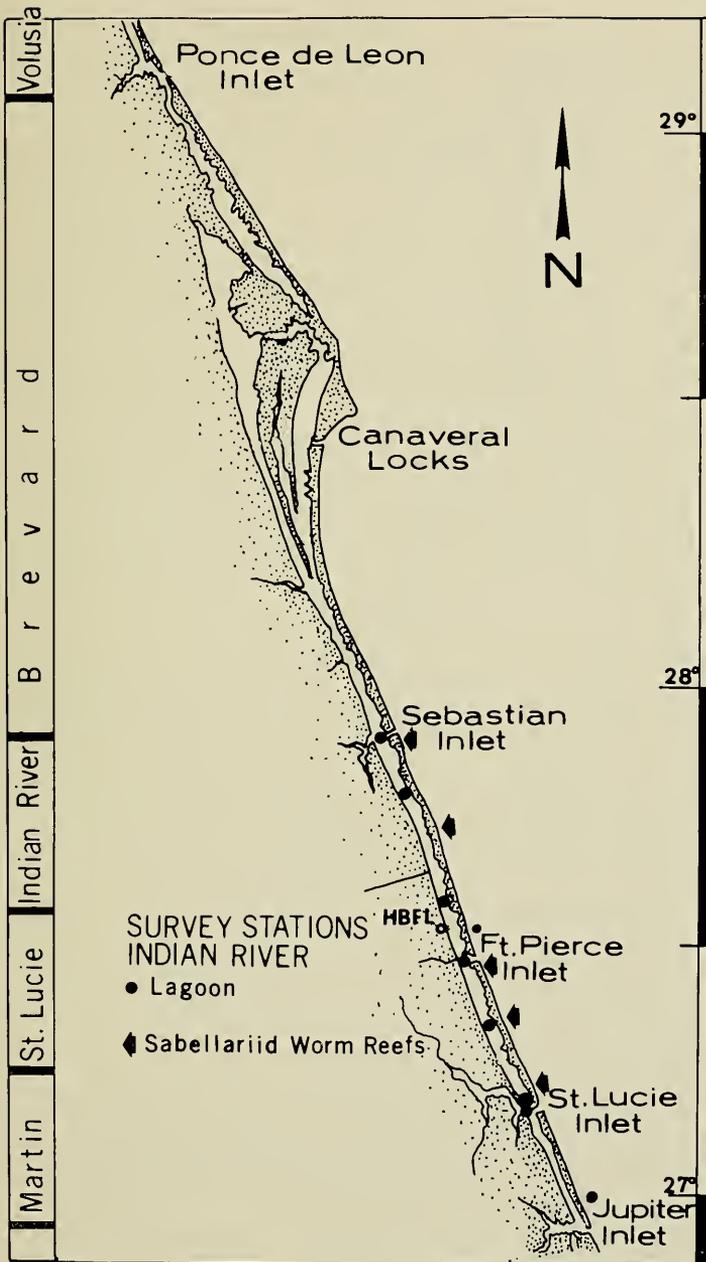
MATERIALS AND METHODS

Specimens were collected using a variety of gear. In the shallow lagoonal estuary and vicinity (Fig. 1), collections were primarily by seine net, hand, or poison station, on intertidal grass and mudflats, and in associated mangrove stands and phragmatopomid worm reefs (Table 1). Continental shelf collections (Fig. 2) were made with 10 and 20 ft otter trawls, 5 ft Blake trawls, box and pipe dredges, in waters from 5 to approximately 215 m deep over sand, mud, coquinoïd shell hash, and coralline rubble bottom (Table 2). A complete listing of all Indian River area stations and associated chemical and biological data are on file at the Smithsonian Institution, Ft. Pierce, Florida (SIFP).

All specimens were measured using either dial calipers, or a stage micrometer calibrated to an ocular reticle in a Wild M-5 stereomicroscope, and are expressed in millimeters (TL) or in millimeters rounded off to the nearest tenth (Rcl). The meristics used in the taxonomy of stomatopods are many and varied, and the reader is referred to Manning's (1969) monograph, or Camp's (1973) study on Hourglass Stomatopoda for definitions. In this report, however, we confine our measure-

→

FIG. 1. Survey stations in the Indian River lagoon at which Stomatopoda were collected, November 1971 to December 1974. HBFL = Harbor Branch Foundation Laboratory, Link Port.



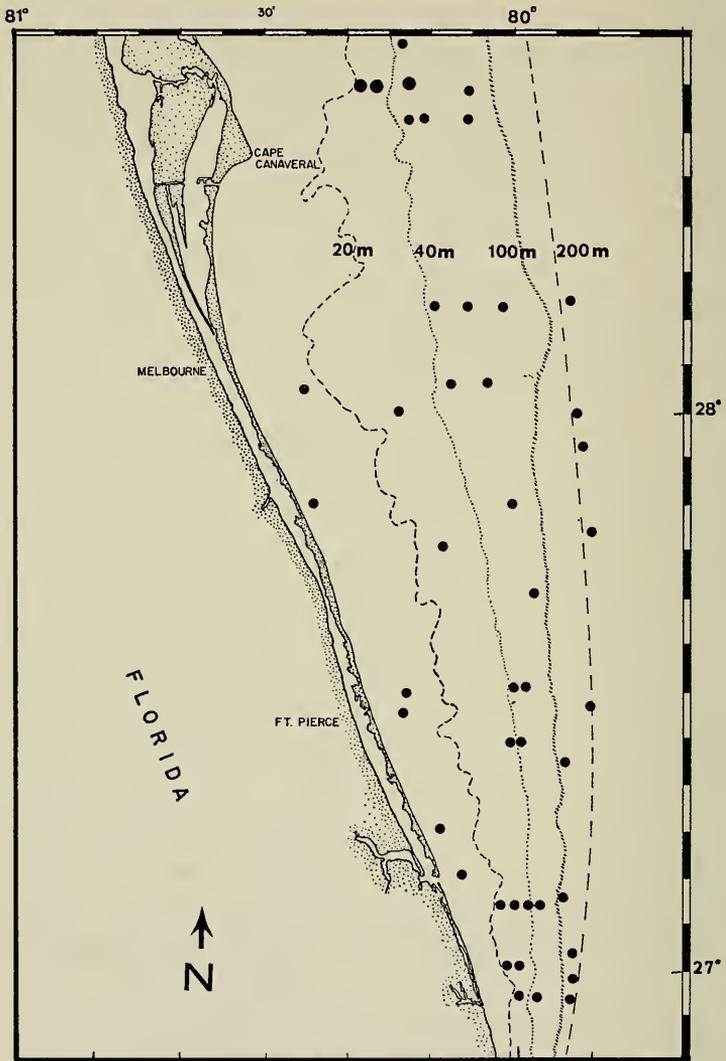


FIG. 2. Survey stations by R/V *Hernan Cortez* and R/V *Gosnold* on the continental shelf offshore of the Indian River region at which Stomatopoda were collected, January 1973 through December 1974. Large dots indicate DNR repetitive stations, Federal Rock Shrimp Project (see text).

ments to (1) total body length (TL) as defined in Manning (1969), even though this measurement may be quite subjective at times, depending on how the specimen is stretched out from its normally curled position in preservative, followed by (2) Rostral-carapace length (Rcl) defined as extending from the anterior margin of the rostrum to the posterior median margin of the carapace.

Synonymies are restricted to pertinent works which were omitted from, or appeared later than Manning's (1969) monograph on western Atlantic Stomatopoda.

Most of the material in this report is now accessioned into the Invertebrate Reference Museum, Smithsonian Institution, Ft. Pierce Bureau. Selected lots representative of some of the species from the Indian River area have been forwarded to the Reference Museum, Florida Department of Natural Resources, Marine Research Laboratory, St. Petersburg, Florida, and to the National Museum of Natural History, Washington, D.C. (USNM 152463 to 152469).

ACKNOWLEDGMENTS

We thank Drs. Raymond B. Manning, National Museum of Natural History (NMNH), Thomas E. Bowman (NMNH) and Austin B. Williams, National Marine Fisheries Service, for critically reviewing the manuscript, and for providing advice on several species identification or procedural points which we had overlooked or omitted. We also express our thanks to the many people of the Indian River Study at both the Smithsonian Institution, Ft. Pierce Bureau, and the Harbor Branch Foundation, Inc., Science Laboratory, for their aid in field collections both ashore and at sea. Special thanks are due to Capt. Harry Seibert and the crew of the R/V GOSNOLD, then on loan from the Woods Hole Oceanographic Institution, and to Capt. Robert Larson, R/V SEA HUNTER II, Florida Institute of Technology, Melbourne, Florida, for their complete, courteous and professional cooperation during collecting operations at sea. We also express our gratitude to Messrs. William Lyons, David Camp and Nick Whiting, as well as to the captain and crew of the R/V HERNAN CORTEZ, all of the Florida Depart-

TABLE 1. Indian River lagoon and shallow off-shore stations at which stomatopods were obtained

Location	Depth	Date	Species
Atlantic Ocean off Jupiter Island, Fla.	10 m	June 1973	<i>Lysiosquilla scabricauda</i> <i>Squilla neglecta</i>
St. Lucie Inlet, Fla.	Intertidal	May 1972; Jan., Apr. to Aug. 1974 Jan. 1975	<i>Gonodactylus bredini</i> <i>G. oerstedii</i> <i>G. spinulosus</i>
Hutchinson Island, Fla.			
Bessie Cove	Intertidal	Oct. 1974	<i>Lysiosquilla</i> sp.*
Walton Rocks	Intertidal	Jan., May to Aug., Oct., 1974	<i>Gonodactylus bredini</i> <i>G. oerstedii</i> <i>G. spinulosus</i>
Big Mud Creek	Intertidal	Mar., Sept. 1974 Mar. 1975	<i>Cloridopsis dubia</i>
Ft. Pierce, Fla.			
Harbor	Subtidal	June 1971	<i>Lysiosquilla scabricauda</i>
	Intertidal	Apr. 1972; Feb., July, Oct. 1974	<i>Gonodactylus bredini</i> <i>G. oerstedii</i> <i>Pseudosquilla ciliata</i>

* *Lysioerichthys* larval stage.

TABLE 1. (cont.)

Location	Depth	Date	Species
Inlet Link Port	Surface Intertidal	Oct. 1974 Aug. 1972 Apr. 1973	<i>Lysiosquilla scabricauda</i> <i>Cloridopsis dubia</i>
Atlantic Ocean, Nearshore, St. Lucie Co., Fla. Vero Beach, Fla.	3-6 m 3 m	May, July 1973 Feb., June, July 1972	<i>Gonodactylus bredini</i> <i>Gonodactylus bredini</i> <i>G. oerstedii</i>
Wabasso, Fla.	Intertidal	Dec. 1972	<i>Cloridopsis dubia</i>
Sebastian Inlet, Fla.	Surface Intertidal	Jan. 1972 Feb. 1974	<i>Lysiosquilla scabricauda</i> <i>Gonodactylus bredini</i>

TABLE 2. Research vessel stations and localities at which stomatopods were obtained*

Station	Date	Location	Depth (m)	Species
	1973			
G-209/041**	17 Nov.	27°24.9'N, 79°59.4'W	64	<i>Squilla empusa</i>
G-210/060	27 Nov.	27°42.8'N, 79°57.3'W to 27°45.2'N, 79°57.2'W	100-97	<i>Squilla deceptrix</i>
G-213/082	12 Dec.	27°49.9'N, 80°24.6'W to 27°51.1'N, 80°25.2'W	10	<i>Squilla empusa</i>
	1974			
G-216/128	17 Jan.	26°57.6'N, 79°59.4'W to 27°00.7'N, 80°01.2'W	48	<i>Squilla deceptrix</i>
/135	18 Jan.	27°27.4'N, 79°59.2'W to 27°30.3'N, 80°03.5'W	60-30	<i>Squilla empusa</i>
G-217/167	25 Jan.	27°01.3'N, 79°58.0'W to 27°03.6'N, 79°58.2'W	100-92	<i>Squilla empusa</i>
G-220/224	13 Feb.	27°28.8'N, 80°14.5'W to 27°32.6'N, 80°16.3'W	15	<i>Gonodactylus bredini</i>
/230	same	28°01.2'N, 80°14.8'W to 28°01.7'N, 80°12.3'W	22	<i>Gonodactylus bredini</i>
G-222/264	25 Feb.	26°56.6'N, 79°57.8'W to 26°56.5'N, 79°57.5'W	105	<i>Gonodactylus</i> sp. <i>Gonodactylus oerstedii</i>
G-224/351	13 Mar.	27°07.5'N, 79°59.7'W to 27°09.7'N, 80°00.6'W	66	<i>Squilla empusa</i>

* Data taken from corrected scientific cruise logs for each vessel.

** G = R/V GOSNOLD; HC = R/V HERNAN CORTEZ; SH = R/V SEA HUNTER II.

TABLE 2. (cont.)

Station	Date	Location	Depth (m)	Species
G-229/408	16 Apr.	27°10.7'N, 80°07.4'W to 27°10.7'N, 80°07.5'W	13	<i>Gonodactylus bredini</i>
G-230/423	17 Apr.	27°29.3'N, 80°00.5'W to 27°32.3'N, 80°01.5'W	53	<i>Squilla empusa</i>
G-237/497 /503	10 June same	27°16.7'N, 80°08.7'W 27°00.0'N, 79°57.7'W to 26°57.7'N, 79°57.8'W	15 100	<i>Meiosquilla tricarinata</i> <i>Squilla empusa</i>
/505	11 June	26°57.0'N, 79°53.7'W to 27°01.5'N, 79°55.9'W	198-148	<i>Squilla edentata edentata</i>
/507	same	27°08.5'N, 79°54.0'W	210	<i>Heterosquilla armata</i>
/510	11 June	27°28.3'N, 79°52.6'W to 27°33.0'N, 79°53.2'W	208	<i>Squilla edentata edentata</i>
/511	same	27°47.3'N, 79°52.9'W to 27°52.3'N, 79°53.2'W	215	<i>Squilla edentata edentata</i>
G-245/687	26 Aug.	26°56.8'N, 79°54.5'W to 27°00.5'N, 79°54.3'W	191-182	<i>Squilla edentata edentata</i>
/688	same	27°03.1'N, 79°54.0'W to 27°07.0'N, 79°55.0'W	200	<i>Squilla edentata edentata</i>
/690	27 Aug.	27°22.3'N, 79°53.0'W to 27°24.1'N, 79°52.8'W	193	<i>Squilla edentata edentata</i>
/695	28 Aug.	27°30.3'N, 79°59.0'W to 27°29.0'N, 79°59.5'W	72	<i>Squilla empusa</i> <i>Parasquilla coccinea</i>

TABLE 2. (cont.)

Station	Date	Location	Depth (m)	Species
G-246/705	4 Sept.	27°59.1'N, 79°53.6'W to 28°06.3'N, 79°53.4'W	185-212	<i>Squilla edentata edentata</i>
G-248/730	17 Sept.	28°11.8'N, 79°53.7'W to 28°16.4'N, 79°54.3'W	203-198	<i>Squilla edentata edentata</i>
/739	18 Sept.	27°56.5'N, 79°52.8'W to 27°58.0'N, 79°52.5'W	200	<i>Squilla edentata edentata</i>
/741	same	27°50.8'N, 80°01.0'W to 27°49.8'N, 80°00.4'W	50	<i>Meiosquilla quadridens</i>
/742	19 Sept.	27°46.2'N, 80°09.5'W to 27°44.1'N, 80°09.5'W	18	<i>Gonodactylus bredini</i>
G-250/761	1975	27°51.6'N, 80°03.0'W	41	<i>Eurysquilla plumata</i>
G-262/780	18 Feb. 13 Aug.	27°53.3'N, 80°09.2'W	20	<i>Meiosquilla schmitti</i>
HC-6**	1973	28°34.8'N, 80°14.8'W	38	<i>Squilla empusa</i>
HC-17	15 Jan.	28°39.4'N, 80°13.2'W	43	<i>Squilla rugosa</i>
HC-23, 25, 27	16 Jan. 17 Jan.	28°37.0'N, 80°11.2'W	45	<i>Squilla deceptrix</i> <i>Squilla empusa</i>
HC-41, 43 45	18 Jan.	28°32.5'N, 80°10.3'W	45	<i>Squilla empusa</i>
HC-47	23 Jan.	27°07.0'N, 79°59.6'W	65	<i>Squilla empusa</i>
HC-49	24 Jan.	27°07.9'N, 80°02.1'W	28	<i>Squilla neglecta</i>
HC-83	6 Feb.	28°37.1'N, 80°04.8'W	71	<i>Parasquilla coccinea</i>

TABLE 2. (cont.)

Station	Date	Location	Depth (m)	Species
HC-103	4 Mar.	28°37.0'N, 80°11.2'W	43	<i>Squilla empusa</i>
HC-114	5 Mar.	28°37.1'N, 80°04.8'W	70	<i>Parasquilla coccinea</i>
HC-151	8 Apr.	28°32.5'N, 80°10.3'W	40	<i>Squilla deceptrix</i>
				<i>Squilla empusa</i>
HC-181	13 Apr.	27°07.3'N, 80°00.4'W	45	<i>Squilla empusa</i>
HC-196	5 May	28°37.1'N, 80°04.8'W	65	<i>Squilla deceptrix</i>
198				<i>Parasquilla coccinea</i>
HC-202	same	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i>
				<i>Squilla neglecta</i>
HC-216	6 May	28°37.0'N, 80°11.2'W	41	<i>Squilla empusa</i>
220				
HC-224	7 May	28°32.5'N, 80°10.3'W	40	<i>Squilla empusa</i>
HC-262	23 May	28°03.0'N, 80°03.5'W	46	<i>Squilla empusa</i>
HC-264	same	28°03.1'N, 80°07.4'W	37	<i>Squilla empusa</i>
				<i>Squilla rugosa</i>
HC-268	same	28°02.4'N, 80°25.6'W	18	<i>Squilla empusa</i>
HC-272	same	28°11.0'N, 80°01.0'W	55	<i>Squilla empusa</i>
HC-274	same	28°11.1'N, 80°05.0'W	46	<i>Squilla empusa</i>
HC-276	same	28°11.3'N, 80°10.1'W	37	<i>Squilla empusa</i>
HC-283	31 May	28°35.9'N, 80°18.6'W	26	<i>Squilla neglecta</i>
				<i>Squilla rugosa</i>
HC-290	1 June	28°37.0'N, 80°11.2'W	40	<i>Conodactylus bredini</i>
HC-338	3 June	28°37.0'N, 80°11.2'W	40	<i>Squilla deceptrix</i>

TABLE 2. (cont.)

Station	Date	Location	Depth (m)	Species
HC-344	1 July	28°32.5'N, 80°10.3'W	40	<i>Squilla deceptrix</i> <i>Squilla empusa</i>
HC-356 360	same	28°37.1'N, 80°04.8'W	64	<i>Squilla deceptrix</i> <i>Parasquilla coccinea</i>
HC-363	2 July	28°35.9'N, 80°18.6'W	26	<i>Squilla neglecta</i>
HC-395	14 Aug.	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i> <i>Squilla neglecta</i>
HC-399 403	15 Aug.	28°37.0'N, 80°11.2'W	40	<i>Squilla deceptrix</i>
HC-417	9 Sept.	28°37.1'N, 80°04.8'W	64	<i>Meiosquilla quadridens</i>
HC-439	10 Sept.	28°37.0'N, 80°11.2'W	40	<i>Squilla deceptrix</i>
HC-441 445	11 Sept.	28°32.5'N, 80°10.3'W	40	<i>Squilla deceptrix</i>
HC-455	13 Sept.	28°59.6'N, 80°30.6'W	37	<i>Squilla deceptrix</i>
HC-472	15 Oct.	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i>
HC-499	2 Nov.	28°37.0'N, 80°11.2'W†	40	<i>Squilla deceptrix</i>
HC-516	3 Nov.	28°37.1'N, 80°04.8'W†	64	<i>Squilla deceptrix</i>
HC-530	4 Nov.	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i>
HC-590	1974 17 Jan.	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i> <i>Squilla neglecta</i>
HC-728	10 Apr.	28°37.0'N, 80°11.2'W	40	<i>Squilla empusa</i>
HC-731	11 April	28°32.5'N, 80°10.3'W	40	<i>Squilla empusa</i>

† See remarks in text.

TABLE 2. (cont.)

Station	Date	Location	Depth (m)	Species
HC-750	20 Apr.	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i>
HC-758	15 May	28°32.5'N, 80°10.3'W	40	<i>Gonodactylus bredini</i>
HC-894	17 July	28°32.5'N, 80°10.3'W	40	<i>Squilla deceptrix</i>
898				
HC-916	18 July	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i>
920				<i>Squilla rugosa</i>
HC-924	19 July	28°37.1'N, 80°04.8'W	64	<i>Squilla deceptrix</i>
926				<i>Parasquilla coccinea</i>
HC-937	13 Aug.	28°37.1'N, 80°04.8'W	64	<i>Meiosquilla quadridens</i>
939				<i>Squilla deceptrix</i>
HC-941	14 Aug.	28°35.9'N, 80°18.6'W	26	<i>Parasquilla coccinea</i>
945				<i>Squilla empusa</i>
HC-948	same	28°37.0'N, 80°11.2'W	40	<i>Gonodactylus bredini</i>
952				<i>Squilla deceptrix</i>
HC-1007	15 Oct.	28°32.5'N, 80°10.3'W	40	<i>Gonodactylus oerstedii</i>
HC-1109	6 Dec.	28°37.0'N, 80°11.2'W	40	<i>Squilla empusa</i>
1111				
1113				
HC-1116	same	28°35.9'N, 80°18.6'W	26	<i>Squilla empusa</i>
1118				
1120				
SH 001-73**	1973			
	21 May	25°29.0'N, 80°13.0'W	17	<i>Lysiosquilla</i> sp.

ment of Natural Resources, for arranging for, and providing us with, specimens collected during their own biological survey on rock shrimp off Cape Canaveral, Florida. Mr. William Davenport of the Harbor Branch Foundation provided the photographic plates of the specimens. Facilities were provided by the Smithsonian Institution-Harbor Branch Foundation, Inc. Scientific Consortium at Link Port, Ft. Pierce, Florida.

Family LYSIOSQUILLIDAE Giesbrecht, 1910

Genus *Heterosquilla* Manning, 1963

Heterosquilla (*Heterosquilloides*) *armata* (Smith, 1881)

Heterosquilla (*Heterosquilloides*) *armata*.—Manning, 1974: 1, 3 [key], 4, figs. 7, 9.—Gore & Becker, 1975: 21, figs. 1–3.

Material examined: 1 ♀; 43 mm (TL); 9.5 mm (Rcl).

Remarks: This species has been previously treated by Gore and Becker (1975).

Distribution: From New England to the central, east coast of Florida, in 96 to 218 m.

Genus *Lysiosquilla* Dana, 1852

Lysiosquilla scabricauda (Lamarck, 1818)

Figure 3

Lysiosquilla scabricauda.—Hildebrand, 1955: 189, 220 [discussion].—Manning, 1972: 315 [listed].—Camp, 1973: 6, 7 [key], 10, fig. 2.—Zeiller, 1974: 69 and color plate.

Material examined: 2 ♂♂, 234 to 257 mm (TL); 46.2 to 49.8 mm (Rcl); 3 ♀♀, 131 to 148 mm (TL); 25.1 to 29.4 mm (Rcl); 1 ovigerous female, 148 mm (TL), 29.3 mm (Rcl).

Remarks: Three specimens including an ovigerous female collected in the Atlantic Ocean off Jupiter Island, Florida were thrown ashore by the dredges of the U.S. Army Corps of Engineers during a beach reclamation project. This crude means of collecting might account for the ovigerous female, which, if like other stomatopods, would not normally leave the burrow while carrying eggs (see Kaestner, 1970: 251).

Lysiosquilla scabricauda has also been collected by means of a dip net or hook and line while swimming at the surface. As Manning (1969) has noted, these animals can be found on an outgoing tide in the evening, associated with shrimp, and such was the case with the female collected at Sebastian Inlet.

Distribution: Widely distributed in the Atlantic from Bermuda to Southern Brazil and off west Africa, from the intertidal zone to 55 m.

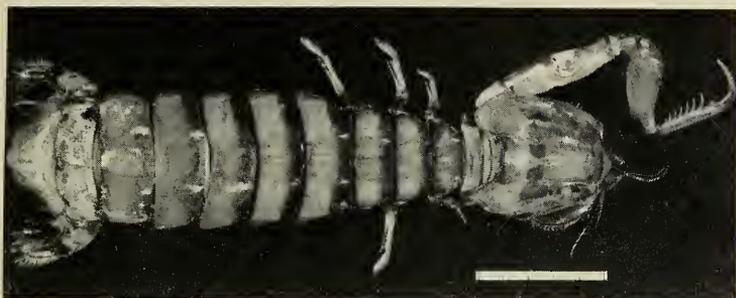


FIG. 3. *Lysiosquilla scabricauda* (Lamarck). Adult male, Indian River, Fort Pierce, Florida. Scale lines each equal 10 mm.

Lysiosquilla sp.

Material examined: 1 larva, 1 postlarva.

Remarks: The larval stage was determined to be a *Lysioerichthus* based on the characteristics of the telson and raptorial claw. In general morphological features the specimens appeared to be *Lysiosquilla scabricauda*, the only species of this genus collected in the survey.

Family SQUILLIDAE Latreille, 1803

Genus *Cloridopsis* Manning, 1968

Cloridopsis dubia (H. Milne-Edwards, 1837)

Figure 4

Cloridopsis dubia.—Manning, 1974a: 107, fig. 3.

Material examined: 1 ♂, 139 mm (TL); 29.7 mm (Rcl); 5 ♀ ♀, 68 to 143 mm (TL); 14.1 to 30.0 mm (Rcl).

Color: The following notes were made on either live or recently preserved specimens. Carapace overall light brown to grey-green. Carinae scarlet to crimson; cervical groove dull blue. Thoracic carinae crimson. Antennules and antennae grey, mottled with black chromatophores. Raptorial claw pale green to blue, flushed with blue green dorsally; margins of merus bright green; carpus brownish white outlined in green; propodus flushed with blue, with additional brown speckles on white background; dactylus white flushed with blue. Propodi of last 3 maxillipeds with scattered light yellow chromatophores. Dorsal surface of abdomen brown, with white or pink maculations, lateral margins dark blue. Telson overall light tan fading to grey around margins; all teeth distinctly dark blue, as are median carinae; tubercles adjacent to latter scarlet. Uropod ventral surface light yellow.

Remarks: According to Manning (1969: 140), the submedian teeth of the telson are without moveable apices, an error he corrected in

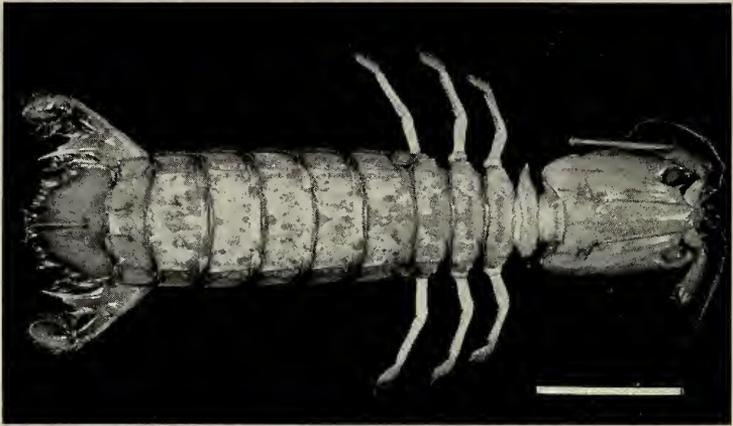


FIG. 4. *Cloridopsis dubia* (H. Milne Edwards). Adult female, Indian River, Link Port, Florida. Scale lines each equal 10 mm.

1974, noting, as did we in our material, that the movable spines can be very minute. Nearly all of the adult material we examined in this study had blunt teeth with fixed apices, whereas the three juvenile females in our material had movable apices on the submedian teeth of the telson. This fact should be considered when one uses the key provided by Manning (1969: 100). The adult forms also appear to be more highly sculptured than the younger forms.

Distribution: Intertidally, from Charleston, South Carolina to Brazil.

Genus *Meiosquilla* Manning, 1968

Meiosquilla quadridens (Bigelow, 1893)

Figure 5

Meiosquilla quadridens.—Manning, 1970: 104.—Camp, 1971: 125 [listed]; 1973: 8 [key], 18, fig. 6.

Material examined: 1 ♂, 27 mm (TL); 7.7 mm (Rcl); 2 ♀♀, 29 to 30 mm (TL); 6.8 to 8.1 mm (Rcl).

Color: The female specimen collected at the R/V GOSNOLD station while still alive was covered overall with scattered iridescent green and brown chromatophores.

Remarks: The specimens we examined agreed well with the description provided by Manning (1969).

Distribution: Although our material indicates that *M. quadridens* is now found in Florida as far north as Cape Canaveral, the species does not seem to be very common in the Indian River region. Elsewhere, it occurs from the Bahamas to Surinam, in the littoral zone to 137 m.

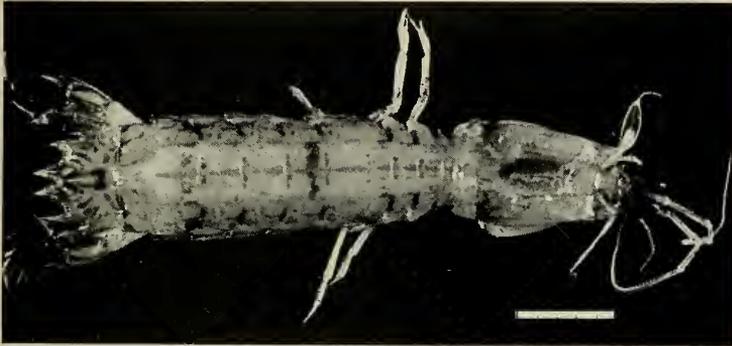


FIG. 5. *Meiosquilla quadridens* (Bigelow). Adult female, off Cape Canaveral, Florida. Scale lines in mm.

Meiosquilla schmitti (Lemos de Castro, 1955)

Meiosquilla schmitti.—Camp, 1973: 1 [abstract], 8 [key], 22 [remarks], 24, fig. 8, 77 ff [discussion, tables].

Material examined: 1♂, 31.1 mm (TL), 8.0 mm (Rcl).

Remarks: The fifth thoracic somite in our single specimen had a laterally projecting, blunt-tipped spine instead of a rounded lobe. We note that the specimen figured by Camp (1973: 25) also appears to have blunt-tipped spines present. Our specimen also differs from that figured by Manning (1969: 112, fig. 32e) and agrees in part with that noted above by Camp, in having the fifth abdominal somite intermediate carinae unspined, and the fourth and fifth marginal and lateral carinae, respectively, unarmed. Apparently, the species may exhibit some variability in this regard.

Distribution: Previously known from the Bahamas, southeastern and southwestern Florida, Texas, Yucatan Peninsula, Colombia, Venezuela, and Brazil. The Indian River specimen collected off Sebastian Inlet marks the northernmost record for the species. Sublittoral to 40 m.

Meiosquilla tricarinata (Holthuis, 1941)

Figure 6

Meiosquilla tricarinata.—Manning, 1969: 114, figs. 33c, 34.

Material examined: 1♀, 31 mm (TL); 7.5 mm (Rcl).

Remarks: Our material extends the known range north from the Miami area approximately 150 miles (240 km). The female had 2–3 as opposed to the usual 3–4 accessory carinae on the dorsal surface of the telson lateral to the submedian carinae. Of these carinae, Manning stated that 2–3 lie in a plane between the submedian and intermediate carinae. However, this specimen had only 1–2 carinae in such

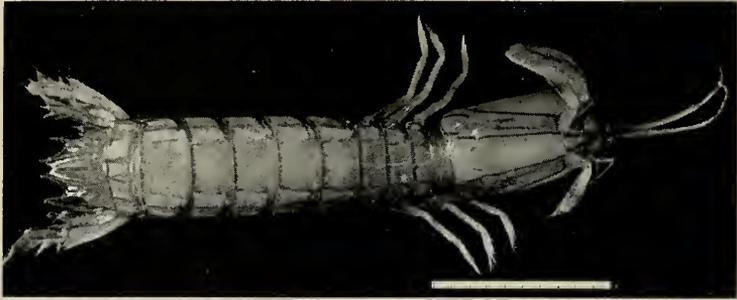


FIG. 6. *Meiosquilla tricarinata* (Holthuis). Adult female, off Jensen Beach, Florida. Scale lines in mm.

a location. Otherwise, the description of the species agreed in all respects.

Distribution: Off Jensen Beach, Florida to Brazil, including Fernando de Noronha, Mogiquiçaba, and the Abrolhos Islands; sublittoral to 48 m.

Genus *Squilla* Fabricius, 1787

Squilla deceptrix Manning, 1969

Figure 7, Table 3

Squilla deceptrix.—Camp, 1971: 125 [listed]; 1973: 8 [key], 33, fig. 12. *Squilla* species.—Camp, 1973: 1 [abstract], 42, fig. 15 [postlarvae, = *S. deceptrix*?].

Material examined: 16 ♂♂, 30 to 55 mm (TL); 7.8 to 13.5 mm (Rcl); 17 ♀♀, 31 to 63 mm (TL); 7.6 to 14.5 mm (Rcl).

Remarks: Manning (1969: 170) noted the possibility of more than one species in the material he examined and described as *S. deceptrix*. However, the material we examined from the offshore Indian River region seemed to be well within the limits of variation described by Manning.

Distribution: *Squilla deceptrix* is known from North Carolina to Tobago between 37 and 346 m. We did not find any specimens in our sampling area in depths greater than 100 m.

Squilla edentata edentata (Lunz, 1937)

Figure 8, Table 3

Squilla edentata.—Manning, 1970a: 270 [discussion].—Camp, 1973: 6, 9 [key].

Material examined: 20 ♂♂, 68 to 135 mm (TL); 15.5 to 30.8 mm (Rcl); 53 ♀♀, 57 to 143 mm (TL); 13.8 to 31.5 (Rcl).

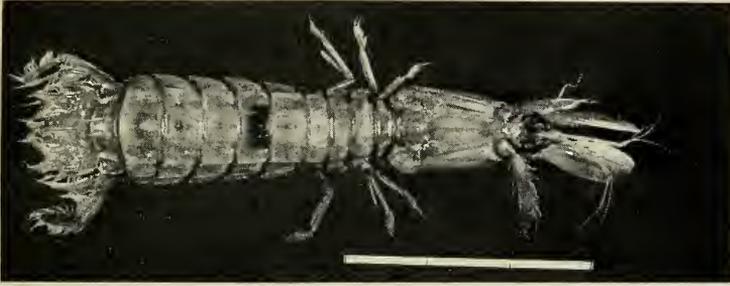


FIG. 7. *Squilla deceptrix* Manning. Adult female, off Cape Canaveral, Florida. Scale lines equal 10 mm.

Color: The following color notes are provided to supplement those of live specimens mentioned by Manning (1969: 224): Telson brown with usual orange spots lateral to median carinae; anterior margin of telson and median carinae iridescent blue; uropods yellow and white; eyes of living specimens bright iridescent green. This last feature, quite striking of itself, has also been noted in *Squilla empusa*, and is a good field character. Preserved specimens exhibited the orange spots on the telson for over a year in ethanol.

Remarks: The raptorial claw on some specimens collected at G-237/505 had 3 sharp tubercles, rather than the usual 2, on the carpus. On all but 2 specimens examined the abdominal carinae were spined in accordance with Manning's (1969: 223) description. Abdominal somite 1 may or may not have spined intermediate carinae and only a juvenile



FIG. 8. *Squilla edentata edentata* (Lunz). Adult male, off Jupiter Inlet, Florida. Scale lines each equal 10 mm.

TABLE 3. Distinguishing morphological features in the species of *Squilla* collected from the Indian River Region of Florida

Character	<i>S. deceptrix</i>	<i>S. edentata edentata</i>	<i>S. empusa</i>	<i>S. neglecta</i>	<i>S. rugosa</i>
Rostral width \times length	W > L	W > L	W > L	W > L	W \cong L
Carapace					
Median carina	Ill-defined	Well defined	Well defined	Well defined	Defined
Anterior bifurcation	None	Present	Present	Present	None
Raptorial claw, teeth	6	6	6	5	6
Thoracic somites, lateral projection					
5th	Curved spine	Curved spine	Curved spine	Spatulate lobe	Acuminate lobe
6th	Sharp, bilobed	Sharp, bilobed	Sharp, bilobed	Bluntly angular, bilobed	Sharp, bilobed
7th	Sharp, not bilobed	Sharp, faintly bilobed	Same	Same	Sharp, not bilobed
Abdominal somites 5 & 6					
Accessory spinules (s) and tubercles (t)	(s) lacking (t) present	(s) lacking (t) lacking	(s) lacking (t) lacking	(s) lacking (t) lacking	(s) present (t) lacking

TABLE 3. (cont.)

Character	<i>S. deceptrix</i>	<i>S. edentata edentata</i>	<i>S. empusa</i>	<i>S. neglecta</i>	<i>S. rugosa</i>
Telson					
Width × length	W > L	W > L	W > L	W ≈ L	W ≈ L
Dorsal armature*	Tubercles	Unarmed	Unarmed	Unarmed	Carinae
Denticle formula	5-7, 8-11, 1	2-5, 11-15, 1	3-5, 6-9, 1	2-4, 5-7, 1	4-6, 7-12, 1
Submedian denticles	Outer largest	Outer largest	Subequal	Inner largest	Subequal
Uropod					
Basal prolongation	Serrated	Serrated	Irregularly bluntly, serrated	Faintly dentate	Spined
Endopodite shape	Elliptically elongate	Tapering distally	Elliptically elongate	Elliptically elongate	Elliptically elongate

* This armature is in addition to the standard armature on the median carina of this genus.

male in our material collected in 215 m had these carinae spined posteriorly. In other material, the first abdominal somite was sometimes armed on the intermediate carinae, but was always armed on the lateral and marginal carinae, again with the exception of one specimen out of 73 examined, which had no armature of any kind on the posterior margins of these carinae. This should be viewed in light of Manning's statement that all specimens of *Squilla edentata australis*, the southern subspecies from South America, had the lateral carinae armed, as opposed to only 6 specimens in his material of *S. edentata edentata* so armed. The Indian River material thus appears to be intermediate in this feature between the 2 subspecies.

Sometimes, the submedian denticles on the telson of our specimens of *S. edentata edentata* were rather swollen and appeared fused as one unit rather than the usual 2-5. This agrees with the formula in Manning (1969: 224) of (1), 2-5, (6) submedian denticles.

Distribution: *Squilla edentata edentata* appeared to be a typical Carolinian species, showing a classical disjunct distribution from South Carolina to Jupiter Inlet, in southeast Florida, and in the Gulf of Mexico, from Cape George, Florida to Texas; it has been collected from 55 to 319 m, although generally at less than 200 m in the Indian River region.

Squilla empusa Say, 1818

Figure 9, Table 3

Squilla empusa.—Hildebrand, 1954: 260, 261, 349 [discussion], table 29; 1955: 189, 220 [discussion].—Lemos de Castro, 1955: 19 [discussion], 21, 22.—Tabb & Manning, 1961: 594.—Tabb and Manning, 1962: 61, 62 [listed].—Dragovich & Kelly, 1964: 79, table 2.—Burrows, 1969: 362, [ethology].—Fingerman & Rao, 1969: 138, [physiology].—Rouse, 1969: 135.—Trevino & Larimer, 1969: 987 [physiology].—Manning, 1970a: 257, [discussion].—Godcharles, 1971: 26, 32 [listed].—Lyons, et al., 1971: 27.—Perret, et al., 1971: 61, tables 4, 7.—Manning, 1972: 315 [listed].—Camp, 1973: 6, 9 [key], 39, fig. 14.—Manning, 1974: 1, 2 [key], 4, figs. 3, 8.

Material examined: 27 ♂♂, 80 to 115 mm (TL); 18.1 to 33.9 mm (Rcl); 66 ♀♀, 56 to 141 mm (TL); 14.8 to 34.3 mm (Rcl).

Remarks: The specimens of *S. empusa* examined agreed well with the description provided by Manning (1969). Some slight variation was noticed in the anterior bifurcation on the dorsal surface of the carapace. Although usually well defined, one adult female collected at HC-202 (Florida Department of Natural Resources, catalog number I-9880) had this bifurcation poorly marked. In both a male and a female from HC-25 (Florida Department of Natural Resources, catalog number I-9794), the distance from the dorsal pit to the bifurcation was slightly greater than one-fifth the distance from the bifurcation to the anterior margin of the carapace. The male in this material had armed sub-

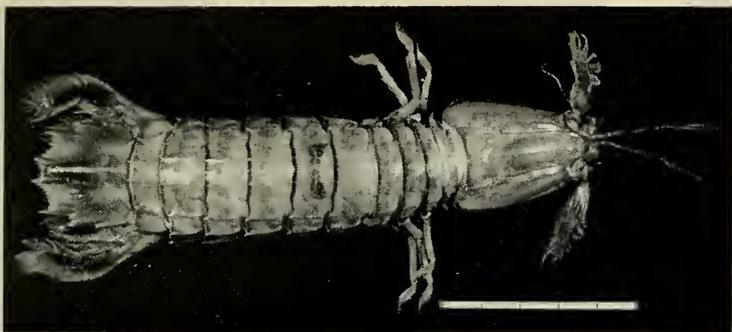


FIG. 9. *Squilla empusa* Say. Adult female, off Cape Canaveral, Florida. Scale lines each equal 10 mm.

median carinae on abdominal somite 4, which apparently is also a variable character.

The dactylus of the raptorial claw normally contains 6 teeth. Camp (1973: 40) examined a specimen obtained from the Hourglass Cruise which had 5 teeth on one claw and 6 on the other. One specimen we examined (HC-276, I-9773) had 7 and 6 teeth on the left and right claw, respectively.

The lateral spine of the 5th thoracic somite is defined as a sharp, anteriorly curved spine. Some specimens had spines which were very noticeably curved, and others curved only slightly more than a laterally directed spine. This minor variation should be kept in mind when considering growth variation between juvenile forms and mature adults of *S. empusa*.

Distribution: *Squilla empusa* is distributed from Maine southward along the eastern seaboard of North America to South America as far south as Surinam. There is a questionable record from Bermuda. The species occurs from the intertidal to 154 m. Even though extensive collecting was done along the 40 m line off the central eastern Florida coast, the specimens we examined were generally found at depths greater than 40 m (see Manning, 1969: 214).

Squilla neglecta Gibbes, 1850

Figure 10, Table 3

Squilla neglecta.—Godcharles, 1971: 26 [listed].—Lyons et al., 1971: 27.—Camp, 1973: 9 [key], 37, fig. 13.

Material examined: 7 ♂♂, 55 to 105 mm (TL); 13.8 to 27.5 mm (Rcl); 3 ♀♀, 87 to 100 mm (TL); 21.7 to 23.8 mm (Rcl).

Remarks: The 2 males collected off Jupiter Island and which were blown ashore as a result of dredging by the U.S. Army Corps of

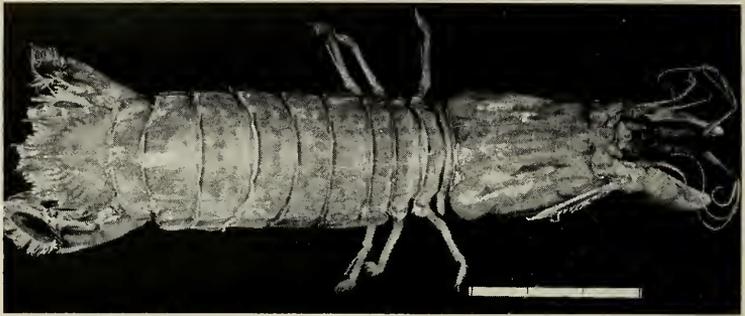


FIG. 10. *Squilla neglecta* Gibbs. Adult male, off Cape Canaveral, Florida. Scale lines each equal 10 mm.

Engineers, constitute the first record of the species from the southeastern coast of Florida. However, those collected by R/V HERNAN CORTEZ off Cape Canaveral lie within the previously noted distributional limits of northeastern Florida.

In all specimens, the outer margin of the raptorial claws had a definite sinuate curvature, a fact which inadvertently appeared contradictory in Manning's (1969: 211–212) discussion of *S. empusa*.

Distribution: From North Carolina to Jupiter Inlet, Florida, the Gulf of Mexico from western Florida to Texas, and southwest to Brazil, from the littoral zone to 64 m.

Squilla rugosa Bigelow, 1893

Figure 11, Table 3

Squilla rugosa.—Camp, 1973: 8 [key], 29, fig. 10.—Zeiller, 1974: 70 and color plate.

Material examined: 2 ♂♂, 62 to 76 mm (TL); 13.9 to 19.7 mm (Rcl); 5 ♀♀, 23 to 79 mm (TL); 6.1 to 19.7 mm (Rcl).

Remarks: This material extends the range of the species in Florida, from Miami to just north of Cape Canaveral, a distance of about 300 miles (485 km).

Variation exists in number of spines on the penultimate segment of the uropodal exopod. Manning (1969) noted 7–8, or occasionally as many as 13 spines, and Camp (1973) also noted variation in these numbers. The 3 animals collected at R/V HERNAN CORTEZ station 916 had 8 or 9 moveable spines on the exopod.

Distribution: *Squilla rugosa* is found from Little Bahama Bank and Florida to Surinam. Although the depth range for the species is littoral to 71 m, in the Indian River area it was collected only from offshore, in 26 to 43 m.

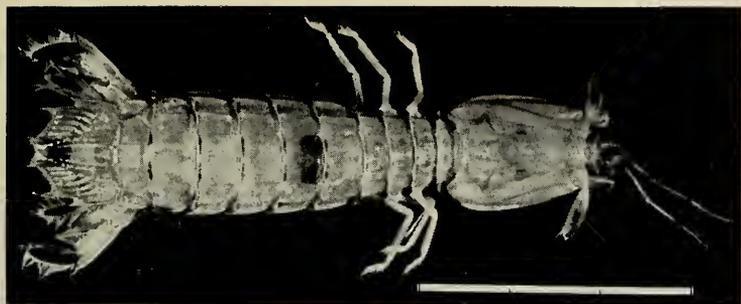


FIG. 11. *Squilla rugosa* Bigelow. Adult male, off Cape Canaveral, Florida. Scale lines each equal 10 mm.

Family GONODACTYLIDAE Giesbrecht, 1910

Genus *Eurysquilla* Manning, 1963

Eurysquilla plumata (Bigelow, 1901)

Eurysquilla plumata.—Camp, 1971: 125 [discussion]; 1973: 1 [abstract], 9 [key], 44, fig. 16, 77 ff. [tables, discussion].—Manning, 1975: 251 [discussion].

Material examined: 1 ♀, 31.9 mm (TL); 6.4 mm (Rel).

Remarks: Both Manning (1969) and Camp (1973) have commented on the variability of some morphological features in this species. Our single female specimen, apparently the largest so far reported in the literature, also showed some variability when compared with published descriptions. The fifth abdominal somite lacked blunt intermediate carinae and had but one tubercle in the region where these carinae would be; there was no indication of even longitudinal swelling here. The carapace lacked posterolateral carinae, the ocular scales terminated in spiniform rather than acute lobes, and only 4 epipods were present.

On the other hand, the dark circles of patches posterolaterally on the fifth abdominal somite were distinct, and are characteristic for this species.

Distribution: The Indian River record from off Sebastian Inlet in 41 m of water extends the range northward from the Florida Keys. The species is also known from Puerto Rico and Brazil in shallow water to 55 m.

Genus *Gonodactylus* Berthold, 1827

Gonodactylus bredini Manning, 1969

Figure 12, Table 4

Gonodactylus bredini.—Dingle, 1969: 561 [ethology]; 1969a: 108 [ethology].—Dingle and Caldwell, 1969: 417, figs. 1–2 [ethology].—

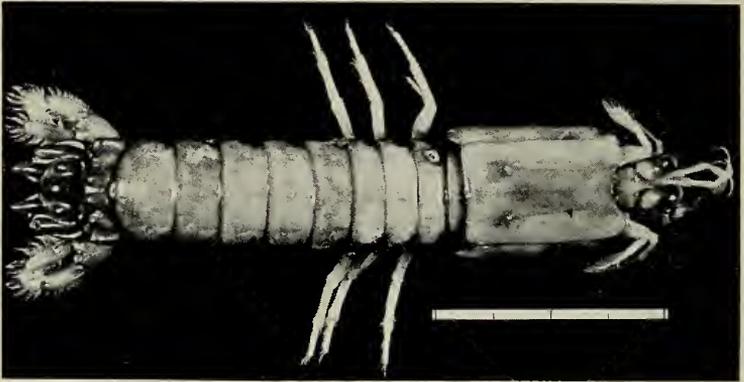


FIG. 12. *Gonodactylus bredini* Manning. Adult male, St. Lucie Inlet, Florida. Scale lines each equal 5 mm.

Camp, 1971: 125 [listed].—Lyons et al., 1971: 27.—Dingle and Caldwell, 1972: 417, ff [ethology].—Manning, 1972: 315 [listed].—Camp, 1973: 10 [key], 53, fig. 21.

Material examined: 37 ♂♂, 13 to 57 mm (TL); 3.8 to 15.5 mm (Rcl); 22 ♀♀, 2 ovigerous, 11 to 56 mm (TL); 3.0 to 15.5 mm (Rcl); smallest ovigerous female, 53 mm (TL), 14.0 mm (Rcl); 6 juveniles, 9 to 15 mm (TL); 2.4 to 3.9 mm (Rcl).

Color: Manning (1969: 321–322) and Camp (1973: 65–70) both provided detailed color patterns indicating the variability of *G. bredini* coloration. All except 2 of the specimens examined exhibited some form of coloration according to those descriptions. We provide herein the following additional color notes, based on live animals.

Male: Overall a purple-brown which appeared under magnification as dull rusty-pink, speckled with many minute red chromatophores. Dorsal surface of body with many indistinctly defined rounded white spots interspersed with white mottling and reticulation. Basal segments of antennules, antennae, and antennal scales with many pastel green chromatophores; antennal scales and setae dark blue. Eyestalks, diffused orange-brown, with many fine black lines; eyespots distinct bronze or copper color. Pereiopods with pastel green chromatophores and orange setae. Lateral and posterior regions of carapace, and thoracic and abdominal somites with white spots interspersed with mottling. Posterolateral margins of abdominal somites rimmed with pea green; carinae of somite 6 light dusky brown, irregularly banded with white. Pleopods with pastel green chromatophores; setae dark blue. Telson with irregular white spots; carinae light brown banded with white. Uropods and uropodal spines with pastel green chromatophores; former with dark blue setae.

Female: Overall color reddish. Dactylus on raptorial claw vinous rose-purple; ischiomeral area green. All other legs red to pink. Carapace and legs covered with white chromatophores, more prominent on latter than former. Telsonal carinae green. Uropods bright orange-red; exopod dorsally light green, ventrally white with pale green spots.

Remarks: We tend to agree with Camp (1973: 57), that the telsonal diagnostic characters are more valid for larger, more mature individuals. That is, the positions of the intermediate denticles relative to the apex of the intermediate teeth in juvenile forms of *G. bredini* and *G. oerstedii* are often difficult to ascertain. In many of these juveniles, the intermediate denticles were very small, although usually sufficiently discernible as being posterior to the tips of the intermediate teeth. Moreover, the intermediate teeth often appeared in close proximity to the submedians, a situation opposite to that seen in juvenile *G. oerstedii*. Camp (1973: 57) stated that all juveniles in the material he examined had moveable apices on the submedian teeth. Only 3 of the juvenile specimens we examined (which came from offshore stations) exhibited this character. In 2 of the juveniles the submedian denticles were totally absent.

Two ovigerous females were captured in May, 1972 and 1973. Two newly molted juvenile specimens, a male and a female, were collected in June and February, 1974, respectively.

One lot, HC-290, contained only a telson, which was identified tentatively as *G. bredini*.

Distribution: *Gonodactylus bredini* is distributed from Bermuda, and the continental United States from the Carolinas south through Florida and northern Gulf of Mexico, through the Caribbean to Aruba, Curaçao and Bonaire; littoral zone to 73 m. In the Indian River region, it is primarily found intertidally in the surf zone on phragmatopomid worm reefs.

Gonodactylus oerstedii Hansen, 1895

Figure 13, Table 4

Gonodactylus oerstedii.—Manning, 1969a: 147.—Camp, 1973: 6, 10 [key].

Gonodactylus oerstedii.—Voss & Voss, 1955: 216, 227 [listed].—McNulty, et al., 1962: 232 [listed].

Material examined: 9 ♂♂, 12 to 55 mm (TL); 3.2 to 15.5 mm (Rcl); 9 ♀♀, 17 to 67 mm (TL); 4.5 to 17.5 mm (Rcl); 1 juvenile, 12 mm (TL); 3.2 mm (Rcl); 1 ♀, (?), 10 mm (TL), 2.7 mm (Rcl).

Color: Manning noted that the color of live specimens is quite variable, and provided notes on some observed variations. We give, herein, yet another pattern which differs from those noted in Manning (1969: 331). Color overall light brown dorsally, finely speckled with tiny red chromatophores; ventrally white with dark brown or red highlights on all legs. Antennae, antennules, maxillipeds and pereopods

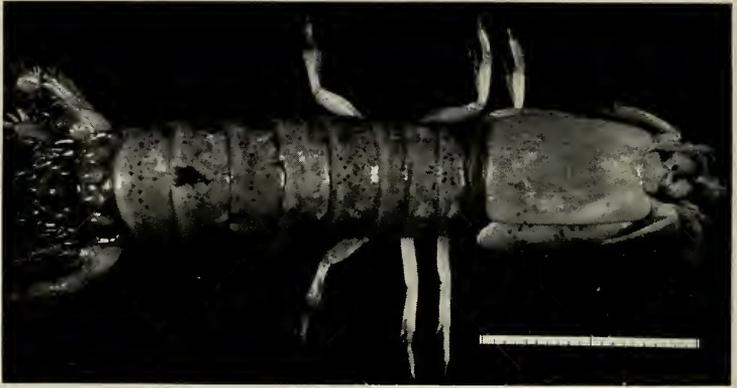


FIG. 13. *Gonodactylus oerstedii* Hansen. Adult female, St. Lucie Inlet, Florida, showing spotted color pattern. Scale lines in mm.

pale golden yellow speckled with white, or light blue-green on pereopods, antennules and antennal scales. Raptorial claw purple; eyes light tan. One specimen, as were some noted by Manning, also had patches and mottlings of white dorsally and laterally and numerous large round black spots dorsally on the carapace, and thoracic and abdominal somites. Abdominal somite 6 flushed olive green; pleopods pale golden yellow. Carinae and teeth of telson olive green; uropods pale golden yellow or light blue-green speckled with white dots. All elongate setae on antennules, antennal scales, pereopods, uropods, and uropodal spines dark blue.

Remarks: The telson carinae in 5 immature specimens varied slightly from Manning's (1969: 331) description, viz. the posterior margins of the median and anterior submedian carinae were more pointed, than rounded, tubercles. This is undoubtedly a juvenile feature which would become more rounded and swollen with age. Of these specimens, 1 juvenile (?) female also had pointed, rather than blunt, apices on the marginal teeth.

The intermediate denticles of the telson also showed some variation on 2 specimens. In a juvenile male, these denticles were not very well developed, but in spite of this the protuberance appeared anterior to the tips of the intermediate teeth, and was distinctly separated from the submedian teeth. In the second specimen, an adult female, 2 intermediate denticles occurred on the right side, the outer being small, but not sharp. The left side of the telson had only one intermediate denticle and it appeared as though the intermediate tooth might have been in the process of regenerating.

Distribution: In the western Atlantic, *G. oerstedii* occurs from central east Florida, through the Caribbean to Curaçao; in the littoral zone from

TABLE 4. Distinguishing morphological features in the species of *Gonodactylus* collected from the Indian River region of Florida

Character	<i>G. bredini</i>	<i>G. oerstedii</i>	<i>G. spinulosus</i>
Telson type	Bredini	Oerstedii	Oerstedii
Dorsal armature*	None	Tubercles	Spinules
Median carina	Unspined	Unspined-adult Spined-juvenile	Spined
Uropod endopodite	Oval	Tapering	Tapering

* This armature is in addition to the standard armature on the median, submedian, intermediate and lateral carinae found in this genus.

generally less than 5 m to 105 m. The majority of the specimens from the Indian River area were collected from surf zone phragmatopomid worm reefs although some of our offshore material occurred as deep as 76 m.

Gonodactylus spinulosus Schmitt, 1924

Table 4

Gonodactylus spinulosus.—Manning, 1972: 315.—Camp, 1973: 6, 9 [key].

Material examined: 2 ♂ ♂, 12 to 26 mm (TL), 2.9 to 6.7 mm (Rcl); 3 ♀ ♀, 19 to 37 mm (TL); 5 to 9 mm (Rcl).

Remarks: Only 5 specimens have been collected as yet during numerous day and night stations made on phragmatopomid worm reefs along the intertidal surf zone between Ft. Pierce and St. Lucie Inlet, and none has been taken from worm reef stations inside these inlets. This suggests that *G. spinulosus* cannot tolerate protected waters, such as the latter, which undergo high salinity fluctuations (22–36‰, von Zweck, unpublished) over typical tidal cycles.

This is yet another species now recorded for the first time in Florida north of the Florida Keys.

Distribution: From Bermuda and the Bahamas, and central east Florida to Aruba, off northeastern South America; intertidal to 10 m.

Gonodactylus sp.

Material examined: 1 juvenile, 12.8 mm (TL); 3.4 mm (Rcl).

Remarks: This specimen agrees in many respects with *G. bredini* even though some of the marginal teeth on the telson and the postero-lateral portion of the fifth abdominal somite are rather sharply pointed. While these latter features are indicative, in part, of *G. curacaoensis*, they are presumably juvenile characteristics. The specimen was collected at the same offshore station at which a specimen of *G. bredini* was taken.

Genus *Parasquilla* Manning, 1961

Parasquilla (*Parasquilla*) *coccinea* Manning, 1962

Figure 14

Parasquilla (*Parasquilla*) *coccinea*.—Manning, 1970: 114 [listed].—Camp, 1971: 125 [listed]; 1973: 9 [key], 46, fig. 18.

Material examined: 3 ♂ ♂, 52 to 101 mm (TL); 13.8 to 26.9 mm (Rcl); 6 ♀ ♀, 50 to 110 mm (TL); 13.4 to 26.3 mm (Rcl).

Remarks: The carinae on the abdominal somites of the single female collected by R/V GOSNOLD were present but not prominent (cf. Camp, 1973).

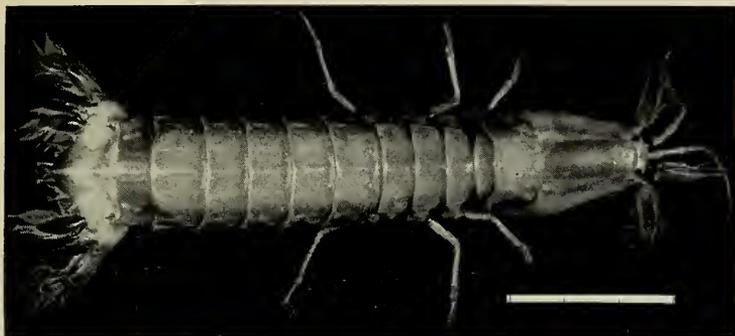


FIG. 14. *Parasquilla coccinea* Manning. Adult female, off Cape Canaveral, Florida. Scale lines each equal 10 mm.

The offshore waters in the general vicinity of Cape Canaveral now appear to be the northern limit of the range of *P. coccinea*.

Distribution: *Parasquilla coccinea* is distributed from central east coast of Florida to the Gulf of Campeche; 55 to 382 m.

Genus *Pseudosquilla* Dana, 1852

Pseudosquilla ciliata (Fabricius, 1787)

Figure 15

Pseudosquilla ciliata.—McNulty, et al., 1962: 232 [listed].—Manning, 1972: 315 [listed].—Camp, 1973: 9 [key].—Zeiller, 1974: 69 and 2 color plates.

Material examined: 1 ♂, 59 mm (TL); 13.2 mm (Rcl).

Remarks: This species predominantly inhabits shallow grassflat areas and was collected on such with a seine net, supporting Manning's contention that the species is more often encountered freely swimming than in hiding. *Pseudosquilla ciliata* is a rare species along this area of eastern central Florida since only the single male has been taken in 3 years of collecting.

Distribution: *Pseudosquilla ciliata* is widely distributed in the Atlantic from Bermuda to northern Brazil, and west Africa; littoral to 110 m.

DISCUSSION

Over 70 species of stomatopod crustaceans in 18 genera and 4 families have now been recorded from the western Atlantic. Recently published distributional records (e.g. Manning, 1969; Camp, 1973) show that at least 50 of these species occur in tropical or subtropical waters in the western North Atlantic. Floridan waters, in turn, support an abundant stomatopod fauna. In the eastern Gulf of Mexico, for example,

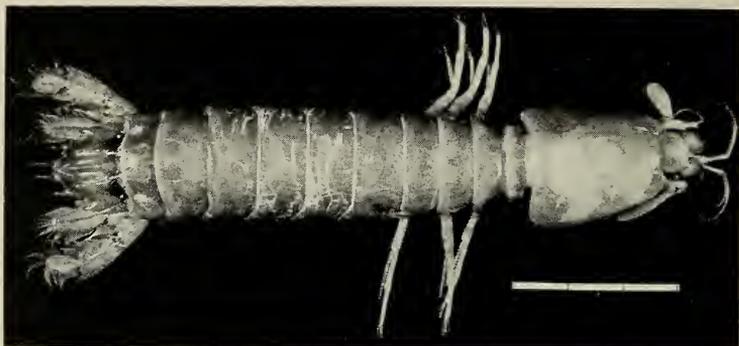


FIG. 15. *Pseudosquilla ciliata* (Fabricius). Adult male, Indian River, Ft. Pierce, Florida. Scale lines each equal 10 mm.

at least 28 species are known, including 3 species which may be endemic to the region (Camp, 1973). Along the tropical southeastern coast of Florida and the Florida Keys, 25 species have been recorded. Prior to the present study, only 10 species were known from the Indian River region along the central eastern Florida coast (i.e. between latitudes 27° and $28^{\circ}30'N$). Our material now indicates that at least 23 species either occur or would be expected to do so. Figure 16 lists these species and provides general distributional data for them throughout their respective ranges.

As might be expected, all the species collected and reported herein, with the exception of *Heterosquilla armata* and *Squilla edentata edentata*, were members of the West Indian fauna. This is a large tropical assemblage with components occurring from Brazil, throughout the Caribbean Sea, through the Indian River region, and, in many instances, into the Carolinian faunal subprovince. The most abundant species in the collections was *Squilla empusa*, a wide ranging eurythermic form, with 93 specimens collected in offshore waters between 12 and 100 m. *Squilla edentata edentata*, was the second most abundant species with 73 specimens collected entirely in offshore waters deeper than about 150 m. Although now known from deeper waters off Jupiter Inlet in southeastern Florida, this species may be more properly considered a member of the Carolinian fauna since it previously had been recorded only as far south as Ft. Pierce in the Indian River region, and it otherwise exhibits the classical disjunct distribution across the northern part of the State of Florida into the Gulf of Mexico. The next most abundant species was *Gonodactylus bredini*, an Antillean form with 68 specimens collected. This species was found primarily in phragmatopomid worm reefs in the surf zone along shore.

As can be seen from Figure 16, the majority of species (87%) seem to be primarily tropical forms most widely distributed throughout the

DISTRIBUTION OF STOMATOPOD SPECIES KNOWN OR EXPECTED* TO OCCUR IN THE INDIAN RIVER REGION OF FLORIDA

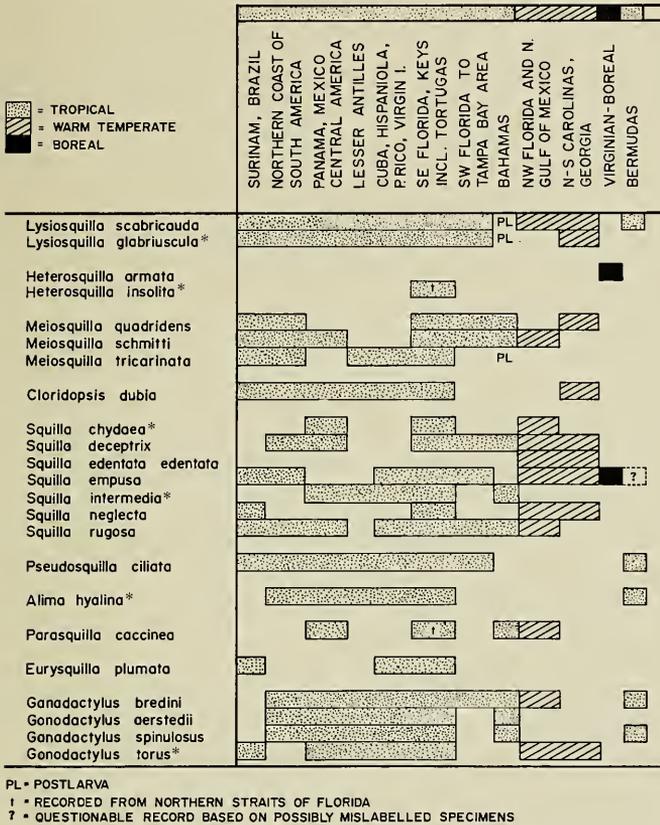


FIG. 16. Zoogeographical distribution of the species of Stomatopoda known or expected to occur on the central eastern Florida coast.

Caribbean, and occurring to as far north as the Bahama Islands. A second group which may be included with these species are those forms whose ranges extend from the lower Caribbean to the vicinity of Cape Hatteras in the Carolinian faunal subprovince. Briggs (1974: 215) has labelled such species "eurythermic tropicals" and considers them to be species which are able to withstand the winter temperatures of onshore waters. This group accounts for about 35% of those expected to occur in the Indian River area.

Within these assemblages 2 smaller groups may also be recognized.

The first, consists of *Squilla chydæa* (see below), *S. deceptrix*, and *S. empusa*, species which, based on available records, seem to be confined primarily to continental margins. Briggs (1974) considers species such as these to be members of the Caribbean [Sub-] Province which he defines as extending essentially along the eastern margins of central Florida, and middle America from southeastern Mexico, including the northern margin of South America to about Trinidad. Although *Squilla empusa* also has been collected from Cuba and Jamaica, some authors consider the island of Cuba at least, to be more "continental" in nature than the typical small Antillean Islands which make up the West Indies region (see e.g. Darlington, 1966).

The second group, consisting of *Meiosquilla quadridens* and *Squilla neglecta* shows a disjunct continental distribution, with records only from the coasts of North and South America, or the islands just offshore of the northeastern coast of the latter continent.

Six species which were not taken in our collections deserve some mention. These are *Squilla chydæa* Manning, 1962a, *S. intermedia* Bigelow, 1893, *Heterosquilla insolita* (Manning, 1963a), *Lysiosquilla glabriuscula* (Lamarck, 1818), *Alima hyalina* Leach, 1817, and *Gonodactylus torus* Manning, 1969. Although *Squilla chydæa* has been collected off Cape Canaveral in 146 m (Manning, 1969: 196) extensive shallow water trawling in that region by R/V HERNAN CORTEZ, and south of that area to depths greater than 200 m by R/V GOSNOLD, produced no specimens for our study. The species is primarily distributed throughout the Gulf of Mexico (Manning, loc. cit.). The Cape Canaveral record, thus, may be extralimital.

Squilla intermedia, a deep water species, has been recorded east of Ft. Pierce in water greater than 290 m. However, this species would not be expected in our sampling since its known depth range extends from about 300–600 m, along and down the continental slope, and thus well beyond the depths sampled both by R/V GOSNOLD and R/V HERNAN CORTEZ for this study.

Records for the remaining 4 species, 3 of which have been recorded in relatively shallow water, indicate that they also may occur in the Indian River region. *Heterosquilla insolita*, for example, has been reported by Manning (1969: 58) from the northern Straits of Florida in 238 m of water. The possibility that this deeper water species may also occur in similar depths off the central eastern Florida coastline cannot be dismissed.

Lysiosquilla glabriuscula has been collected (in presumably 1–2 m) at Lake Worth, Palm Beach County, Florida, just south of Jupiter Inlet, the mouth of the Indian River. Moreover, 2 other species, *Alima hyalina* and *Gonodactylus torus*, have both been recorded in relatively shallow water (55 m) off Palm Beach and all 3 of these species thus may be expected to occur occasionally in the shallow coastline waters of the lower Indian River region.

However, the exact reason as to why none of the last 3 species has

been collected yet in the Indian River region must remain speculative at this point. The northward distribution of the shallow water species may be influenced in part by the directional flow of the Florida Current, the waters of which diverge away from the Florida coastline in the vicinity of Palm Beach County. Larval settlement thus would take place on a progressively wider and deeper shelf area proceeding northward, perhaps accounting for the few published records.

LITERATURE CITED

- BAYER, F. M. 1961. The shallow-water Octocorallia of the West Indian region. The Hague, Netherlands, Martinus Nijhoff, 373 pp., 101 text-figs., 27 pls.
- BRIGGS, J. C. 1974. Marine Zoogeography. New York (McGraw-Hill Book Co.), ix + 475 pp., 65 text-figs.
- BURROWS, M. 1969. The mechanics and neural control of the prey capture strike in the mantid shrimps *Squilla* and *Hemisquilla*. Z. Vergl. Physiol. 62:361-381, 11 figs.
- CAMP, D. K. 1971. *Platysquilla horologii* (Stomatopoda, Lysiosquillidae), a new species from the Gulf of Mexico, with an emendation of the generic definition. Proc. Biol. Soc. Wash. 84(15): 119-128, 1 fig.
- . 1973. Memoirs of the Hourglass Cruises: Stomatopod Crustacea. Fla. Dept. Nat. Resour. Mar. Res. Lab. 3(2):1-100, figs. 1-28, 1 pl.
- DARLINGTON, P. J., JR. 1966. Zoogeography, the geographical distribution of animals. New York (John Wiley and Sons, Inc.) xi + 675 pp., 80 text-figs.
- DINGLE, H. 1969. A statistical and information analysis of aggressive communication in the mantis shrimp *Gonodactylus bredini* Manning. Anim. Behav. 17:561-575, 1 fig.
- . 1969a. Ontogenetic changes in phototaxis and thigmokinesis in stomatopod larvae. Crustaceana 16:108-110.
- , AND R. L. CALDWELL. 1969. The aggressive and territorial behavior of the mantis shrimp *Gonodactylus bredini* Manning (Crustacea: Stomatopoda). Behavior 33:115-136, 8 figs.
- . 1972. Reproductive and maternal behavior of the mantis shrimp *Gonodactylus bredini* Manning (Crustacea: Stomatopoda). Biol. Bull. 142(2):417-426, figs. 1-3.
- DRAGOVICH, A., AND J. A. KELLY, JR. 1964. Ecological observations of macro-invertebrates in Tampa Bay, Florida, 1961-1962. Bull. Mar. Sci. Gulf Carib. 14(1):74-102, 1 fig.
- FINGERMAN, M., AND K. RANGA RAO. 1969. Physiology of the brown-black chromatophores of the stomatopod crustacean *Squilla empusa*. Physiol. Zool. 42:138-147, figs. 1-5.
- GODCHARLES, M. F. 1971. A study of the effects of a commercial hydraulic clam dredge on benthic communities in estuarine

- areas. Fla. Dept. Nat. Resour., Tech. Ser. (64):viii + 51 pp., figs. 1-6.
- GORE, R. H., AND L. J. BECKER. 1975. Studies on Stomatopod Crustacea of the Indian River region of Florida. 1. Rediscovery and extension of range of *Heterosquilla armata* (Smith, 1881). Proc. Biol. Soc. Wash. 88(3):21-28, figs. 1-3.
- HILDEBRAND, H. H. 1954. A study of the fauna of the brown shrimp (*Penaeus aztecus* Ives) grounds in the western Gulf of Mexico. Publ. Inst. Mar. Sci. Univ. Texas 3(2):233-366, figs. 1-7.
- . 1955. A study of the fauna of the pink shrimp (*Penaeus duorarum* Burkenroad) grounds in the Gulf of Campeche. Publ. Inst. Mar. Sci. Univ. Texas 4(1):169-232, figs. 1-2.
- KAESTNER, A. 1970. Invertebrate Zoology. Volume III, Crustacea. New York (Wiley Interscience) xi + 523 pp., plus text-figs.
- LYONS, W. G., S. P. COBB, D. K. CAMP, J. A. MOUNTAIN, T. SAVAGE, L. LYONS, AND E. A. JOYCE, JR. 1971. Preliminary inventory of marine invertebrates collected near the electrical generating plant, Crystal River, Florida, in 1969. Fla. Dept. Nat. Resour. Mar. Res. Lab., Prof. Pap. Ser. 14:vii + 45, figs. 1-10.
- MCNULTY, J. K., R. C. WORK, AND H. B. MOORE. 1962. Level sea bottom communities in Biscayne Bay and neighboring areas. Bull. Mar. Sci. Gulf Carib. 12(2):204-233, figs. 1-14.
- MANNING, R. B. 1969. Stomatopod crustacea of the western Atlantic. Stud. Trop. Oceanogr. (Miami) 8:viii + 380, figs. 1-91.
- . 1969a. Notes on the *Gonodactylus* section of the family Gonodactylidae (Crustacea, Stomatopoda), with descriptions of four new genera and a new species. Proc. Biol. Soc. Wash. 82:143-166, fig. 1-8.
- . 1970. Nine new American stomatopod crustaceans. Proc. Biol. Soc. Wash. 83(8):99-114, figs. 1-9.
- . 1970a. The R/V Pillsbury deep-sea biological expedition to the Gulf of Guinea, 1964-65.—13—The Stomatopod Crustacea. Stud. Trop. Oceanogr. (Miami) 4(2):256-275, figs. 1-4.
- . 1972. *Gonodactylus spinulosus* Schmitt, A West Indian stomatopod new to Bermuda. Crustaceana 23(3):315.
- . 1974. Marine flora and fauna of the northeastern United States. Crustacea: Stomatopoda. NOAA Tech Rep. NMFS, Circ-387, pp. 1-6, figs. 1-10.
- . 1974a. Stomatopods collected by Th. Mortensen in the eastern Pacific region (Crustacea, Stomatopoda). Steenstrupia Zool. Mus. Univ. Copenhagen 3(11):101-109, figs. 1-3.
- . 1975. *Eurysquilla pacifica*, a new stomatopod crustacean from New Britain. Proc. Biol. Soc. Wash. 88(23):249-252, fig. 1.
- PERRET, W. S., W. R. LATAPIE, J. F. POLLARD, W. R. MOCK, G. B. ADKINS, W. J. CADRY, AND C. J. WHITE. 1971. Fishes and invertebrates collected in trawl and seine samples in Louisiana

- estuaries. In: Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana. Phase I, Area description and Phase IV, Biology. Louisiana Wildl. Fish Comm., New Orleans, pp. 41-105.
- ROUSE, W. L. 1969. Littoral Crustacea from southwest Florida. Quart. Jour. Fla. Acad. Sci. 32(2):127-152, 1 fig.
- TABB, D. C., AND R. B. MANNING. 1961. A checklist of the flora and fauna of northern Florida Bay and adjacent brackish waters of the Florida mainland collected during the period July, 1957 through September, 1960. Bull. Mar. Sci. Gulf Carib. 11(4): 552-649, figs. 1-8.
- . 1962. II. Aspects of the biology of northern Florida Bay and adjacent estuaries. In: Tabb, D. C., D. L. Dubrow and R. B. Manning. The ecology of northern Florida Bay and adjacent estuaries. Fla. Board Conserv., Tech. Ser. (39):1-81, 13 figs.
- TREVINO, D. L., AND J. L. LARIMER. 1969. The spectral sensitivity and flicker response of the eye of the stomatopod, *Squilla empusa* Say. Comp. Biochem. Physiol. 31:987-991, 1 fig.
- VOSS, C. L., AND N. A. VOSS. 1955. An ecological survey of Soldier Key, Biscayne Bay, Florida. Bull. Mar. Sci. Gulf Carib. 5(3): 203-229, figs. 1-4.
- WORK, R. C. 1969. Systematics, ecology, and distribution of the mollusks of Los Roques, Venezuela. Bull. Mar. Sci. 19(3):614-711, figs. 1-4.
- ZEILLER, W. 1974. Tropical marine invertebrates of southern Florida and the Bahama Islands. New York (John Wiley and Sons, Inc.) ix + 132 pp. plus unnumbered color plates.

