

Figure 26. *Parthenope serrata* (H. Milne Edwards). A. male, off Honduras, Central America, dorsal view; B. same, ventral view; C. female, off Sanibel Island, Florida, dorsal view; D. same, ventral view. Scale lines = 10 mm. (After Gore, 1977).

convex at anterolateral angle, continuing as general curve around branchial region, especially in larger individuals; long, flattened, outward-pointing spine directed laterally at posterolateral angle before concave posterolateral margin; posterior margin wide, slightly convex. Surface of carapace punctate, sparsely to moderately pilose, with rough granulous elevations on gastric, branchial, cardiac and intestinal regions; each of latter bearing numerous, small, granulate tubercles clumped to form larger tuberculosities, surrounded by lower, less distinct granulations; those on branchial regions and midline of carapace most noticeable. Gastric and branchial regions separated by deep depression; depressions between hepatic and metabranchial regions shallower, often only slightly expressed. Rostrum short, produced into bluntly rounded, tubercle-like tooth, more widely expanded at tip in some, tridentate, often laterally dentate or granular in older individuals; smaller, narrower tooth below and outside of lateral tooth. Seven (up to ten) triangular, irregularly dentate teeth on branchial margin anterior to posterolateral spine; fourth or fifth tooth posteriad from orbit usually largest. Seven large tubercles on pilose posterior and posterolateral margins, often curved anteriorly, terminating in longitudinal or oblique line of smaller tubercles in adults; latter tubercles often obsolete or lacking in young, or indiscernible among profuse granulation in older individuals. Pterygostomian region

densely setose, with excavation extending to infero-exterior margin of orbit, forming covered afferent passages when chelipeds contracted against body; external aperture of passage visible between base of finger and margin of orbit. Sub-branchial spine present. Outer maxilliped usually lightly granulate, tuberculate to some degree in older specimens; inner margin bluntly dentate, especially in mature individuals.

Chelipeds long, 2.5 to over 3 times RCL, flattened, lower face smooth, outer margin coarsely serrate; manus with nine or ten alternately large and small acutely triangular teeth, rounded posteriorly, with tips directed forward slightly to moderately obliquely toward fingers; teeth on inner margin pilose, triangular, smaller, more numerous (15 or 16), granularly bifid or trifid; upper surface with few low, scattered tubercles; arm with longitudinal row of large, granular tubercles mesially, extending obliquely in straight line toward inner distal angle, several isolated single or double tubercles scattered over surface on either side of these; posterior margin with about nine or ten triangular, blunt teeth curved outward; all teeth on outer margin of cheliped with setae interspersed, more dense on posterior margin of arm. Walking legs smooth to moderately spinulose, first pair not reaching end of arm; anterior and posterior margins of meri variably granulate, more so on last pair.

Abdomen of male with somites 3-5 fused, sixth with median spine or tubercle; female abdomen with all somites free, with low, rounded transverse carinae on somites 1-3. Gonopods and gonopores as figured (Figures 24 E-h, 25 B).

Type-locality: Erroneously as "L'Océan indien"; restricted to Vera Cruz, Mexico, by subsequent designation of lectotype (Gore, 1977); lectotype in Muséum National d'Histoire Naturelle, Paris; MNHNP 4051. Two other specimens (MNHNP 629) without locality data, which may possibly be considered paralectotypes if and when collection data are rediscovered, are also in the Paris Museum.

Distribution: Bermuda; Ft. Pierce, Florida, around the Gulf of Mexico; Central America; Cuba; Lesser Antilles; islands off the northern coast of South America, southward to Bahia, Brazil; intertidally to 110 m. Hourglass Stations A, B, C, D, I, J, K and L; 6-55 m.

East Pacific analogue: None.

Remarks: The general shape of the carapace in young individuals is less circular and may be almost perfectly hexagonal. Branchial and posterolateral margins become more inflated with increasing maturity. Juvenile specimens are often nearly smooth dorsally, and the carapace is punctate instead of tuberculate; as in *P. granulata*, tuberculation increases with maturity, and in large adults, especially females, the dorsal surface is highly tuberculate and pustulose, although exhibiting a wider range of smaller granules, pustules, and tubercles than that seen in *P. granulata*.

Parthenope serrata may be distinguished from *P. granulata* by the laterally directed (instead of obliquely posteriad) posterolateral spine of the carapace, the more pilose carapace, and the angle formed by the posterolateral spine, gastric tubercle, and outer orbital margin which is always noticeably less than 90°, whereas it approaches closely or equals 90° in *P. granulata*. The anterior margin of the carapace in *P. serrata* is more or less obliquely straight, while in *P. granulata* it is more rounded. Teeth on the anterolateral and lateral margins appear slightly more produced in *P. serrata*, and the posterolateral tooth is usually longer, straighter, and more acuminate. Teeth on the manus are more noticeably triangular, never lanceolate, and almost invariably directed toward the fingers, especially the tips; their posterior margins are more convex and slanted than in *P. granulata*. The row of tubercles on the arm extends in an oblique straight line toward the

inner distal angle, while in *P. granulata* this row is curved. In many female specimens of *P. serrata*, the seventh abdominal somite is more acutely triangular, with a sharper tip and more concave margins than in *P. granulata*, but this feature often becomes quite subjective to interpret. The transverse abdominal carinae appear to be less developed in *P. serrata* than in *P. granulata*. Gonopods and gonopores, however, allow immediate distinction between the two species.

Color of *P. serrata* and *P. granulata* is quite similar to that noted by Rathbun (1925), but some individuals in both species appeared light brown, mottled with tan and white maculations overall, and with marginal teeth bordered in white. Eyes of juveniles were chestnut brown, those of adults bronze, in preservative. In many specimens of *P. serrata*, color of the fingers of chelipeds never was as dark, nor as completely diffused over the inner surface of the manus, as in *P. granulata*, but this feature assumes less value the longer specimens are preserved.

Because of our recognition of *P. granulata* among the Hourglass material, specimens identified earlier by FDNR researchers as *P. serrata* and since discarded may not all have been correctly identified. These specimens are not used in further analyses of either species but are listed as *Parthenope (Platylambrus) incertae sedis*.

Felder (1971, unpubl.) noted the occurrence of *P. serrata* in the gut contents of the red snapper, *Lutjanus campechanus* (Poey).

Parthenope incertae sedis

Lambrus crenulatus: Stimpson, 1860, p. 201; 1871a, p. 129; 1871b, p. 101 [discussion]; Von Martens, 1872, p. 85.

Platylambrus serratus: Kingsley, 1880, p. 390; A. Milne Edwards, 1880b, p. 5; Smith, 1886, p. 629 [25]; Rathbun, 1897, p. 12; 1898, p. 261 [in part, probably not Bahia Honda specimen (= *P. granulata*?)]; 1900, p. 514 [key]; A. Milne Edwards and Bouvier, 1923, p. 355; Balss, 1924, p. 181; Flipse, 1930, p. 86 [listed].

Lambrus serratus: Miers, 1886, pp. 94 [listed], 97; Ortmann, 1893, p. 415; Moreira, 1901, pp. 62, 129, 130 [synonymy]; Flipse, 1930, p. 84 [listed].

Parthenope (Platylambrus) serrata: Boone, 1927, p. 42; Rathbun, 1933, pp. 38 [key], 39; 1935, p. 114 [discussion]; Chace, 1956, p. 162 [in part, MHN LaSalle material only]; Righi, 1966, p. 140; Rodrigues da Costa, 1968, p. 143; 1969, p. 177 [abstract]; Türkay, 1968, p. 251; Coelho and Araújo Ramos, 1972, p. 205 [listed]; L. Pequegnat, 1975, p. 48 [listed].

Parthenope serrata: Hildebrand, 1955, p. 193; Wass, 1955, pp. 140 [key], 172; Hulings, 1961, p. 219 [listed]; Rouse, 1970, p. 146; Godcharles and Jaap, 1973, p. 48.

Discarded material: HOURGLASS STATION B: 2; 4 October 1965; dredge. — 2 ♂; 8 November 1965; trawl. — 1 ♂; 7 February 1966; trawl. — 1 ♂; 6 June 1966; dredge. — 1 ♀; 2 July 1966; trawl. — 1 ♂, 1 ♀; 10 July 1966; dredge. — HOURGLASS STATION C: 2; 3 August 1965; dredge. — 1 ♂, 1 ♀; 8 November 1965; trawl. — 1 ♂, 1 undet.; 6 June 1966; trawl. — 1 ♂; 18 June 1966; trawl. — 1 ♂; 18 June 1966; dredge. — 1 ♂, 1 ♀; 2 July 1966; dredge. — 2 ♀; 11 July 1966; dredge. — 1 ♂, 1 ♀; 1 August 1966; trawl. — 1 ♂, 1 ♀; 31 August 1966; trawl. — 1 ♂; 8 September 1966; trawl. — 1 ♂; 8 October 1966; dredge. — HOURGLASS STATION D: 1 ♂; 4 January 1966; dredge. — 1 ♂, 3 ♀; 2 August 1966; trawl. — 1 ♀; 2 August 1966; dredge. — 1 ♂; 11 August 1966; dredge. — 1 ♂; 9 September 1966; dredge. — HOURGLASS STATION E: 1 ♀; 8 February 1966; dredge. — HOURGLASS STATION I: 1 ♂; 12 November 1965; dredge. — 1 ♂; 6 December 1965; dredge. — HOURGLASS STATION J: 3; 3 September 1965; dredge. — 1 ♀; 12 November 1965; dredge. — 1 ♂, 1 ♀; 6 December 1965; trawl. — 1 ♂, 6 December 1965; dredge. — 1 ♂,

1 ♀; 13 January 1966; trawl. — 1 ♂, 2 ♀; 13 January 1966; dredge. — 1 ♀ (ovigerous); 5 July 1966; dredge. — 1 ♀; 21 July 1966; trawl. — 1 ♂, 2 ♀ (1 ovigerous); 4 September 1966; dredge. — 1 ♂; 12 October 1966; trawl. — 1 ♂, 2 ♀; 12 October 1966; dredge. — HOURGLASS STATION K: 1; 6 August 1965; trawl. — 1 ♂; 7 December 1965; dredge. — 1 ♀ (ovigerous); 13 January 1966; trawl. — 1 ♂; 13 January 1966; dredge. — 1 ♂; 5 August 1966; trawl. — 1 ♂, 2 ♀; 5 August 1966; dredge. — 1 ♂, 1 ♀; 12 October 1966; trawl. — 1 ♂; 12 October 1966; dredge.

Remarks: Because of either lack of adequate descriptions or illustrations, specimens noted in the literature above cannot be safely assigned to either *Parthenope serrata* or *P. granulata*. In many cases (*e.g.*, Stimpson's material and perhaps von Martens'), the material has been destroyed. In still other instances, the material is so widely scattered that it is presently unfeasible to locate and examine it, although many of the specimens are undoubtedly still extant. It is hoped that future authors, working in the regions denoted by the above citations, will be able eventually to reduce this synonymy by examination of the respective material where such is still available.

Cheliped armature of the fossil species, *Parthenope (Platylambrus) charlottensis* Rathbun, 1935, from the southwestern Floridan Pliocene, Caloosahatchee marl, shows a closer relationship to *P. (P.) granulata*, and not to *P. (P.) serrata* as Rathbun (1935) stated, based on her knowledge of the species at the time.

Seventy Hourglass specimens contained in 44 lots listed above were identified as *Parthenope serrata*, recorded, and discarded by Marine Research Laboratory personnel before we received the remaining specimens for examination, so actual species determinations cannot be made on this material. We know only that the specimens were either *P. serrata* or *P. granulata* but, because of uncertain identifications, the data cannot be used for analyses of either species. The lost specimen from Station E is particularly unfortunate, because neither species was otherwise noted to occur as deep as 73 m in the Hourglass study area.

Genus *Tutankhamen* Rathbun, 1925

Tutankhamen Rathbun, 1925, p. 530.

Tutankhamen cristatipes (A. Milne Edwards, 1880)

Mesorhoea cristatipes A. Milne Edwards, 1880a, p. 352, pl. 31A, fig. 6-6c; 1880b, p. 5; Young, 1900, p. 111; A. Milne Edwards and Bouvier, 1923, p. 359, pl. 10, fig. 3.

Lambrus cristatipes: Rathbun, 1898, p. 261 [listed].

Tutankhamen cristatipes: Rathbun, 1925, p. 530, pl. 277, figs. 3-5; Flipse, 1930, p. 90 [listed and synonymy].

Material examined: None.

Diagnosis: Carapace equilaterally subtriangular; rostrum large, deeply trilobed; lateral teeth of carapace small. Basal antennal article long, nearly or completely attaining orbital hiatus. Afferent channels of carapace deep, resembling *Mesorhoea* in aspect; channels differ markedly from those of *Mesorhoea* in being shorter, deeper, bordered above by laminar expansion of hepatic and anterior branchial margins; channels bordered below by parallel lamina with emargination near beginning of branchial regions; canals terminating in cul-de-sac behind orbit, opening on epistome by fissure between external angle of thin lamina forming anterior edge

of buccal cavity and promontory formed by infero-internal angle of orbit. Epistome spacious, very concave, separated by thin ridge and considerable distance from antennules. Maxilliped merus without antero-internal angle produced into point (as in *Mesorhoea*) or emarginated for insertion of palpus (as in *Parthenope*). (Modified from Rathbun, 1925).

Type-locality: St. Vincent, Lesser Antilles; type in Paris Museum (*vide* Rathbun, 1925), but not yet located in reorganized collections (J. Forest, personal communication).

Distribution: Pourtales Plateau in Straits of Florida, and St. Vincent, Lesser Antilles; 124-200 fms (227-366 m).

Remarks: This exceedingly rare species seems to be known only from the male holotype and one other specimen, according to Rathbun (1925). It has not, to our knowledge, been reported again in the literature. The known depth range for *Tutankhamen cristatipes* may account in part for its rarity, as it implies that the species is an outer continental shelf and upper continental slope form. Consequently, it would not be expected to occur in the notably more shallow continental shelf waters sampled by R/V *Hernan Cortez* or R/V *Gosnold*. The species has not been listed in reports of collections made by R/V *Oregon*, R/V *Silver Bay*, R/V *Pelican*, and R/V *Combat* along the central and southern Florida coast (Springer and Bullis, 1956; Bullis and Thompson, 1965), nor in the extensive collections by R/V *Alaminos* in the deep waters of the Gulf of Mexico (W. Pequegnat, 1970).

DISCUSSION

Members of the family Parthenopidae, while not actually burrow-formers, are considered to be semi-burrowing, cryptic species, well-camouflaged to blend with the shell hash and rocky rubble substrate in which they live. They share with some members of the Oxystomata a carapace modified with grooves and ridges to allow respiratory water currents to be drawn over the gills while they lie nearly buried in the substratum. Both carapacial and functional morphology are undoubtedly protective adaptations to the open, exposed, rubble-covered benthos in which they live, an area which, on the continental shelf of the Indian River region of Florida's east coast, supports over 170 species of benthic, open-shelf fishes (Gilmore, unpublished), many of which are known predators of parthenopid crabs. Over five years of sampling in the adjacent estuarine waters of the Indian River lagoon, however, produced no parthenopid crabs, so it would appear that members of the family in this region may be classified as strictly marine. Faunal surveys on the west coast of Florida indicate similar stenohalinic requirements for various members of the family, usually with salinities above 28‰ prevailing. Records from Tampa Bay (Dragovich and Kelly, 1964), Florida Bay (Rouse, 1970), Alligator Harbor (Wass, 1955) and other areas all show that parthenopids may be collected nearshore, even off estuarine river mouths, but still in marine waters. Other records (Rathbun, 1925; Soto, 1972) show continental shelf distribution in totally marine waters.

COMPARISON OF DREDGE AND TRAWL COLLECTIONS

Dredging at Hourglass stations produced more specimens in all species of parthenopids (from 52% to

100% of all collected individuals in a species at all stations) than did trawling (from 48% to 0% of all collected individuals in a species at all stations) (Table 5). We noted similar results in R/V *Gosnold* collections with most specimens being taken by box or pipe dredge. This is hardly surprising because trawling with nets is usually intended to skim the benthos, and unless set incorrectly, most otter trawls do not "bite" deeply into the substratum. They consequently tend to sample fewer semi-burrowed organisms unless the latter are startled upward by a tickler chain. Parthenopid crabs are among the more lethargic decapod crustaceans, and it seems highly unlikely that they would startle at all. Smaller adult individuals and most juveniles would also tend to escape or be winnowed out through the relatively wider net mesh on an otter trawl, but would tend to be compacted in sediment dug by the heavier dredge.

COMPARISON OF DAY AND NIGHT COLLECTIONS

With the exception of *Parthenope agona* and *P. fraterculus*, there did not seem to be appreciable differences in the numbers of specimens collected during day compared with those taken during night sampling (Table 5). This result is, again, not unexpected because of the general cryptic nature of parthenopid species. We suspect that in general Floridan parthenopid crabs do not burrow during the day and emerge during the night; they simply burrow or move among the impedimentiae of their respective substrata and may therefore be collected at almost any given time, day or night.

The data for *P. agona* and *P. fraterculus* suggest that these two species may be more prevalent at night than during the day; both species were collected in large numbers, and the relative number of each species during these times was noticeably different. The two species are relatively large (up to RCL 18 mm), and could conceivably be more susceptible to predation if their large size was a hindrance to burrowing. Both crabs are noticeably spiny and tuberculate, and they probably rely on these attributes as a means of camouflage during the day (they bear a remarkable resemblance to eroded coralline pebbles), and as a defensive mechanism at night against predators (both carapace and chelipeds possess large, sharp spines). Unfortunately, day-night comparative collections were made only at Hourglass Stations B, C, and D, so there is little further support for these admittedly speculative suggestions.

Comparison of day-night sampling routines is not possible for the eastern Floridan species because the Rock Shrimp stations, which provided the majority of material, were carried out solely at night. However, R/V *Gosnold* stations were made around the clock on biological cruises and nearly equal numbers of individuals in a species were taken regardless of the time of day or night.

SPAWNING SEASONALITY

Seasonality in the Parthenopidae is difficult to determine because there are few records in the literature concerning presence or absence of ovigerous females. We have listed the more important of these in Table 6, along with numbers of ovigerous females from both the Hourglass material and collections made on the central eastern Florida coast that we have been able to examine. As can be seen, the only species which appears to breed throughout the year in Floridan waters is *Parthenope agona*, although *P. serrata*, *P. granulata*, *P. fraterculus*, *Heterocrypta granulata*, and *Solenolambrus tenellus* also exhibit extensive breeding seasons. Data are otherwise insufficient to allow more than generalized statements of seasonality, but it is intriguing to speculate on possible "staggered" breeding seasons between the Gulf of Mexico and Atlantic

TABLE 5. COMPARISON BY STATION OF DREDGE/TRAWL AND DAY/NIGHT COLLECTIONS OF HOURGLASS PARTHENOPID CRABS.

Species	Station Depth (m)	A	B	C	D	E	I	J	K	L	M	
		6	18	37	55	73	6	18	37	55	73	
<i>Cryptopodia concava</i>	Total:	48	--	--	6	13	7	--	--	1	17	4
	Night:	10		--	4	6						
	Day:	9		--	2	7						
	Dredge:	37										
	Trawl:	11										
<i>Heterocrypta granulata</i>	Total:	37	11	5	--	--	--	18	2	--	1?	--
	Night:	5		5	--	--						
	Day:	0		--	--	--						
	Dredge:	37										
	Trawl:	0										
<i>Mesorhoea sexspinosa</i>	Total:	6	--	4	--	--	--	--	1	1	--	--
	Night:	4		4	--	--						
	Day:	0		--	--	--						
	Dredge:	5										
	Trawl:	1										
<i>Parthenope agona*</i>	Total:	584	1	--	2	161	306	--	2	6	45	61
	Night:	123		--	1	122						
	Day:	40		--	1	39						
	Dredge:	396										
	Trawl:	188										
<i>Parthenope fraterculus</i>	Total:	149	--	--	1	32	28	--	--	--	32	56
	Night:	28		--	--	28						
	Day:	5		--	1	4						
	Dredge:	125										
	Trawl:	24										
<i>Parthenope granulata</i>	Total:	64	--	9	19	9	--	--	4	23	--	--
	Night:	19		7	10	2						
	Day:	18		2	9	7						
	Dredge:	33										
	Trawl:	31										
<i>Parthenope serrata</i>	Total:	48	1	6	9	4	--	10	14	2	2	--
	Night:	11		4	6	1						
	Day:	8		2	3	3						
	Dredge:	28										
	Trawl:	20										
<i>Solenolambus tenellus</i>	Total:	82	--	--	--	23	27	--	--	--	11	21
	Night:	14		--	--	14						
	Day:	9		--	--	9						
	Dredge:	77										
	Trawl:	5										

*Includes discarded material

populations in the genus *Parthenope*. The majority of ovigerous females in *P. agona*, for example, occurred between October and January in the Gulf of Mexico, but were collected between April and September in the Atlantic. One possibility suggested by these data is that the Gulf of Mexico population tends to spawn during the subtropical dry season (from October-November through March), whereas the Atlantic population spawns during the concomitant wet season (April through September-October). Much more data are required, however, before further conclusions are warranted.

The remaining parthenopid species are little known. This may well be an artifact of collecting because very few specimens of *Cryptopodia concava* and *Mesorhoea sexspinosa*, for example, were taken during Hourglass, Rock Shrimp, or IRCZS cruises; the species are also poorly known in the literature. No ovigerous females of *Parthenope pourtalesii* occurred in any samples from these cruises, and the dearth of information on this species is also reflected in scanty literature records. Indeed, the seemingly paradoxical situation with *P. pourtalesii*, where no ovigerous females were taken during survey work on the central eastern Florida coast, and the total absence of the species from the extensive Hourglass collections in the eastern Gulf of Mexico, merely points up the need for further investigations in this regard because the species itself was otherwise relatively common.

LARVAL DEVELOPMENT IN WESTERN ATLANTIC PARTHENOPIDAE

The larval development of Western Atlantic species in the family is almost completely unknown. Yang (1971) summarized the knowledge and provided data on *Parthenope serrata*, describing six zoeal stages, one megalopa, and the first crab stage. Development required 30 days at 25°C and 45 days at 20°C. He also discussed first zoeal stages of *P. agona* and *Solenolambrus tenellus*. Yang noted that larval characters observed in species he reared suggested closer relationships to the Brachyrhyncha than to the Oxyrhyncha, the group to which the Parthenopidae has been traditionally assigned. Further studies are clearly needed in this aspect (see Thiriot, 1973, for review).

STOMACH CONTENT ANALYSES

Floridan parthenopid crabs may be classified as omnivores, and probably benthic-directed detritivores to some degree, if presence of large amounts of sediment particles in gut contents are indicative (Table 7). Most material in stomachs we examined was nearly completely macerated, suggesting both efficient mouthparts (especially mandibles) and an effective gastric mill. The function of sediment particles (sand, shell sherds) in food maceration in the gut remains an interesting but as yet unanswered question. Except for easily identifiable items, such as diatom frustules, foraminiferan shells, and spicules from sponges and holothurians (both usually quite distinctive), the remainder of the gut material could only be classified into very general categories, although a wide and varied diet of benthic related organisms and sediments is apparent. The ingested food items appear to be commensurate with the general substratum in which the crabs live. Our observations at sea on freshly trawled shell hash, for example, showed that this substratum is often covered with a variety of animal and plant life, both macroscopic and microscopic. Larger shell fragments (e.g., *Argopecten gibbus*, *Dinocardium robustum*, *Chione latilirata*) often supported colonies of algae, polychaete worm tubes, encrusting bryozoans, barnacles, and other members of a generalized fouling assemblage. These probably form a diversified diet for the parthenopid crabs living among the shell hash on the nearshore continental shelf. Those crabs found on silty sand or sandy mud substrata presumably feed on either infauna

TABLE 7. FREQUENCY OF OCCURRENCE OF FOOD ITEMS BASED ON STOMACH CONTENT ANALYSES.

Species	Stations Examined*	Size Range (RCL mm)	Stomach Contents**													
			A	SF	D	F	SS	CF	PS	M	CS	HS	US	UT	SP	TS
<i>Cryptopodia concava</i>	C, D, E, L	3.1-7.4	--	--	3	1	--	--	1	--	2	--	--	5	5	5
<i>Heterocrypta granulata</i>	A, I, L	5.0-8.1	--	--	1	1	2	--	2	--	2	--	--	3	3	3
<i>Mesorhoea sexspinosa</i>	B	5.0	--	--	--	--	1	--	1	--	1	--	--	1	1	1
<i>Parthenope agona</i>	C, D, E, L, M	5.3-15.5	4	1	14	9	11	1	1	9	5	14	3	2	20	20
<i>Parthenope fraterculus</i>	C, D, E, L, M	5.0-16.3	--	--	5	4	8	--	6	2	10	--	--	15	11	15
<i>Parthenope granulata</i>	B, C, D, K	15.5-21.9	--	--	6	2	4	1	2	1	1	1	1	6	6	6
<i>Parthenope serrata</i>	A, I, J, L	7.3-19.9	--	--	3	2	5	--	3	--	4	--	--	5	5	5
<i>Solenolambrus tenellus</i>	D, E, L, M	3.3-4.0	2	--	7	2	1	--	5	--	5	--	5	8	8	8

*Does not necessarily include all stations at which a species was collected

** A = Algae
 SF = Seagrass Fragments
 D = Diatoms
 F = Foraminiferans
 SS = Sponge Spicules
 CF = Coral Fragments
 PS = Polychaete Setae and Fragments
 M = Mollusca
 CS = Crustacean Setae and Fragments
 HS = Holothurian Spicules
 US = Unidentified Setae
 UT = Unidentifiable Animal Tissue
 SP = Sediment Particles
 TS = Total Specimens Examined

or attached or slow-moving epifauna in their respective habitats. Whether obligate or facultative predation is involved, or simply scavenging, could not be ascertained from the relatively amorphous masses of material in the gut contents, but none of these possibilities can be completely excluded.

ZOOGEOGRAPHICAL DISTRIBUTION

The widespread distribution of members of the family Parthenopidae in the western North Atlantic and Gulf of Mexico-Caribbean Sea regions, and to a lesser extent along the northeastern coast of South America, precludes the easy categorization of the species into any zoogeographical level other than "province" (Table 8). Six species, for example, could be considered members of the Caribbean faunal province, in which distribution occurs primarily along the continental margins of the Caribbean Sea, and lower Gulf of Mexico (Briggs, 1974), or in some cases, along continent-like islands such as Cuba or Jamaica (Darlington, 1957). Eleven species occur in the warm temperate Carolinian faunal province, although two of these (*Parthenope serrata* and *Solenolambrus decemspinus*) are known only from their records off northwestern Florida. Two species (*Heterocrypta granulata* and *Parthenope pourtalesii*) are recorded into the cold temperate Virginian province above Cape Hatteras. Eight species have ranges extending southward along the northern and eastern coasts of South America into the Guianian, Brazilian, and Paulistan provinces (Coelho and Araújo Ramos, 1972); however, these subdivisions may eventually prove to be too finely divided. These areas are all delimited continentally, the first by the states of Amapá, Pará, and part of Maranhão; the second from south of the vicinity of Ilha de São Luis, Maranhão, to the state of Espiritu Santo; the third from Espiritu Santo to the state of Santa Catarina, all in Brazil. All these provinces are tropical and subtropical in their decapod crustacean faunal affinities.

Species with primarily insular distribution (e.g., *Solenolambrus*) may be classified as members of the West Indian faunal province (Briggs, 1974). Insular records are relatively fewer in number, but if they merely reflect less numerous collections, as we suspect they do in some cases, then most of the species in this report may eventually have to be classified simply as members of the Western Atlantic Warm Water Region. This region would include all of the previously named provinces, and several other subcategories of various authors.

Certainly none of the species in this report can be thought of as strictly tropical, or even subtropical, as a glance at the accompanying maps (Figures 27-32) will show. Latitudinally, the parthenopid crabs appear to be best classified as eurythermic tropical species (Briggs, 1974), and include those forms able to withstand some winter temperatures along warm and cold temperate coastlines. A good example would be *Heterocrypta granulata*, known from Nantucket Sound to Bahia, Brazil. The respective depth distributions of many of the species, however, imply a relationship more with warm temperate than cold temperate decapod crustaceans, if temperature tolerances are an important factor in their distribution (but see Abele, 1972; Coelho and Araújo Ramos, 1972).

Species of *Parthenope* treated herein as distributed primarily along continental margins of North America and Mexico, but records for *P. agona*, *P. fraterculus*, *P. pourtalesii* and *P. serrata* are also known from various islands in the Greater and Lesser Antilles. Absence of the genus along the lower coast of Central America is probably a collecting artifact because several related species of *Parthenope* are found along the northern coast of South America (Coelho and Araújo Ramos, 1972; Righi, 1966; Rodrigues da Costa, 1959, 1961, 1968, 1969), and to Brazil (Figures 27-29).

A partially exclusionary distribution between *Parthenope serrata* and *P. granulata* was noted. The

TABLE 8. DISTRIBUTION DATA FOR SPECIES OF FLORIDAN PARTHENOPIDAE.

Species	Locations*											
	AA	BB	CC	DD	EE	FF	GG	HH	II	JJ	KK	LL
<i>Cryptopodia concava</i>	X			X	X	X	X	X	X	X		
<i>Heterocrypta granulata</i>	X	X			X		X	X	X	X	X	
<i>Leiolambrus nitidus</i>	X	X	X		X				X			
<i>Mesorhoea sexspinosa</i>	X				X		X	X	X	X		
<i>Parthenope agona</i>	X	X		X	X		X	X	X	X		
<i>Parthenope fraterculus</i>	X		X	X			X	X	X	X		
<i>Parthenope pourtalesii</i>				X	X		X	X	X	X	X	
<i>Parthenope granulata</i>				X	X?		X	X	X	X		X
<i>Parthenope serrata</i>	X	X	X		X	X	X	X	X	X		X
<i>Solenolambrus decemspinus</i>					X			X				
<i>Solenolambrus tenellus</i>				X	X	X	X	X	X	X		
<i>Solenolambrus typicus</i>	X	X		X	X	X	X	X	X	X		
<i>Tutankhamen cristatipes</i>				X			X					

- *AA = Surinam and Brazil
 BB = Trinidad; north coast of South America, including Dutch West Indies
 CC = Panama, Central America, Yucatan, Mexico
 DD = Lesser Antilles
 EE = Cuba, Hispanola, Puerto Rico, Virgin Islands
 FF = Bahamas
 GG = Central and southeastern Florida and Keys, including Tortugas
 HH = Southwest Florida to Tampa Bay and Clearwater
 II = Northwest Florida; north Gulf of Mexico to Texas
 JJ = Georgia, North Carolina and South Carolina
 KK = Virginia to Massachusetts (Boreal)
 LL = Bermuda

former species extends from Brazil northward through the Caribbean Sea (predominantly but not exclusively along continental margins), into the western Gulf of Mexico and eastward around the southern tip of the Floridan peninsula. *Parthenope granulata*, on the other hand, appears to exhibit an extended Carolinian distribution (warm temperate/subtropical) from the vicinity of Cape Hatteras southward to the Indian River region on the eastern Florida coast, around peninsular Florida and northward to Louisiana (Figure 29). There is a single record from St. Thomas, Virgin Islands (Aurivillius, 1889) and a questionable record from the north coast of Cuba (Gore, 1977). Unlike *P. serrata*, which seems to have an extended tropical distribution, *P. granulata* does not appear to occur elsewhere in the Caribbean Sea. Both species, however, are known from Bermuda. The two are sympatric predominantly along the western and southern Florida continental

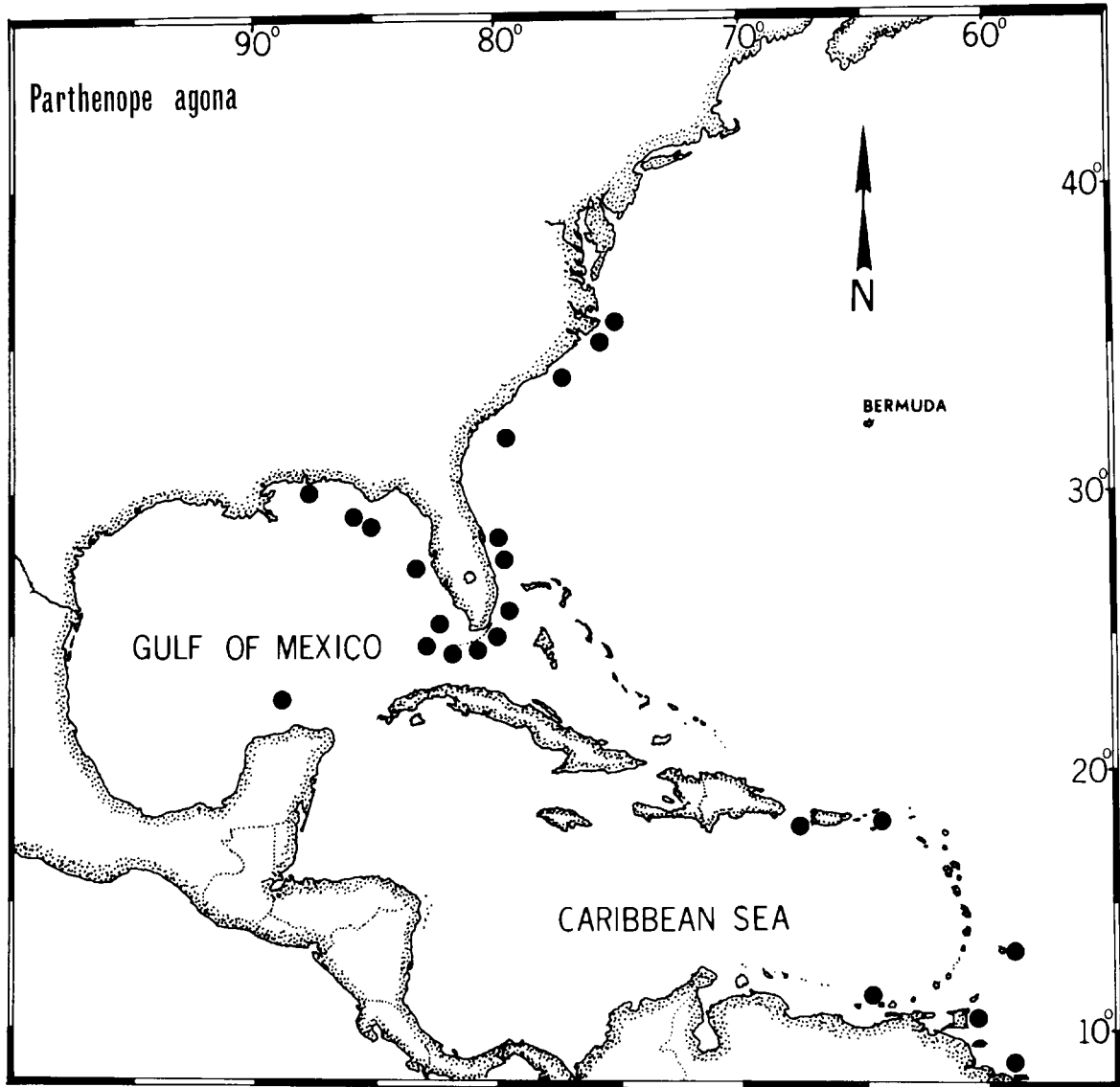


Figure 27. Distribution of *Parthenope agona* in the northwestern Atlantic and Gulf of Mexico.

shelves. Either species may be defined as a continental form, at least in the northern part of their respective ranges in Florida and may be categorized as belonging in part to the Caribbean faunal province. The insular distribution of *P. serrata* and its presence along northern and eastern South America show that it must also be included in the West Indian, Guianian, Brazilian, and Paulistan provinces (Coelho and Araújo Ramos, 1972; Briggs, 1974).

The genera *Mesorhoea*, *Cryptopodia*, *Leiolambrus*, and *Heterocrypta* are also primarily limited to continental waters with some insular records. Species in these genera occur on continental margins of the North and Central American coasts, with several records from the coastal areas of northeastern South America and Brazil (Figures 30, 31). Again, collections of the lower Central American coast have not yet been examined, and the distributional picture will undoubtedly be modified when they are.

Little can be said for *Tutankhamen cristatipes*, presently known from only two specimens, and with a

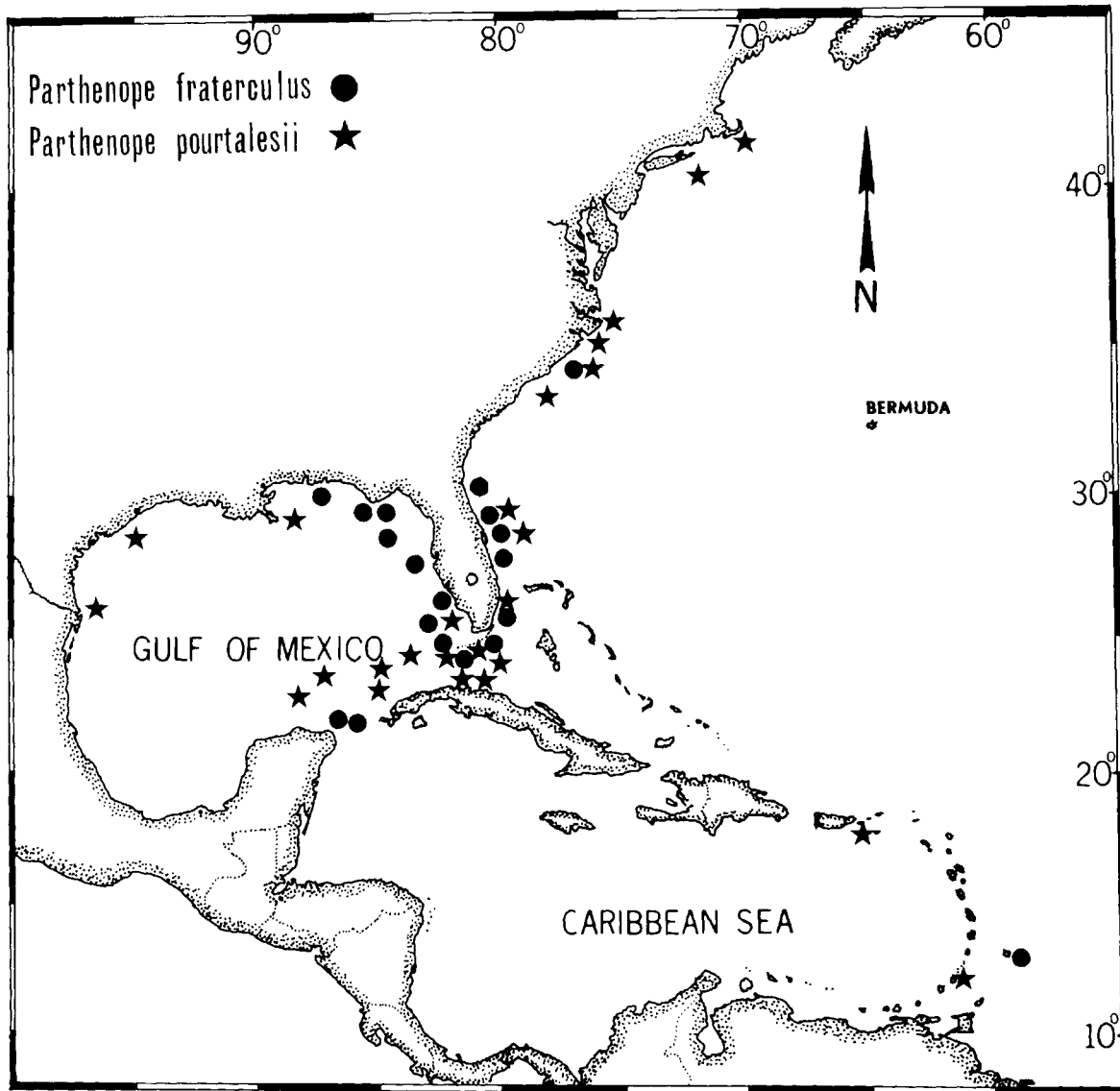


Figure 28. Distributions of *Parthenope fraterculus* and *P. pourtalesii* in the northwestern Atlantic and Gulf of Mexico.

distribution restricted, in Floridan waters, to the deeper continental shelf and upper slope of the Pourtales Plateau. The only other record is from 227 m off St. Vincent, Lesser Antilles (Rathbun, 1925).

In the western Atlantic, the genus *Solenolambrus* appears to have its major distribution along the Antillean chain and in the deeper waters off Cuba and the Straits of Florida (Figure 32). The insular distribution of *Solenolambrus typicus* and *S. tenellus*, and the records from along the Central and North American continental margins, including Texas, the Floridan peninsula, and northward to the Carolinas, imply a great thermal tolerance. The general depth range of both species (see below) also suggests that deeper and cooler waters pose no problems to the adults. The northern limit of both species at Cape Hatteras and vicinity possibly reflects a thermal barrier to further larval dispersal along the Gulf Stream. The Cape Hatteras-Cape Fear area is a notable barrier to many decapod crustaceans with tropical affinities (Williams, 1965).

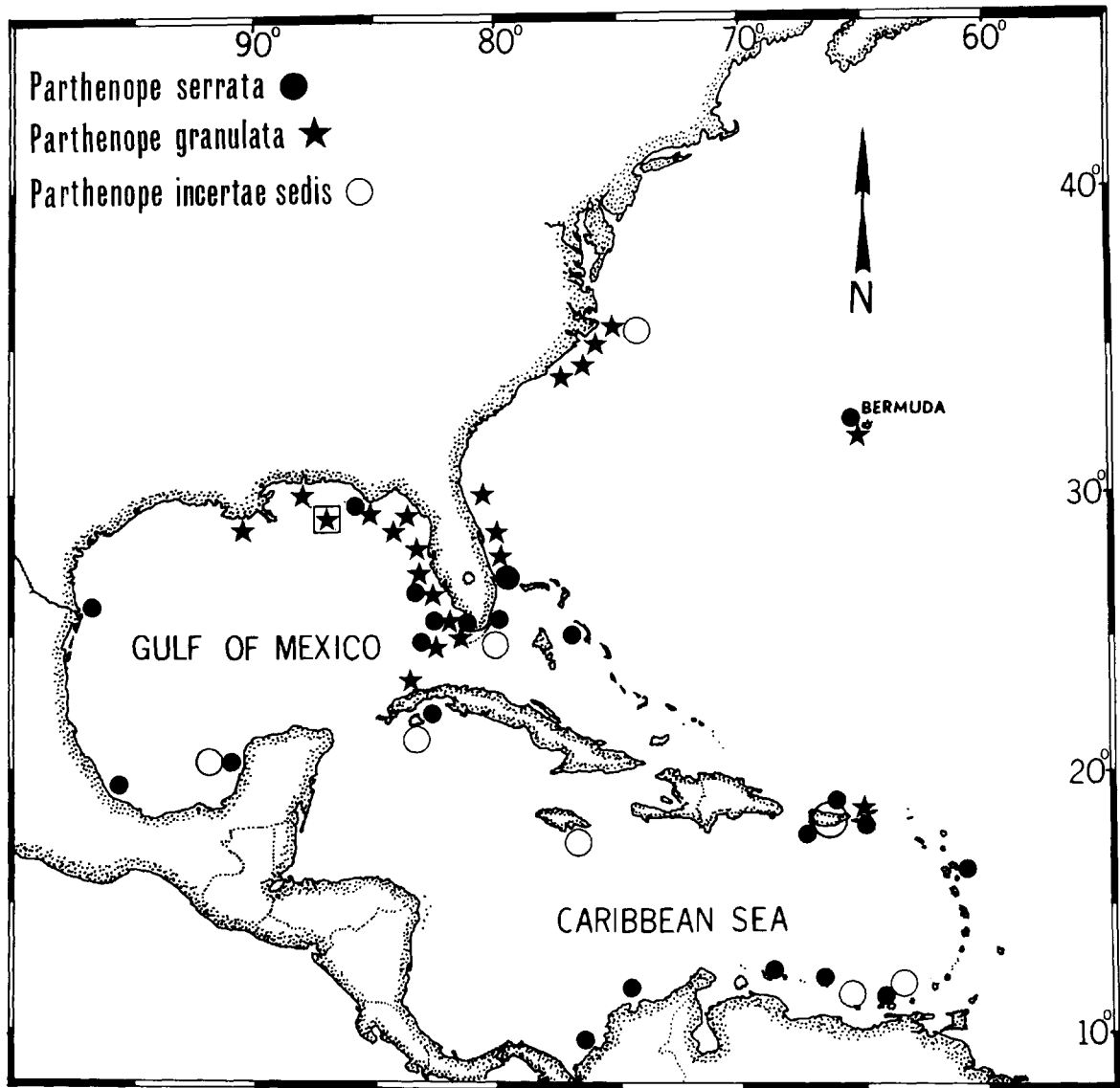


Figure 29. Distributions of *Parthenope serrata* and *P. granulata* in the northwestern Atlantic and Gulf of Mexico, including literature records not positively attributable to either species (*P. incertae sedis*); box denotes record for both species at same station.

BATHYMETRIC DISTRIBUTION

The depth distribution of Floridan parthenopids appears to reflect, in part, the zoogeographical distribution noted for the species in other areas of the Western Atlantic. Most of the species occur from nearshore, subtidal waters to the deep continental shelf, or in relatively shallow depths associated with continental or continental-associated islands throughout the Caribbean Sea. Only *Parthenope serrata* occurs intertidally (Rathbun, 1919).

In seven species, the general depth distribution is to waters less than 200 m deep (Figure 33); the remaining six species have more extensive ranges. *Parthenope agona*, *P. granulata*, *P. pourtalesii*,

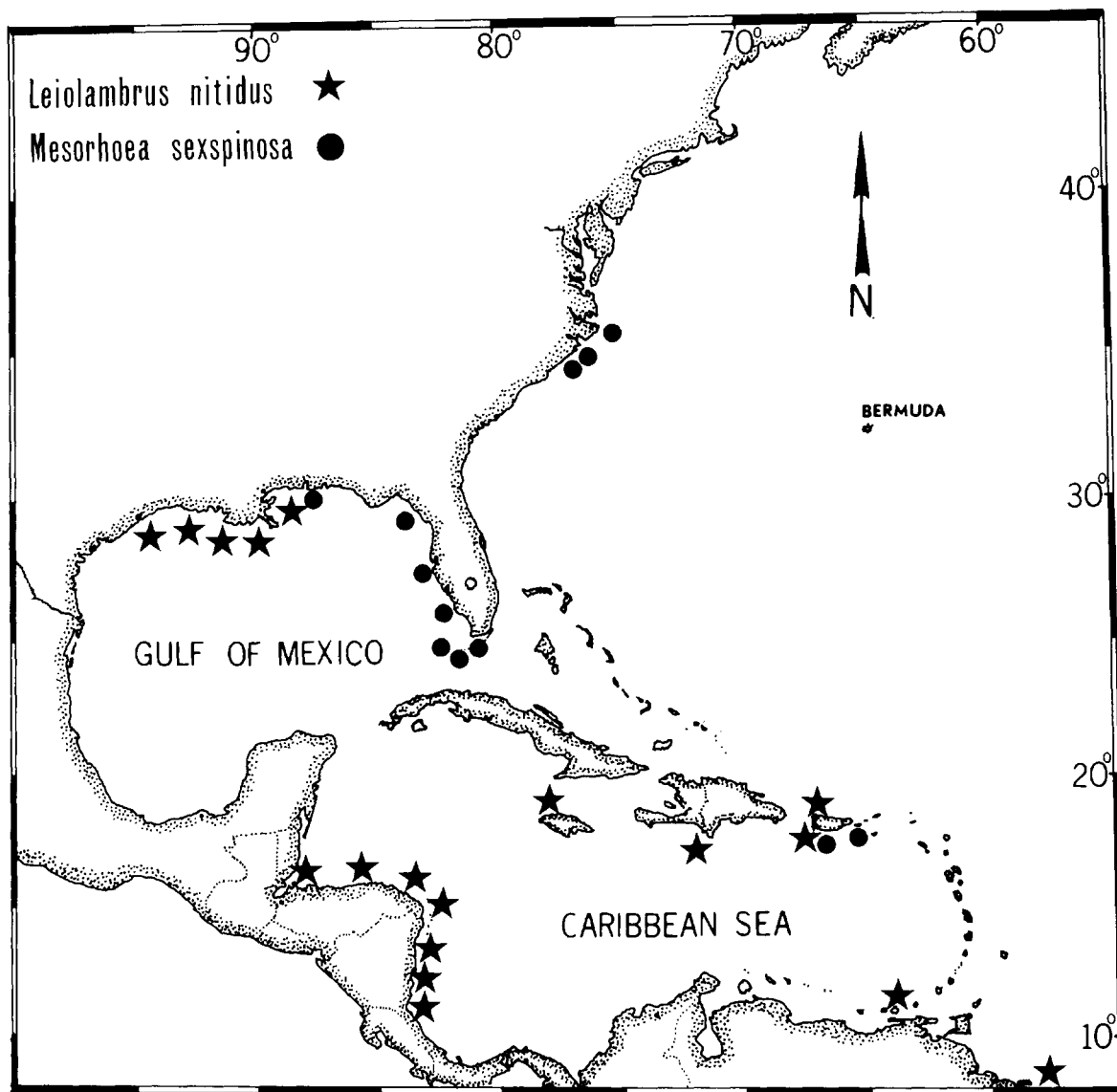


Figure 30. Distributions of *Leiolambrus nitidus* and *Mesorhoea sexspinosa* in the northwestern Atlantic and Gulf of Mexico.

Solenolambrus tenellus, *S. typicus* and *Tutankhamen cristatipes* are all known to depths greater than 300 m, and, in two instances (*P. granulata* and *S. typicus*), to over 600 m depth.

Although all species of *Parthenope* in this report are continental shelf forms, three species noted above occasionally exceed this area and can be collected on continental or island slopes. There seems to be no question as to the validity of depth records for *P. agona* and *P. pourtalesii*, but the remarkable depth range of *P. granulata* deserves some comment. Because the majority of records list this species in water less than 100 m deep, the R/V *Oregon* record is quite aberrant. Lyons and Camp (personal communication) offered two possible explanations. One is that station numbers were inadvertently transposed, and the specimen may have been collected at R/V *Oregon* Station 634, made one day earlier using the same gear type (40 ft otter trawl) in about 40 m depth, but was erroneously listed as coming from Station 635, made the following day in 677 m depth. Another alternative is that the net may have been inadequately cleaned after Station 634, and, when brought on deck at Station 635, produced the "found" specimen of *P. granulata* which actually was

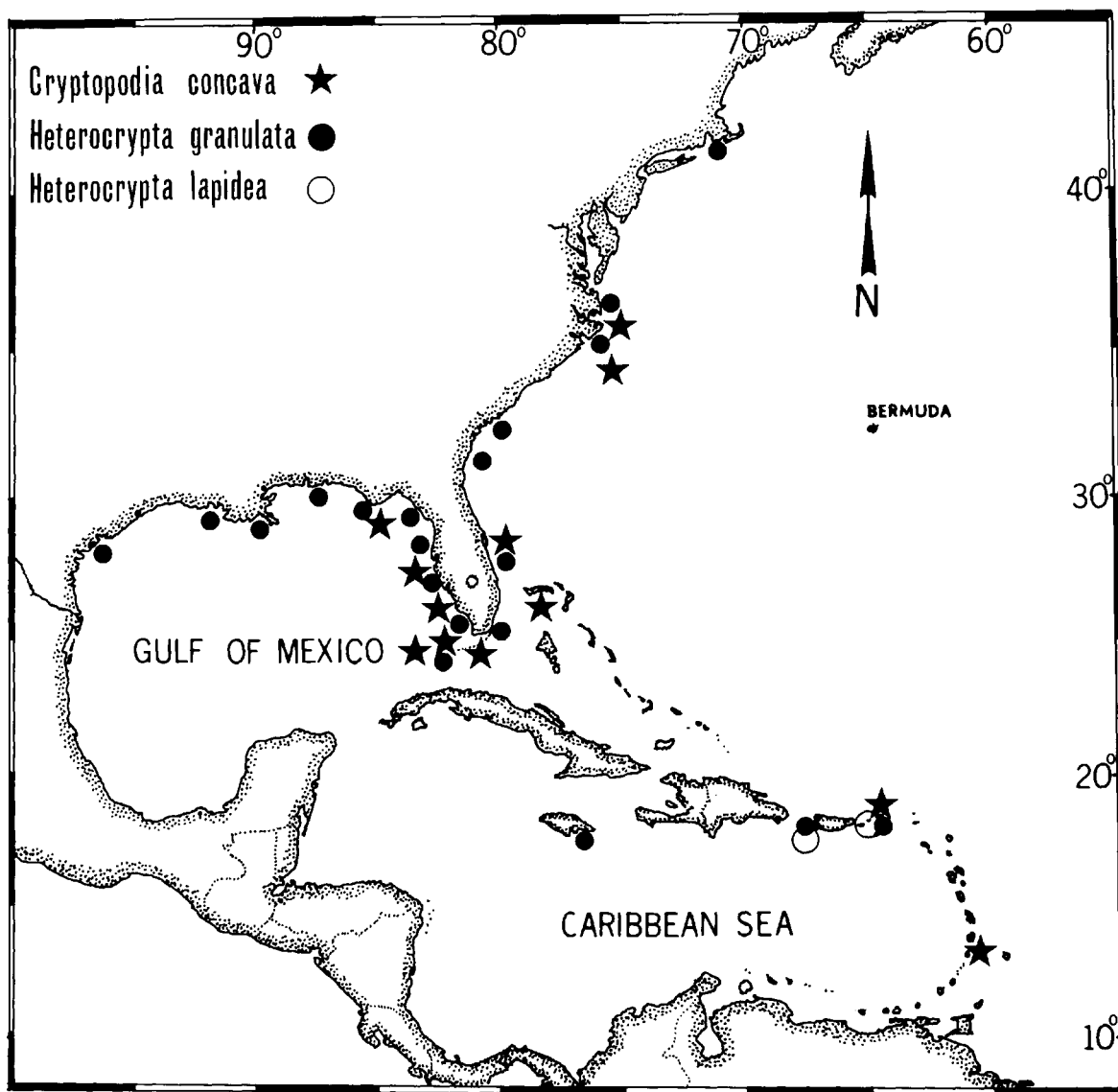


Figure 31. Distributions of *Cryptopodia concava*, *Heterocrypta granulata*, and *H. lapidea* in the northwestern Atlantic and Gulf of Mexico.

collected the previous day. The deep record should rightfully be viewed with some suspicion, but also weighed against the possibility that *P. granulata* may occur to 600+ m depths on rare occasions.

Three other depth records deserve comment. Rathbun (1925) recorded *Parthenope pourtalesii* from a *Fish Hawk* station at 10 fms (18 m), an uncharacteristically shallow (but not improbable) depth. However, the species has also been collected at Sand Key (Rathbun, 1898) in 15 fms (27 m), and the minimum depth of the type localities on the Florida Keys reef tract was 40 fms (73 m).

A second unusually shallow record is that of Rathbun (1925) for Henderson's specimen of *Parthenope fraterculus* from 4 fms (7 m). The species is usually not found in waters less than 25 m deep, although on one occasion a specimen was dredged in 18 m on the eastern Florida continental shelf by R/V *Gosnold*. Henderson's specimen from off the Tortugas, an area well known for the numerous shallow water collections

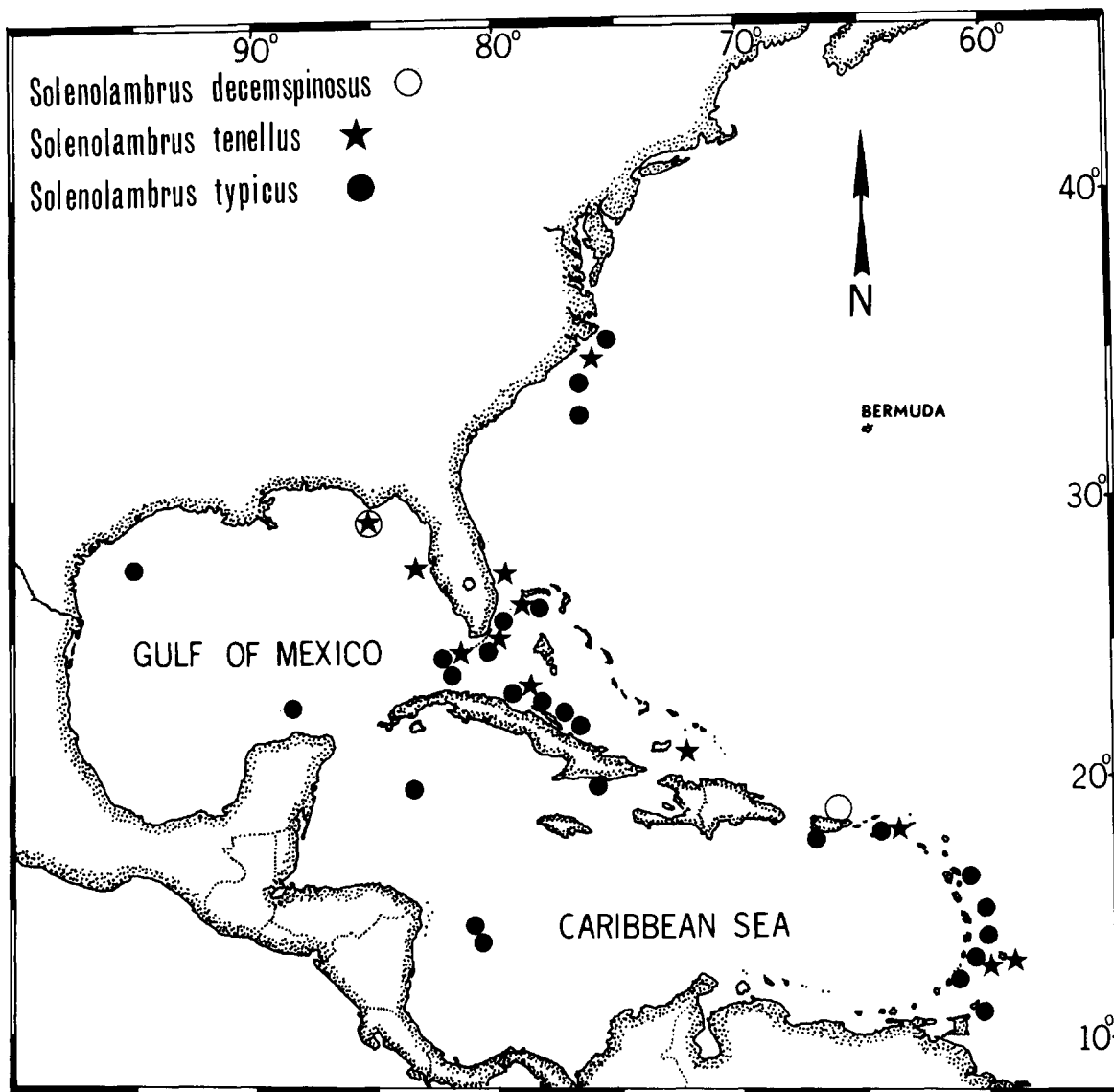


Figure 32. Distributions of *Solenolambrus decemspinusus*, *S. tenellus*, and *S. typicus* in the northwestern Atlantic and Gulf of Mexico.

made there, indicates that the species can occasionally be found in the shallow subtidal region.

Rathbun's (1925) record of *Heterocrypta granulata* from 75 fms (137 m) may be an error for 7.5 fms (14 m). This species is not otherwise known to occur in depths greater than about 50 m. The record, while not impossible, should probably be viewed with suspicion until corroborated by other material.

In the Hourglass study area, both intraspecific and interspecific relationships with particular depth zones were apparent among the eight parthenopid species. Analyses of these relationships included the following qualifications. Thirty-eight Hourglass lots containing 136 specimens of *Parthenope agona* were recorded and discarded by FDNR Marine Research Laboratory personnel. Ten lots containing 46 specimens collected during the same period were retained at the Marine Research Laboratory. We reexamined these and found them to be correctly identified. Results of analyses of relative abundance, both inter- and intraspecific,

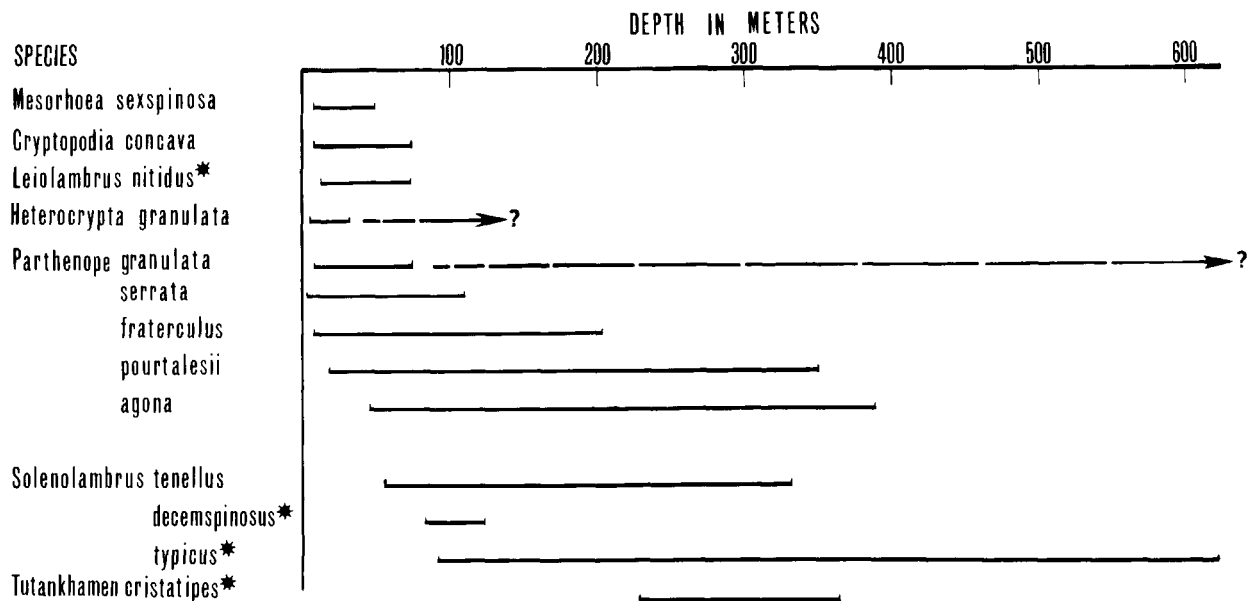


Figure 33. Depth distributions of Floridan Parthenopidae. Species marked with an asterisk (*) not collected by R/V *Hernan Cortez* or R/V *Gosnold*. Questionable ranges (?) discussed in text.

would possibly be more accurate by including both these reexamined specimens and others which had been previously discarded. However, the possibility, albeit remote, remains that some discarded specimens may have been misidentified. Additionally, all such analyses of *P. granulata* and *P. serrata* were based only upon retained specimens examined by us, because actual identity of specimens discarded as "*P. serrata*" could not be made. Therefore, analyses of relative abundance took two forms: 1) relative dominance of eight species by depth (Figure 34), excluding the discarded specimens; 2) intraspecific relative abundance (Appendix Figure 1) and interspecific relative dominance (Appendix Figure 2), including discarded *P. agona* and a separate category (*Parthenope incertae sedis*) for discarded "*P. serrata*". We are responsible for the former, whereas the latter was graciously performed by Marine Research Laboratory personnel. A discussion of the former analysis follows; the latter is provided in Appendix I.

Eight species collected during the Hourglass project were ranked according to the percent relative abundance of extant specimens of each species at a given depth (Figure 34). Hourglass Stations A/I, B/J, C/K, D/L, and E/M were made in about 6, 18, 37, 55, and 73 m respectively (Joyce and Williams, 1969).

The shallowest stations (A/I, 6 m) were dominated by two species, *Heterocrypta granulata* and *Parthenope serrata*. Occurrence of *Parthenope agona* was based on a single molted carapace. The shallowest depth at which this species was collected at other Hourglass stations and by R/V *Gosnold* on the eastern Florida coast was at least 37 m.

At Stations B/J (18 m) two species again were dominant. *Parthenope serrata* was most abundant, followed by its sympatric congener, *P. granulata*. *Heterocrypta granulata* assumed decreasing importance at these depths, while *Mesorhoea sexspinoso* attained its greatest abundance there.

At the intermediate depth stations (C/K, 37 m) *P. granulata* reached its greatest relative abundance. These stations showed increasing species richness (six species). *Parthenope fraterculus*, *P. agona*, and *Cryptopodia concava* exhibited increasing importance. *Parthenope serrata* remained about as numerous as

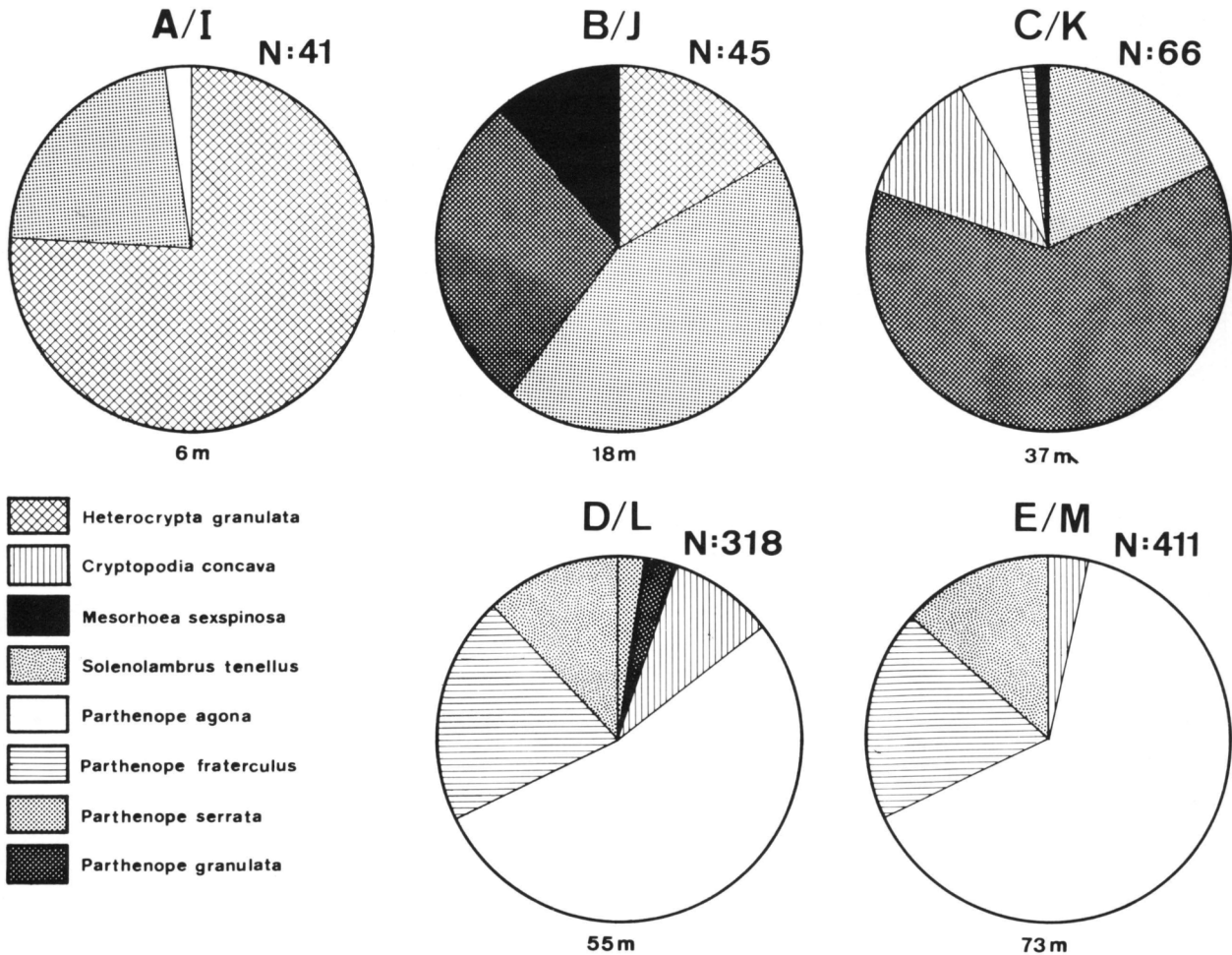


Figure 34. Relative dominance by depth of species of Hourglass Parthenopidae, based on extant specimens.

the latter three species, but *Mesorhoea sexspinoso* was almost eliminated at these depths.

The deeper stations (D/L, 55 m) were also species rich (six species), but with elimination of *M. sexspinoso* and decreased importance of both *P. granulata* and *P. serrata*, the deep water species *Solenolambrus tenellus* first made its appearance. *Parthenope agona* became numerically dominant and remained so.

At the deepest Hourglass stations (E/M, 73 m) *P. agona* was by far the most abundant species, followed by *P. fraterculus* which assumed increasing importance since its first appearance at the intermediate stations (C/K). Only four species were recorded from the deepest stations. Three of these (*P. agona*, *P. fraterculus*, and *S. tenellus*) are all deeper water species known to occur to depths greater than 200+ m. The fourth species, *C. concava*, reaches its greatest recorded depth (73 m) at the Gulf of Mexico Hourglass stations noted here.

The relative abundances by depth are in good agreement with the depth distributions recorded in the literature, and those noted for eastern Floridan species (Figure 33). Two important species not represented in Hourglass collections (*Parthenope pourtalesii* and *Solenolambrus typicus*) both occur down the continental

slope to depths greater than 300 and 600 m, respectively. Data in Figure 33 suggest that *P. pourtalesii* has depth requirements similar to *P. agona*, although the latter is known from slightly deeper waters than the former. *Solenolambrus typicus* is probably the only species which will occur at depths greater than 400 m (excluding the previously discussed *P. granulata*). The paradoxical absence of *P. pourtalesii* has been discussed earlier, whereas *S. typicus* would not be expected to occur in Hourglass collections, because its shallowest recorded depth is 91 m, well beyond that sampled by R/V *Hernan Cortez* during this study.

Leiolambrus nitidus appears to be bathymetrically similar to *Cryptopodia concava* and *Mesorhoea sexspinosa*, but all three species are relatively rare in collections, so little more can be said regarding them.

Tutankhamen cristatipes is far too rare to allow any speculation, as is *Solenolambrus decemspinus*. It is worth noting that if the latter species is merely a juvenile of *S. typicus*, then the shallow depth range of that species would be extended only a little, from 91 to 82 m.

TRANSPANAMANIAN RELATIONS AMONG SPECIES

Before the Panamanian-Central American land bridge became permanent, approximately 2-5 million years B.P. (Woodring, 1966), both the Atlantic and Pacific Oceans were interconnected, and so, presumably, were many if not all populations of marine organisms in this area. By the Miocene, and certainly by the Pliocene, the emergence of the land bridge was complete, thus splitting the formerly continuous marine biota into two separate populations which continued to evolve independently. The Panamanian-Central American land bridge presently continues to act as a barrier to marine organisms, producing consequent geographical isolation and preventing genetic exchange between the species. Approximately 45% of the species of decapod crustaceans once common to the Tertiary Caribbean Province have since sufficiently diverged morphologically, physiologically or ontogenetically to be considered separate but similar species called twin, geminate, cognate, or analogous. Abele (1976) provides further treatment and discussion on this subject, and points out the unique study opportunities this geological/biological situation has presented.

Seven of the 13 species (54%) treated herein have analogous species in the Eastern Pacific Ocean. Of the remaining six which do not, one (*Solenolambrus decemspinus*) may ultimately prove to be only a juvenile of *S. tenellus*; a second (*Tutankhamen cristatipes*) is monotypic and known only from a very restricted range off Florida and St. Vincent, Lesser Antilles; and two (*Parthenope granulata* and *P. serrata*) are most closely related to each other.

Solenolambrus tenellus lacks, as yet, an Eastern Pacific analogue. The species is distinctly different in carapace form and gonopod structure from its closest Atlantic relative, *S. typicus* (Figures 9, 10). The latter species, however, is very similar in carapace and gonopod morphology to its Panamic geminate, *S. arcuatus* (see Garth, 1958).

The close relationship between *Parthenope granulata* and *P. serrata*, now separated easily by gonopod and gonopore morphology, has been discussed at length earlier. Although the Eastern Pacific species *Parthenope (Platylambrus) depressiuscula* (Stimpson, 1871) appears somewhat similar in carapace morphology to both *P. granulata* and *P. serrata*, the gonopods, as figured by Garth (1958), show little resemblance to those of either of the latter two species. Indeed, the gonopod most similar in form to either species is that figured by Garth (1958) for *Parthenope (Pseudolambrus) triangula* (Stimpson, 1860), which resembles somewhat that seen in *P. serrata* but not that of *P. granulata*. *Parthenope triangula* is otherwise not

comparable in carapace morphology to *P. (Platylambrus) serrata*, as evidenced by the different subgenera into which each has been assigned.

Parthenope fraterculus superficially resembles at least two Eastern Pacific species, *P. excavata* (Stimpson, 1871) and *P. stimpsoni* Garth, 1958, but, based on carapace morphology and gonopod structure and armature, it appears to be only distantly related to *P. excavata*; it is even less closely related to *P. stimpsoni*. The two Eastern Pacific species are closely related to each other, however, and were separated by Garth on the basis of differences in gonopod structure. They reflect the situation previously described for *P. granulata*-*P. serrata* herein.

LITERATURE CITED

ABELE, L. G.

1972. Comparative habitat diversity and faunal relationships between the Pacific and Caribbean decapod Crustacea: a preliminary report, with some remarks on the crustacean fauna of Panamá. Pp. 125-138 in M.L. Jones, ed. The Panamic biota: some observations prior to a sea-level canal. Bull. Biol. Soc. Wash. No. 2. 270 pp.
1976. Comparative species composition and relative abundance of decapod crustaceans in marine habitats of Panamá. Mar. Biol. 38: 263-278, figs. 1-5.

ARNOLD, A. F.

1903. The sea-beach at ebb-tide. Century Co., New York. 450 pp., unnumbered text-figs., pls. 1-85.

AURIVILLIUS, C. W. S.

1889. Die Maskirung der oxyrrhynchen Dekapoden, durch besondere Anpassungen ihres Körperbaues vermittelt. K. Svenska Vetensk Akad. Handl. 23(4): 1-71, pls. 1-5.

BALSS, H.

1924. 3. Westindische Decapoden. Zool. Anz. 61: 177-182.

BEATTY, H. A.

1944. Brachyura crabs of St. Croix, V.I. J. Agric. Univ. P.R. 28: 173-177.

BEHRE, E. H.

1950. Annotated list of the fauna of the Grand Isle region, 1928-1946. Occas. Pap. Mar. Lab. La. St. Univ. 6: 1-66.

BOONE, L.

1927. Scientific results of the first oceanographic expedition of the "Pawnee", 1925. Crustacea from tropical east American seas. Bull. Bingham Oceanogr. Collect. 1(2): 1-147, 33 text-figs.
1930. Scientific results of the cruises of the yachts "Eagle" and "Ara", 1921-1928, William K. Vanderbilt, Commanding. Crustacea: Stomatopoda and Brachyura. Bull. Vanderbilt Mar. Mus. 2: 1-228, pls. 1-74.

BORRADAILE, L. A.

1907. On the classification of the decapod crustaceans. Ann. Mag. Nat. Hist. Ser. 7, 19: 457-486.

BOSCHI, E. E.

1965. Un nuevo crustaceo Brachyura Parthenopidae para el Atlantico sudoeste (Uruguay). Physis, B. Aires 25(69): 33-36.

BRIGGS, J. C.

1974. Marine zoogeography. McGraw-Hill, New York. 475 pp., 65 text-figs.

- BRITO CAPELLO, F. DE
1871. Descrição de algumas especies novas de Crustáceos. J. Sci. Mat. Phys. e Nat. Lisboa 3: 262-265, pl. 3.
- BULLIS, H. R., JR., and J. R. THOMPSON
1965. Collections by the exploratory fishing vessels *Oregon*, *Silver Bay* and *Pelican* made during 1956-60 in the southwestern North Atlantic. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Fish. No. 510: 1-130.
- CANO, G.
1889. Crostacei Brachiuri ed Anomuri raccolti nel viaggio dell "Vettor Pisani" intorno al globo. Bol. Soc. Nat. Napoli 3: 79-105, 169-268, figs. 1-15, pl. 7.
- CAPART, A.
1951. Crustacés Decapodes, Brachyures. Result. Sci. Exped. Oceanogr. Belge Atlant. Sud 3(1): 11-205, text-figs. 1-80, pls. 1-3.
- CHACE, F. A., JR.
1940. Reports on the scientific results of the *Atlantis* expeditions to the West Indies, under the joint auspices of the University of Havana and Harvard University. The brachyuran crabs. *Torreia* 4: 3-67, text-figs. 1-22.
1956. Crustaceos decapodos y stomatopodos del Archipielago de Los Roques e Isla de La Orchila. Pp. 145-168, 4 pls. in *El Archipielago Los Roques y La Orchila*. Soc. Cienc. Nat. Inst. La Salle.
- COELHO, P. A. and M. D. ARAÚJO RAMOS
1972. A constituição e a distribuição da fauna de decapodos do litoral leste da America do sul entre as latitudes de 5° N e 39°S. *Trabhs. Oceanogr. Univ. Fed. Pe. Recife* 13: 133-236, figs. 1-4.
- COUES, E. and H. C. YARROW
1878. Notes on the natural history of Fort Macon, N.C., and vicinity. *Proc. Acad. Nat. Sci. Phila.* 30(5): 297-315.
- CRANE, J.
1937. The Templeton Crocker Expedition. III. Brachygnathous crabs from the Gulf of California and the west coast of lower California. *Zoologica* 22(3): 47-78, pls. 1-8.
- DARLINGTON, P. J., JR.
1957. *Zoogeography: the geographical distribution of animals*. John Wiley, New York. 675 pp., 80 figs.
- DAWSON, C. E.
1966. Additions to the known marine fauna of Grand Isle, Louisiana. *Proc. La. Acad. Sci.* 29: 175-180.
- DESBONNE, I.
1867. I. Partie. Brachyures. 60 pp., pls. 1-8 in A. Schramm, ed. *Desbonne and A. Schramm, Crustacés de la Guadeloupe d'après un manuscrit du Docteur Isis Desbonne comparé avec les échantillons de crustacés de sa collection et les dernières publications de MM Henry de Saussure et William Stimpson*. Basse-Terre, Guadeloupe.
- DRAGOVICH, A. and J. A. KELLY, JR.
1964. Ecological observations of macro-invertebrates in Tampa Bay, Florida 1961-1962. *Bull. Mar. Sci. Gulf Caribb.* 14(1): 74-102, 1 fig.
- FAUSTO-FILHO, J.
1970. Quarta contribuição ao inventário dos crustáceos decápodos marinhos do Nordeste Brasileiro. *Arq. Ciênc. Mar.* 10(1): 55-60.
- FAXON, W.
1893. Reports on the dredging operations off the west coast of Central America to the Galapagos,

- to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U.S. Fish Commission steamer "Albatross", during 1891, Lieut. Commander Z. L. Tanner, U.S.N., Commanding. VI. Preliminary descriptions of new species of Crustacea. Bull. Mus. Comp. Zool. Harv. Univ. 24(7): 149-220.
1895. Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos Islands by the U.S. Fish Commission steamer "Albatross", during 1891 . . . XV. The stalk-eyed Crustacea. Mem. Mus. Comp. Zool. Harv. Univ. 18: 1-292, pls. A-K, 1-56.
1896. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico and the Caribbean Sea, and on the east coast of the United States, 1877-1880, by the U.S. Coast Survey steamer "Blake", Lieut.-Commander C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N., Commanding. XXXVII. Supplementary notes on the Crustacea. Bull. Mus. Comp. Zool. Harv. Univ. 30(3): 153-166, 2 pls.
- FELDER, D. L.
1971. The decapod crustaceans of Seven and One-half Fathom Reef. M.S. Thesis. Texas A & I Univ., Kingsville, Texas. 121 pp., 22 figs.
1973. An annotated key to crabs and lobsters (Decapoda, Reptantia) from coastal waters of the northwestern Gulf of Mexico. La. St. Univ. Publ. No. LSU-SG-73-02. 103 pp., 12 pls.
- FLIPSE, H. J.
1930. Die Decapoda Brachyura der Siboga-Expedition. Part VI. Oxyrrhyncha: Parthenopidae. Siboga-Exped. Monogr. 39C²: 1-96, text-figs. 1-45.
1931. Einige Parthenopidae aus dem naturhistorischen Museum in Leiden. Zool. Meded. Leiden 14: 80-96.
- FOWLER, H. W.
1912. The crustacea of New Jersey. Rep. New Jersey St. Mus. 1911. 650 pp., 150 pls.
- GARTH, J. S.
1940. Some new species of brachyuran crabs from Mexico and the Central and South American mainland. Allan Hancock Pacif. Exped. 5(3): 53-127, pls. 11-26.
1946. Littoral brachyuran fauna of the Galapagos Archipelago. Allan Hancock Pacif. Exped. 5(10): 341-601, text-fig. 1, pls. 49-87.
1958. Brachyura of the Pacific coast of America, Oxyrrhyncha. Allan Hancock Pacif. Exped. 21(1): 1-499, 9 text-figs. 21(2): 501-854, pls. A-Z, Z₁-Z₄, 1-55.
- GIBBES, L. R.
1849. Crustacea. Pp. 21-24 in George White, ed. Statistics of the state of Georgia: Including an account of its natural, civil, and ecclesiastical history, . . . etc. W. Thirne Williams, Savannah, Georgia.
1850. On the carcinological collections of the United States, and an enumeration of species contained in them, with notes on the most remarkable, and descriptions of new species. Proc. Am. Assoc. Advmt. Sci. 3: 167-201.
1856. Monograph of the genus *Cryptopodia*. Proc. Elliott Soc. Nat. Hist. 1: 14, 32-38, plus text-figs.
- GILMORE, R. G.
- Regional description and checklist of fishes of the Indian River lagoon and adjacent waters, Florida. 63 pp., 2 figs. (unpubl. ms.)
- GODCHARLES, M. F. and W. C. JAAP
1973. Fauna and flora in hydraulic clam dredge collections from Florida's west and southeast coasts. Fla. Dep. Nat. Resour. Mar. Res. Lab. Spec. Sci. Rep. No. 41: 89 pp., 17 text-figs.

- GORE, R. H.
 1977. Studies on decapod Crustacea from the Indian River region of Florida. VI. The identity of *Parthenope (Platylambrus) serrata* (H. Milne Edwards, 1834) and *Parthenope (Platylambrus) granulata* (Kingsley, 1879). Proc. Biol. Soc. Wash. 90(3): 505-531, 5 text-figs., 2 pls.
- GUINOT-DUMORTIER, D.
 1960. Sur une collection de crustacés (Decapoda Reptantia) de Guyane Française II. Brachyura Oxyrhyncha et Macrura. Bull. Mus. Natl. Hist. Nat. Paris 2^e série 32(2): 177-187, figs. 18-26.
- GUNDLACH, J. and J. I. TORRALBAS
 1899. Contribución al estudio de los Crustáceos de Cuba. Notas compiladas y completadas por el
 1900. Dr. J.I. Torralbas. An. Acad. Cienc. Méd. Fís. Nat. Habana (36): 292-305, plus text-figs.
- HAECKEL, E.
 1904. Kunstformen der Natur. Leipzig. [Not seen].
- HAY, W. P. and C. A. SHORE
 1918. The decapod crustaceans of Beaufort, N.C., and the surrounding region. Bull. Bur. Fish. 35: 369-475, 20 text-figs., pls. 25-39.
- HEDGPETH, J. W.
 1953. An introduction to the zoogeography of the northwestern Gulf of Mexico with reference to the invertebrate fauna. Publ. Inst. Mar. Sci. Univ. Tex. 3(1): 110-224, 46 text-figs.
- 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. Tex. 3(2): 233-366, 7 text-figs.
 1955. A study of the fauna of the pink shrimp (*Penaeus duorarum* Burkenroad) grounds in the Gulf of Campeche. Publ. Inst. Mar. Sci. Univ. Tex. 4(1): 169-232, figs. 1, 2.
- HOLTHUIS, L. B.
 1959. The Crustacea Decapoda of Suriname (Dutch Guiana). Zool. Verh. Rijksmus. Nat. Hist. Leiden (44): 1-296, 68 text-figs., 16 pls.
- HUGHES, H. G.
 1750. The natural history of Barbados. Book IX. Of crustaceous animals. London. Pp. 261-266, pl. XXV.
- HULINGS, N. C.
 1961. The barnacle and decapod fauna from the nearshore area of Panama City, Florida. Q.J. Fla. Acad. Sci. 24(3): 215-222.
- JOYCE, E. A., JR. and J. WILLIAMS
 1969. Memoirs of the Hourglass Cruises: Rationale and pertinent data. Fla. Dep. Nat. Resour. Mar. Res. Lab. I(I): 1-50.
- KENNEDY, F. S., J. J. CRANE, R. A. SCHLIEDER, and D. G. BARBER
 1977. Studies of the rock shrimp, *Sicyonia brevirostris*, a new fishery resource on Florida's Atlantic shelf. Fla. Mar. Res. Publ. 27: 69 pp., 27 text-figs.
- KINGSLEY, J. S.
 1878. List of decapod Crustacea of the Atlantic coast whose range embraces Ft. Macon. Proc. Acad. Nat. Sci. Phila. 30: 316-328.
 1879. Notes on North American Decapoda. Proc. Boston Soc. Nat. Hist. 20: 145-160.
 1880. On a collection of Crustacea from Virginia, North Carolina and Florida, with a revision of the genera of Cragonidae and Palaemonidae. Proc. Acad. Nat. Sci. Phila. 31(for 1879): 383-427, pl. 14.

- LEARY, S. P.
1967. The crabs of Texas. Texas Parks Wildl. Dept. Coastal Fish. Bull. 7(43): 1-57.
- LEWIS, J. B.
1965. A preliminary description of submarine benthic communities from Barbados, West Indies. Can. J. Zool. 43: 1049-1074.
- 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. Dep. Nat. Resour. Mar. Res. Lab. Prof. Pap. Ser. No. 14: 1-45, 10 text-figs.
- MACLEAY, W. S.
1838. On the brachyurous decapod Crustacea brought from the Cape by Dr. Smith. Pp. 53-72 in Illustrations of the Annulosa of South Africa, 1838: 75 pp., 4 pls.
- MIERS, E. J.
1879. Descriptions of new or little known species of maioid Crustacea (Oxyrhyncha) in the collection of the British Museum. Ann. Mag. Nat. Hist. 5(4): 1-28, pls. 4, 5.
1881. XXI. On a collection of Crustacea made by Baron Hermann-Maltzam at Goree Island, Senegambia. Ann. Mag. Nat. Hist. 8(45): 204-220; (46): 259-281; (47): 364-377, pls. 13-16.
1886. Report on the Brachyura collected by the H.M.S. *Challenger* during the years 1873-1876. Rep. Scient. Results H.M.S. *Challenger*. Zoology 17: 1-362, pls. 1-29.
- MILNE EDWARDS, A.
1873- Études sur les Xiphosures et les Crustacés de la région Mexicaine. Pp. 1-368, pls. 1-61 in
1881. Mission scientifique au Mexique et dans l'Amérique centrale, pt. 5; Rech. Zool. Hist. Faune Am. Centr. Mex. [Published in numbers, as follows: 1873, Nos. 1, 2, pp. 1-56, pls. 1-14; 1875, No. 3, pp. 57-120, pls. 15-20; 1878, No. 4, pp. 121-184, pls. 21-27, 29, 30; 1879, Nos. 5, 6, pp. 185-264, pls. 15A, 28, 31-36; 1880a, Nos. 7, 8, pp. 265-368, pls. 37-54; 1881, pls. 55-61].
1880b. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico, and in the Caribbean Sea, 1877, 1878, 1879, by the United States Coast Survey steamer "Blake", Lieut.-Commander C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N., Commanding. VIII. Études Préliminaires sur les Crustacés. Bull. Mus. Comp. Zool. Harv. Univ. 8(1): 1-68, pls. 1, 2.
- MILNE EDWARDS, A. and E. L. BOUVIER
1923. Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877-78), in the Caribbean Sea (1878-79) and along the Atlantic coast of the United States (1880), by the U.S. Coast Survey steamer "Blake" . . . XLVII. Les Porcellanides et des Brachyures. Mem. Mus. Comp. Zool. Harv. Univ. 47(4): 283-395, 22 text-figs., 12 pls.
- MILNE EDWARDS, H.
1834. Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux. 1: 1-468; and Atlas: 1-32, pls. 1-42.
- MONOD, Th.
1956. Hippidea et Brachyura ouest-africains. Mem. Inst. Fr. Afr. Noire (45): 1-674, 884 text-figs.
- MOREIRA, C.
1901. Contribuições para o conhecimento de fauna Brasileira. Crustáceos do Brazil. Archos. Mus. Nac. Rio de J. 11: 1-151, pls. 1-5.
- ORTMANN, A. E.
1893. Die Decapoden-Krebse des Strassburger Museums. VII. Theil Abtheilung: Brachyura

(*Brachyura genuina* Boas) II. Unterabtheilung: Cancroidea, 2. Section: Cancrinea, 1. Gruppe: Cyclometopa. Zool. Jahrb. Abt. Syst. Oekol. Geogr. Tiere 7: 411-495, pl. 17.

PARKER, R. H.

1959. Macro-invertebrate assemblages of central Texas coastal bays and Laguna Madre. Bull. Am. Assoc. Pet. Geol. 43(9): 2100-2166.

PEARSE, A. S., H. J. HUMM, and G. W. WHARTON

1942. Ecology of sand beaches at Beaufort, N.C. Ecol. Monogr. 12(2): 135-190, 23 text-figs., 1 map.

PEQUEGNAT, L. H.

1975. List of catalogued invertebrate species in the Texas A & M University systematic collection of marine organisms. Rep. Sea Grant Tex. A & M Univ. TAMU-SG-76-601: 109 pp.

PEQUEGNAT, W. E.

1970. Deep water brachyuran crabs. Pp. 171-204, figs. 6-1 to 6-11 in Pequegnat, W.E. and F.A. Chace, Jr., eds. Contributions on the biology of the Gulf of Mexico. Texas A & M University Oceanographic Studies, 1: 270 pp. Gulf Publ. Co., Houston, Texas.

PEQUEGNAT, W. E., L. H. PEQUEGNAT, R. W. FIRTH, JR., B. M. JAMES, and T. W. ROBERTS

1971. Gulf of Mexico deep-sea fauna. Decapoda and Euphausiacea. Serial Atlas of the Marine Environment, Folio 20. Am. Geogr. Soc. 12 pp.

RATHBUN, M. J.

1893. Scientific results of explorations by the U.S. Fish Commission steamer *Albatross*. XXIV. Descriptions of new genera and species of crabs from the west coast of North America and the Sandwich Islands. Proc. U.S. Natl. Mus. 16: 223-260.

1894. Description of a new genus and four new species of crabs from the Antillean Region. Proc. U.S. Natl. Mus. 17: 83-86.

1897. List of the decapod Crustacea of Jamaica. Ann. Inst. Jamaica 1(1): 1-46.

1898. The Brachyura of the biological expedition to the Florida Keys and the Bahamas in 1893. Bull. Lab. Nat. Hist. St. Univ. Iowa 4(3): 250-294, pls. 1-9.

1900. Synopses of North American invertebrates. X. The oxyrhynchous and oxystomatous crabs of North America. Am. Nat. 34: 503-520, 15 text-figs.

1901. The Brachyura and Macrura of Porto Rico. Bull. U.S. Fish Comm. 20 (for 1900), pt. 2: 1-127, text-figs. 1-26, pls. 1-2.

1905. Fauna of New England. 5. List of the Crustacea. Occas. Pap. Boston Soc. Nat. Hist. 7: 117 pp.

1919. Stalk-eyed crustaceans of the Dutch West Indies collected by Dr. J. Boeke 1904-1905. Rep. Fish. Aquat. Resour. Dutch W. Indies (Curaçao) pt. 2: 317-349 [1-32], figs. 1-5.

1921. Report on the Brachyura collected by the Barbados-Antigua Expedition from the University of Iowa in 1918. Stud. Nat. Hist. Iowa Univ. 9(5): 65-90, pls. 1-3.

1924. New species and subspecies of spider crabs. Proc. U.S. Natl. Mus. 64: 1-5.

1925. The spider crabs of America. Bull. U.S. Natl. Mus. 129: 1-613, text-figs. 1-153, pls. 1-283.

1933. Brachyuran crabs of Porto Rico and the Virgin Islands. Scient. Surv. P. Rico 15(1): 1-121, 107 text-figs.

1935. Fossil Crustacea of the Atlantic and Gulf Coastal Plain. Spec. Pap. Geol. Soc. Am. (2): 1-160, 2 text-figs., pls. 1-26.

RIGHI, G.

1965. Uma nova especie de Parthenopidae (Crustacea, Brachyura). Pap. Dep. Zool. Univ. S. Paulo 18: 57-60, 1 fig.

1966. A familia Parthenopidae no Brasil (Crustacea, Brachyura). Ciênc. Cult. (São Paulo) 18(2): 140.

- RODRIGUES DA COSTA, H.
1959. *Heterocrypta tommasii* nova especie de Crustacea Brachyura (Oxyrhyncha Parthenopidae). Centr. Estud. Zool. Fac. Nac. Filosof. Univ. Brasil Av. 2: 4 pp., 1 text-fig.
1961. Um novo caraquejo partenopideo da costa Brasileira. Descrição de *Solenolambrus brasiliensis* n. sp. (Brachyura, Oxyrhyncha, Parthenopidae). Centr. Estud. Zool. Fac. Nac. Filosof. Univ. Brasil Av. 9: 1-6, 1 text-fig.
1968. As especies de "Parthenopidae" que ocorrem nas costas do Brasil. I. (Crustacea, Brachyura). Atas Soc. Biol. Rio de J. 12(3): 143-147.
1969. As especies de "Parthenopidae" que ocorrem nas costas do Brasil. (Crustacea, Brachyura) II. Atas Soc. Biol. Rio de J. 12(4): 175-177.
- ROUSE, W. L.
1970. Littoral Crustacea from southwest Florida. Q.J. Fla. Acad. Sci. 32(2): 127-152, 1 fig.
- ROUX, P.
- 1828-1830. Crustacés de la Méditerranée et de son littoral. Pls. 1-45, with accompanying text, unnumbered. Paris and Marseille. [Not seen].
- SAUSSURE, H. de
1858. Mémoire sur divers Crustacés nouveaux du Mexique et des Antilles. Mém. Soc. Phys. Hist. Nat. Genève 14(2): 417-496, pls. 1-6.
- SMITH, S. I.
1881. Preliminary notice of the Crustacea dredged, in 64-325 fathoms, off the south coast of New England, by the United States Fish Commission in 1880. Proc. U.S. Natl. Mus. 3 (for 1880): 413-452.
1883. Preliminary report on the Brachyura and Anomura dredged in deep water off the south coast of New England by the United States Fish Commission in 1880, 1881, and 1882. Proc. U.S. Natl. Mus. 6(1): 1-57, pls. 1-4.
1886. XXI. Report on the decapod Crustacea of the *Albatross* dredgings off the east coast of the United States during the summer and autumn of 1884. Rep. U.S. Comm. Fish. (1885) pt. 13: 605-705, 22 pls.
- SOTO, L. A.
1972. Decapod shelf-fauna of the northeastern Gulf of Mexico. Distribution and zoogeography. M.S. Thesis. Florida State University, Tallahassee, Florida. 128 pp., 47 text-figs.
- SPRINGER, S. and H. R. BULLIS, JR.
1956. Collections by the *Oregon* in the Gulf of Mexico. U.S. Fish Wildl. Serv. Spec. Scient. Rep.: Fish. No. 196: 1-134.
- STEPHENSEN, K.
1945. The Brachyura of the Iranian Gulf. Dan. Scient. Invest. Iran Pt. 4: 57-237, text-figs. 1-60.
- STIMPSON, W.
1860. Notes on North American Crustacea, in the museum of the Smithsonian Institution. No. II. Ann. Lyceum Nat. Hist. N.Y. 7: 176-246, pls. 2, 5.
- 1871a. Preliminary report on the Crustacea dredged in the Gulf Stream in the Straits of Florida, by L.P. de Pourtales, Assist. U.S. Coast Survey, Part I: Brachyura. Bull. Mus. Comp. Zool. Harv. Univ. 2(2): 109-160.
- 1871b. Notes on North American Crustacea in the museum of the Smithsonian Institution. No. III. Ann. Lyceum Nat. Hist. N.Y. 10: 92-136.
- SUMNER, F. B., R. C. OSBURN, and L. J. COLE
- 1913a. Section I. Physical and zoological. Pp. 3-442 in A biological survey of the waters of Woods Hole and vicinity. Bull. Bur. Fish. Wash. 31 (for 1911, part 1).

- 1913b. Section III. A catalogue of the marine fauna. Pp. 545-794 in A biological survey of the waters of Woods Hole and vicinity. Bull. Bur. Fish. Wash. 31 (for 1911, part 2).
- 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 Caribb. 11(4): 552-649, text-figs. 1-8.
1962. Aspects of the biology of northern Florida Bay and adjacent estuaries. Pp. 39-79 in D.C. Tabb, D.L. Dubrow, and R.B. Manning, eds. The ecology of northern Florida Bay and adjacent estuaries. Fla. State Board Conserv. Tech. Ser. 39: 81 pp., 10 text-figs.
- THIRIOT, A.
1973. Stades larvaires de Parthenopidae mediterraneens: *Heterocrypta maltzani* Miers et *Parthenope massena* (H. Milne-Edwards). Cah. Biol. Mar. 14: 111-134, figs. 1-11.
- TÜRKAY, M.
1968. Dekapoden von den Margarita-Inseln (Venezuela). Senckenb. Biol. 49(374): 249-257, plate-figs. 1-8.
- VERRILL, A. E.
1873. A. Habits and distribution of the invertebrate animals. Pp. 295-513 in A.E. Verrill, ed. Report upon the invertebrate animals of Vineyard Sound and the adjacent waters, with an account of the physical characters of the region. Rep. U.S. Comm. Fish. Pt. I: 295-778.
1885. XVI. Results of the explorations made by the steamer "Albatross", off the northern coast of the United States, in 1883. Rep. U.S. Comm. Fish. (for 1883) Pt. II: 503-699, pls. 1-44.
1908. Decapod Crustacea of Bermuda, Pt. I. Brachyura and Anomura, their distribution, variations and habits. Trans. Conn. Acad. Arts Sci. 13: 299-474, 67 text-figs., pls. 9-28.
1922. Decapod Crustacea of Bermuda, Pt. II. Macrura. Trans. Conn. Acad. Arts Sci. 26: 1-179, 12 text-figs., pls. 1-48.
- VERRILL, A. E., S. I. SMITH, and O. HARGER
1873. D. Catalogue of the marine invertebrate animals of the southern coast of New England, and adjacent waters. Pp. 537-747 in A.E. Verrill, ed. Report on the invertebrate animals of Vineyard Sound and adjacent waters, with an account of the physical characters of the region. Rep. U.S. Comm. Fish. Pt. I: 295-778.
- VON MARTENS, E.
1872. Ueber cubanische Crustaceen nach den Sammlungen Dr. J. Gundlach's. Arch. Naturgesch. 39(1): 77-147, pls. 4, 5.
- WASS, M. L.
1955. The decapod crustaceans of Alligator Harbor and adjacent inshore areas of northwestern Florida. Q.J. Fla. Acad. Sci. 18(3): 129-176, 13 text-figs.
- WEBER, F.
1795. Nomenclator entomologicus secundum entomologiam systematicum III. Fabricii, adjectis speciebus recens detectis et varietatibus. Chilonii [Kiel] et Hamburgi. 171 pp. [Not seen].
- WHITE, A.
1847. List of the specimens of Crustacea in the collections of the British Museum. By the Trustees, London. 143 pp.
- WILLIAMS, A. B.
1965. Marine decapod crustaceans of the Carolinas. U.S. Fish Wildl. Serv. Fishery Bull. 65(1): 1-298, text-figs. 1-252.
1974. Marine flora and fauna of the northeastern United States. Crustacea: Decapoda. NOAA Tech. Rept. NMFS CIRC-389: 50 pp., 111 text-figs.

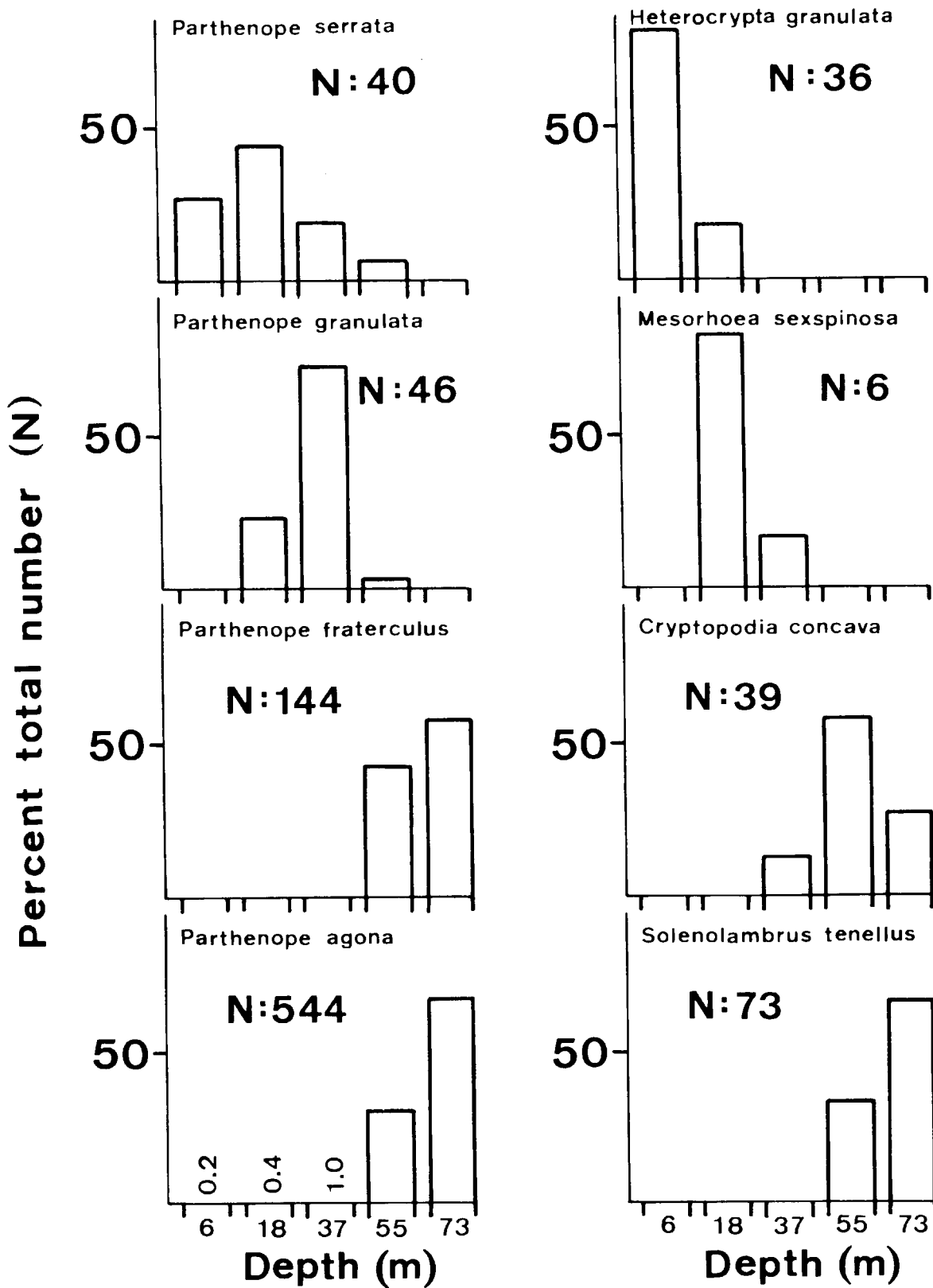
- WILLIAMS, A. B., L. R. McCLOSKEY, and I. E. GRAY
1968. New records of brachyuran decapod crustaceans from the continental shelf off North Carolina, U.S.A. *Crustaceana* 15(1): 41-66, 17 text-figs.
- WOODRING, W. P.
1966. The Panama land bridge as a sea barrier. *Proc. Am. Philos. Soc.* 110: 425-433.
- YANG, W. T.
1971. The larval and postlarval development of *Parthenope serrata* reared in the laboratory and the systematic position of the Parthenopinae (Crustacea, Brachyura). *Biol. Bull.* 140(1): 166-189, text-figs. 1-12.
- YOUNG, C. G.
1900. The stalk-eyed Crustacea of British Guiana, West Indies, and Bermuda. John M. Watkins, London. 514 pp., 7 pls.
- ZEILLER, W.
1974. Tropical marine invertebrates of southern Florida and the Bahama Islands. John Wiley & Sons, Inc., New York. 132 pp., plus unnumbered color plates.

APPENDIX I

Hourglass Stations A/I, B/J, C/K, D/L, and E/M were made in about 6, 18, 37, 55, and 73 m depths, respectively (Joyce and Williams, 1969), and marked allocations of these depth zones by Hourglass species were noted (Appendix Figure 1). Among species of *Parthenope*, *P. serrata* was most common at 18 m and was also common at 6 m depths, whereas *P. granulata* appeared most common at 37 m. *Parthenope fraterculus* and *P. agona* occurred almost exclusively at 55 and 73 m, both primarily at the latter depth where sampling terminated. Whether these species attained even greater relative abundances at greater depths remains unknown. The remaining four species, all in separate genera, were similarly partitioned by depth. *Heterocrypta granulata* occurred primarily at 6 m depths. *Mesorheia sexspinosa*, never common, was collected almost exclusively at 18 m stations. *Parthenope granulata* was most abundant at 37 m stations. Although these depths also marked the initial appearance of *Cryptopodia concava*, this was the only species to occur most frequently at 55 m. *Solenolambrus tenellus* was most abundant at 73 m stations.

Hourglass parthenopid species were also arranged according to their comparative interspecific abundances at each depth zone. Discarded *Parthenope agona* and a separate category (*Parthenope incertae sedis*) for discarded specimens of "*Parthenope serrata*" were included, thereby illustrating relative numerical dominance for these species (Appendix Figure 2).

As can be seen, little significant change is apparent in the previously discussed species (see Figure 34). However, those discarded forms labelled *Parthenope incertae sedis* exhibit a noticeable effect on overall relative dominance. In general, *Heterocrypta granulata* remains the dominant species at 6 m. Relative numerical dominance by all species at 18 m stations is reduced considerably by insertion of *Parthenope incertae sedis*, but that apparent reduction actually consists of additional relative abundances of both *Parthenope granulata* and *P. serrata*. It is reasonable to assume, as retained specimens indicate, that the two species are about equally abundant at these depths, which are intermediate between those where each of the two species exerts individual dominance. Together, the two species comprise about 82% of all parthenopids at these stations. Also at 18 m depths may now be included records for single discarded specimens twice taken at Station J and identified previously as *Parthenope agona*. It will be recalled that this species assumed increasing importance at deeper stations. The situation is similar at 37 m stations, with *Parthenope incertae sedis* diminishing the overall relative abundance of both *P. serrata* and *P. granulata* to some degree (compare Figure 34). Proportions of retained specimens, however, suggest that most discarded crabs were *P. granulata*. If so, that species would contribute more than 50% of all parthenopids at 37 m, as indicated in Figure 34. Inclusion of discarded data also slightly increases the relative dominance of *P. agona* at 37 m. At deepest stations (55 and 73 m), inclusion of data from discarded specimens shows decreasing effect on overall dominance percentages. What is important to note, as previously indicated (Figure 34), is that *P. agona* has now become the dominant species at both 55 and 73 m depths. At 73 m stations, inclusion of the discarded specimen of "*P. serrata*" would bring the total number of species to five instead of the four noted in the previous analysis which did not consider discarded specimen data. In summary, inclusion of discarded specimen data shows an increased, though less well defined, relative numerical dominance of *P. serrata* and *P. granulata* at shallower stations. The inclusion of a single molted carapace of *P. agona* at 6 m, the discarded data on this species at 18 m, and the increasing numerical dominance of *P. agona* as depth increases, all suggest that it may be considered the dominant parthenopid species in the Hourglass study area.



Appendix Figure 1.

Intraspecific relative abundance by depth of species of Hourglass Parthenopidae, including discarded specimens.