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Zoogeography of Tropical Western Atlantic Crinoidea (Echinodermata)

David L. Meyer
University of Cincinnati - Main Campus

Charles G. Messing
University of Miami, messingc@nova.edu

Donald B. Macurda Jr.
University of Michigan - Ann Arbor

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BIOLOGICAL RESULTS OF THE UNIVERSITY OF MIAMI DEEP-SEA EXPEDITIONS. 129.

ZOOGEOGRAPHY OF TROPICAL WESTERN ATLANTIC CRINOIDEA (ECHINODERMATA)

David L. Meyer, Charles G. Messing, and Donald B. Macurda, Jr.

ABSTRACT

Recent collections of crinoids from the intertidal zone to 1,650 m in the tropical western Atlantic have provided significant range extensions for more than half of the 44 comatulid and stalked species known from the region. Of the 34 comatulid species, over 60% are endemic to the region; of the 10 stalked species, 90% are endemic. At the familial level, this fauna has its strongest affinities with the tropical Indo-Pacific region. Comatulids are most abundant above 300 m, while stalked species occur primarily between 100 and 700 m. Species that occur primarily above 600 m (the deepest penetration of the 10°C isotherm in the region) have depth ranges generally narrower than 200 m. Species that are found below 1,000 m generally have much broader depth ranges.

During the 1950's and 1960's, extensive collections of marine life were made in the tropical western Atlantic Ocean by M/V OREGON, operated by the U.S. Fish and Wildlife Service, and R/V JOHN ELLIOTT PILLSBURY and R/V GERDA, in connection with the University of Miami's Deep-Sea Biology Program. These collections have generously broadened our knowledge of the marine biogeography of the region, a knowledge based previously on the expeditions of the 19th and early 20th centuries. The recent widespread use of SCUBA in marine research has opened up previously inaccessible environments and has thus added to the picture.

This paper summarizes zoogeographical and bathymetric data on the Crinoidea (Echinodermata) collected by these vessels and by SCUBA and presents revised distributions for many of the 44 species, both comatulid and stalked, currently known from the tropical western Atlantic. In this paper, the tropical western Atlantic region extends from southeastern Florida southward along the Antillean Arc to Trinidad, and along the Brazilian coast as far south as Rio de Janeiro, and includes the Caribbean Sea, southern Gulf of Mexico, and the Bahama Islands. The Caribbean, including the Antillean Arc and the Bahamas, constitutes the richest part of this region in both diversity and abundance of crinoids, and is also the most intensively studied part to date. The Blake Plateau and the coast of the United States from southeastern Florida to Cape Lookout, North Carolina, appear to represent a warm temperate transitional zone. At least regarding crinoids, this zone is more closely related to the tropics than to more northerly waters. With the exception of the more tropical Flower Garden Banks, south of Port Arthur, Texas, the northern Gulf of Mexico also falls into this zone. For the crinoid fauna, however, the precise tropical-temperate boundaries in the Gulf are unknown. The difficulties encountered in erecting marine zoogeographic boundaries are compounded by species, including many crinoids, that are limited to warm water latitudes but that live in deeper, colder waters. The parameters governing the distribution of these deep water, tropical species remain largely undefined.

The tropical western Atlantic crinoids first became widely known during the period of intensive oceanographic exploration of the late 1800's. The U.S. Coast Survey pioneered the work in this region during the late 1860's (Pourtalès, 1867, 1869), followed by the extensive work of BLAKE

(1877–80) and the U.S. Fish Commission vessel ALBATROSS (1884–85). CHALLENGER visited the Caribbean in 1873. The BLAKE and ALBATROSS collections provided the bulk of the material on which studies of tropical western Atlantic crinoids have been based until recently (Pourtalès, 1878; Carpenter, 1881, 1884, 1888; Hartlaub, 1895, 1912; A. H. Clark, 1915, 1921a, b, 1923a, b, 1931, 1947, 1950; A. H. Clark and A. M. Clark, 1967). In particular, A. H. Clark's "Monograph of the existing crinoids" represents a comprehensive systematic treatment of the comatulid crinoids which summarized all previous information on the group. Carpenter (1884, p. 374–385) summarized all previous records of stalked crinoids in the tropical western Atlantic and elsewhere. A. H. Clark (1923a) listed all comatulid and stalked crinoids known from the Atlantic and provided keys.

Collection of additional crinoid material in the Caribbean and adjacent areas during the late 19th and early 20th centuries was due mainly to the University of Iowa's Bahamas Expedition of 1893 (H. L. Clark, 1918) and Barbados-Antigua Expedition of 1918 (A. H. Clark, 1921b) and Woods Hole Oceanographic Institution's R/V ATLANTIS, operating off Cuba in 1938–39 (H. L. Clark, 1941). More recently, Tommasi (1965, 1969, 1971a) reported on Brazilian crinoids, a species from the Gulf of Mexico (1966) and a series of collections made by M/V OREGON from Florida to Brazil (1971b). Zoppi de Roa (1967) listed crinoids from the Venezuelan coast. Diving investigations of the Caribbean crinoids above 60 m were initiated by Meyer in the 1960's and have been continued by Meyer and Macurda (Meyer, 1972, 1973a, b; Macurda, 1973, 1975; Meyer and Macurda, 1976). Crinoids from the West Flower Garden Bank, Gulf of Mexico, have been listed by Burke (1974). The first direct observations of stalked crinoids were made from the submersible NEKTON GAMMA in 1972 (Macurda and Meyer, 1974). Messing (unpublished thesis) studied the systematics and distribution of crinoids in the Straits of Florida using the collections made from R/V GERDA in the 1960's.

MATERIALS AND METHODS

Crinoids were taken at approximately 25% of the successful bottom stations made by PILLSBURY and GERDA. We have included several R/V COLUMBUS ISELIN (University of Miami) stations, as well as OREGON material in the University of Miami collections. These specimens were divided among the three authors in such a way that each investigator examined some representatives of most of the species. Macurda took primary responsibility for the stalked crinoids and noncomasterid comatulids; Messing has studied all comatulids from the Straits of Florida (Messing, unpublished thesis and 1978); and Meyer took primary responsibility for the comasterid comatulids. Identifications were made following A. H. Clark's monograph for the comatulids, and Carpenter (1884), Clark (1923b), and Gislén (1938) for the stalked crinoids. The distributional and bathymetric summaries presented for each species combine all previous records with the new material, and range extensions are indicated. Appendix 1 lists the stations at which each species was collected. GERDA operated in the Straits of Florida and Yucatán Channel; PILLSBURY collected chiefly in the Caribbean proper.

The bathymetric distribution of each species is presented as both a confirmed depth range and possible depth range because of the uncertainties inherent in deep-sea collecting methods. The actual depth at which trawling or dredging gear is operating can almost never be determined with certainty. Depths measured by a Precision Depth Recorder do not necessarily coincide with actual gear depth. Furthermore, one cannot always be certain the gear is actually on the bottom for the duration of the trawl. A range of depth is usually given for each station, since depth changes are recorded during the entire period of trawling. Specimens can be taken from any part of that depth range, which is often considerable.

In the following text, the possible depth range of a species extends from the shallowest point of the shallowest station to the deepest point of the deepest station at which the species was collected. The confirmed range extends from the deepest point of the shallowest station to the shallowest point of the deepest station. While a species *may* occur throughout the former range, it *must* occur within the latter.

Additional sources of error occur in the collecting and recording process. Occasionally, specimens caught in the netting are washed into the cod end during the next haul and are included with the catch from the subsequent station. This can result in a species being recorded far out of its normal depth range. We have eliminated such anomalous stations from our compilations wherever possible. Despite the utmost care, specimens can be mislabeled with the wrong station number. Also, the number of specimens per station does not necessarily reflect abundance in the catch because excessive numbers of individuals are sometimes discarded. While such instances should be recorded in the station log, this is not always done. Given all of these uncertainties involved in modern deep-sea techniques, it is clear that many of the older records should be treated with extreme caution and skepticism.

We have utilized the higher taxonomic categories proposed by Gislén (1924) and Ubaghs (1953). The order of presentation of the comatulids follows that of A. H. Clark's monograph. The reader is referred to this work and other systematic studies cited in the text for descriptions and illustrations of the species.

Results

Order COMATULIDA
Suborder COMASTERINA
Family COMASTERIDAE
Subfamily CAPILLASTERINAE

Neocomatella pulchella (Pourtalès, 1878)

Neocomatella pulchella: A. H. Clark, 1931: 124–142.

Neocomatella alata: A. H. Clark, 1931: 142–150.

Material examined.—289 specimens; 38 stations.

Distribution.—Southeastern Gulf of Mexico (Campeche Bank and Florida continental shelf); Bahama and Turks and Caicos Islands; Antillean Arc from the north coast of Cuba to Grenada and Barbados; Arrowsmith Bank in the Yucatán Channel; San Blas Islands off Panamá; off Venezuela; St. Paul's Rocks; off Guanabara, Brazil. A questionable record exists from off Cape Canaveral, Florida.

The GERDA material extends the known range northward along the Bahamian side of the Straits of Florida, north of the Little Bahama Bank and into the Northwest Providence Channel. In addition, Tommasi (1971b: 3) has reported this species (identified by him as *N. alata*, but see below) from an OREGON station off Cape Canaveral, Florida (but see p. 419). The PILLSBURY collections include the first reports of this species from the Caribbean coast of South America.

Confirmed depth range: 10–567 m. Possible: 10–695 m.

PILLSBURY collected *N. pulchella* at five stations above 200 m, three stations between 200 and 400 m, two stations below 400 m, and at four stations either overlapping these depths or lacking depth data. GERDA collected this species at one station above 200 m, 11 stations between 200 and 400 m, four stations below 400 m, and at five stations either overlapping these depths or lacking data.

We consider *Neocomatella alata* (Pourtalès, 1878) a junior synonym of *N. pulchella* (Pourtalès) following Messing (thesis) who found the two to intergrade smoothly.

Nemaster grandis Clark, 1909

Nemaster grandis: A. H. Clark, 1931: 216–218.

Material examined.—102 specimens; 31 stations.

Distribution.—Jamaica; along the Caribbean coast of Central and South America from Honduras to Islas los Roques, Venezuela, including Curaçao and Bonaire. A single speci-

men was collected by PILLSBURY northwest of the Dominican Republic. No other specimens of *N. grandis* were collected during that particular cruise along the north coast of Hispaniola. The record appears to be valid unless the specimen was mislabeled.

Nemaster grandis was first collected by ALBATROSS in 1884 off Colón, Panamá. This remained the only record until Bayer et al. (1970) reported it from PILLSBURY stations along the coast of Panamá and Tommasi (1971b: 2) recorded it from two OREGON stations, one off Jamaica and the other off Venezuela. Studies of the ecology of *N. grandis*, made while using SCUBA in waters off Curaçao, Colombia, and Panamá (Meyer, 1973a), have supplemented these records and show that this species is rheophilic and occurs where persistent currents of low to moderate velocity exist. Our examination of the entire PILLSBURY collection extends the known range of *N. grandis* northward and eastward along the coasts of Central and South America, and confirms its presence off Jamaica.

Confirmed: 3–102 m. Only a single record below 100 m exists, an OREGON station made off Venezuela (Tommasi, 1971b). Observations of *N. grandis* when using SCUBA have established its abundance in less than 60 m. In the San Blas Islands off Panamá, it occurs as shallow as 3 m. Meyer (1973a) showed that the density of *N. grandis* increases sharply below about 30 m along the lower part of the fore-reef slope off Curaçao. Elsewhere, the species is concentrated along the foot of reef slopes.

Nemaster rubiginosa (Pourtalès, 1869)

Nemaster rubiginosa: A. H. Clark, 1931: 225–232.
Nemaster iowensis: A. H. Clark, 1931: 218–225.
Nemaster mexicanensis Tommasi, 1966: 155–157.

Material examined.—26 specimens; 10 stations.

Distribution.—Western Gulf of Mexico; southeastern Florida from the Dry Tortugas to Key Largo; Bahama and Turks and Caicos Islands; Antillean Arc from Hispaniola to Barbados and the Grenadines (no definite records from Cuba exist), including Grand Cayman and Jamaica; the Caribbean coast of Central and South America from (at least) Belize to Bahia, Brazil.

Confirmed: 1–334 m. All PILLSBURY records of *N. rubiginosa* are shallower than 60 m. The poor representation of this species in the collections belies its actual abundance. *N. rubiginosa* is the most abundant comatulid on coral reefs virtually throughout the tropical western Atlantic, but these habitats are not sampled by trawling or dredging. Observations with SCUBA have shown that *N. rubiginosa* favors the fore-edges of reef escarpments at depths of 3–15 m (Meyer, 1973a, b; Macurda, 1973, 1975).

Nemaster iowensis (Springer) has been designated as a synonym of *N. rubiginosa* by Meyer (1973a). In 1966, Tommasi described *Nemaster mexicanensis* from the western Gulf of Mexico, and differentiated it from *N. rubiginosa* chiefly on the absence of well-developed dorsal processes on the basal pinnulars of the oral pinnules. Our experience with *Nemaster rubiginosa* throughout the West Indian region has shown this to be variable and unlikely to be a reliable specific character. We therefore regard *N. mexicanensis* to be an intraspecific variant of *N. rubiginosa*.

Nemaster discoidea (Carpenter, 1888)

Nemaster discoidea: A. H. Clark, 1931: 232–240.

Material examined.—87 specimens; 28 stations.

Distribution.—Gulf of Mexico; southeastern Florida from the Dry Tortugas at least to Boca Raton; Bahama and Turks and Caicos Islands; Antillean Arc from the north coast of Cuba to Barbados and the Grenadines, including Grand Cayman and Jamaica; Caribbean coast of Central and South America from Yucatán to Colombia, Curaçao, and Bonaire.

Confirmed: 0.6–355 m. For the PILLSBURY and GERDA collections, there are only three possible occurrences deeper than 100 m. This is another shallow-water species that has been widely encountered by diving

(Meyer, 1973a, b; Macurda, 1973, 1975). These studies have shown that the depth range of *N. discoidea* overlaps that of *N. rubiginosa*, with which it often occurs, but that *N. discoidea* is most common below the primary occurrence of *N. rubiginosa* on fore-reef slopes. The higher frequency of *N. discoidea* in the PILLSBURY and GERDA collections compared to *N. rubiginosa* is in accordance with these diving observations.

Leptonemaster venustus Clark, 1909

Leptonemaster venustus A. H. Clark, 1931: 276–284.

Material examined.—164 specimens; 34 stations.

Distribution.—Southeastern Gulf of Mexico (Campeche Bank and Florida continental shelf); Bahama Islands; Antillean Arc from the north coast of Cuba to Barbados and Grenada, including Jamaica; Caribbean coast of Central and South America from Honduras east to Trinidad (Fig. 1).

The GERDA collections extend the known range of this species northward along the Bahamian side of the Straits of Florida. Previous to the PILLSBURY expeditions, it had been collected off the northern coast of South America only at a single station in the Gulf of Darien. The PILLSBURY collections establish its occurrence along this coast to Trinidad.

Confirmed: 24–236 m. Possible: 24–549 m. Seventeen of the total of 34 stations (72 of 164 specimens) are from confirmed depths above 100 m. In the Straits of Florida there are no records above 100 m while most records from the northern coast of South America and Panamá are above 100 m.

Comatilia iridometriformis Clark, 1909

Comatilia iridometriformis A. H. Clark, 1931: 285–287.

Material examined.—36 specimens; 4 stations.

Distribution.—Blake Plateau; northern Straits of Florida; Northwest Providence Channel.

Confirmed: 256–686 m. The GERDA collections include the only records of this species since it was first collected by ALBATROSS in 1886 on the Blake Plateau off Georgia (A. H. Clark, 1931). The new records extend the range southward to the Straits of Florida and the Northwest Providence Channel.

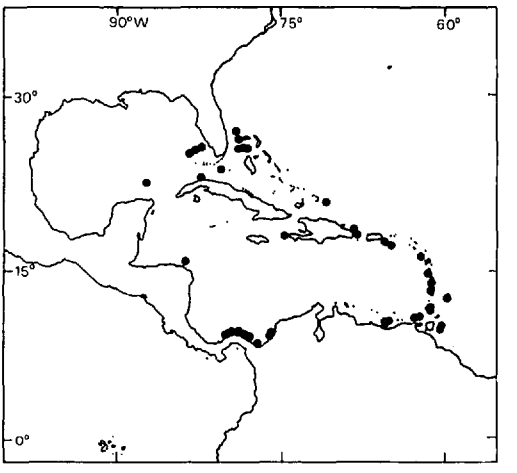

Figure 1. Distribution of *Leptonemaster venustus* Clark; a species restricted in the tropical western Atlantic to the central and most diverse portion.

Microcomatula mortenseni Clark, 1931

Microcomatula mortenseni A. H. Clark, 1931: 287–288.

Material examined.—none.

Distribution.—This species is based on a single specimen taken off St. Croix, U.S. Virgin Islands, in 91–183 m. It is either quite rare, a synonym of another comasterid, or inhabits environments not adequately sampled by trawling (e.g., *Ctenantedon kinziei* Meyer). According to A. H. Clark (1931) this is the smallest known comatulid (he gives no measurements other than cirri 4.5 mm long). Despite the presence of well-developed gonads, this small size suggests that it may be a precociously developed juvenile of another species.

Comatonia cristata (Hartlaub, 1912)

Comatonia cristata: A. H. Clark, 1931: 289–292.

Material examined.—13 specimens; 8 stations.

Distribution.—Off Cape Lookout, North Carolina; south of the Lower Florida Keys (Pourtalès Terrace); Arrowsmith Bank, Yucatán Channel. All but two of the known specimens were collected on the Pourtalès Terrace south of the Florida Keys. FISH HAWK collected one off Cape Lookout, North Carolina and GERDA took one off Arrowsmith Bank in the Yucatán Channel.

Confirmed: 14–366 m. Possible: 14–419 m. For specimens collected on the Pourtalès Terrace, the possible range is 146–411 m and the confirmed range is 152–306 m. The Cape Lookout specimen was taken in 14 m and the Arrowsmith Bank specimen was collected between 419 and 434 m.

Subfamily COMACTINIINAE

Comactinia echinoptera (Müller, 1840)

Comactinia echinoptera: A. H. Clark, 1931: 375–400 (part); Messing, 1978: 49–80.

Material examined.—16 specimens; 7 stations.

Distribution.—Southeastern Florida; Bahama and Turks and Caicos Islands; Antillean Arc from Cuba to Barbados, including Grand Cayman and Jamaica; Caribbean coast of Central and South America, from Arrowsmith Bank in the Yucatán Channel to Cabo Frio (and, perhaps, to Isla de los Alcatraces off São Paulo), Brazil. A single specimen is known from off South Carolina (Messing, 1978).

SCUBA stations: 2–30 m. PILLSBURY stations: 18–27 m, possible. GERDA stations: 37–92 m, confirmed; 37–183 m, possible. This species appears to be widely distributed throughout the West Indian region. Diving investigations have shown that this species feeds nocturnally at depths above 30 m (Meyer, 1973a, b; Macurda, 1973, 1975).

Comactinia meridionalis meridionalis (Agassiz, 1865)

Comactinia echinoptera: A. H. Clark, 1931: 375–400 (part).
Comactinia meridionalis meridionalis: Messing, 1978: 49–80.

Material examined.—1,576 specimens; 77 stations.

Distribution.—Gulf of Mexico; southeastern United States from Cape Lookout to the Florida Keys; Bahama Islands; throughout the Caribbean from Yucatán and Cuba to Surinam (possibly extending southward along the Brazilian coast to São Paulo, but material previously collected there has yet to be re-examined). This species occurs at more dredging stations and in generally greater abundance in dredge hauls than any other crinoid in the tropical western Atlantic.

Confirmed: 3–190 m. Possible: 3–508 m. Though occurring in very shallow water off the Carolinas and Central America, this subspecies appears to occur no shallower than 50 m in the Straits of Florida.

Comactinia meridionalis hartlaubi Messing, 1978

Comactinia echinoptera: A. H. Clark, 1931: 375–400 (part).
Comactinia meridionalis hartlaubi Messing, 1978: 49–80.

Material examined.—87 specimens; 19 stations.

Distribution.—Gulf of Mexico; Bahama Islands; Antillean Arc from the north coast of Cuba to Carriacou and Barbados; Caribbean coast of Colombia; off Surinam.

Confirmed: 58–373 m. Possible: 46–549 m. Of the 19 PILLSBURY and GERDA stations, only 2 are from confirmed depths above 100 m, indicating that this subspecies generally occurs at greater depth than the more common *C. m. meridionalis*. *C. m. hartlaubi* is distributed over much the same area as *C. m. meridionalis*, but it is not clear as to what differences there might be in preferred habitats between the two, other than depth. Messing (1978) has noted that *C. m. hartlaubi* occurs only on the southern and eastern slopes of the Straits of Florida, while *C. m. meridionalis* occurs on both sides of the Straits.

Suborder MARIAMETRINA
Family COLOBOMETRIDAE

Analcidometra armata (Pourtalès, 1869)

Analcidometra armata: A. H. Clark, 1947: 79–83.

Analcidometra caribbea A. H. Clark, 1947: 84–88.

Material examined.—177 specimens; 23 stations.

Distribution.—Dry Tortugas; Bahama and Turks and Caicos Islands; Antillean Arc from Hispaniola to Barbados and Grenada, including Jamaica and Grand Cayman; Caribbean coast of Central and South America from Honduras to Guyana. No material has been definitely identified from Cuban waters.

Confirmed: 3–148 m. This species was collected below 100 m at only one station. Most material was taken between 50 and 70 m.

Examination of the PILLSBURY collections and collections made by diving (Meyer, 1973a, b; Macurda, 1973, 1975) have shown that there are no consistent differences which justify recognition of both *A. armata* and *A. caribbea* Clark, 1908. The latter is treated as a junior synonym of *A. armata* in this compilation.

The PILLSBURY collections and those made by diving (Meyer, 1973a, b; Macurda, 1973, 1975) have demonstrated that *A. armata* is widespread throughout the Caribbean region. It had been previously known only from the Straits of Florida, Bahamas, scattered localities along the Antillean Arc, and from one station off Panamá. The preference of this species for shallow water and the fore-edge of reef escarpments suggests that trawling records will not provide a complete picture of its abundance and distribution.

Family TROPIOMETRIDAE

Tropiometra carinata (Lamarck, 1816)

Tropiometra carinata: A. H. Clark, 1947: 291–337.

Material examined.—382 specimens; 27 stations.

Distribution.—Tropical western Atlantic: Antillean Arc from Guadeloupe south; coast of South America from Cartagena, Colombia eastward and southward to the Santa Catarina Islands, Brazil, including Trinidad, Tobago, and islands off the Venezuelan coast (Fig. 2). St. Helena. Indian Ocean: east Africa from the Cape of Good Hope to northern Somalia, including Zanzibar; Madagascar; islands from the Comoros to the Seychelles, Mascarene Islands, and Cargados Carajos Shoals.

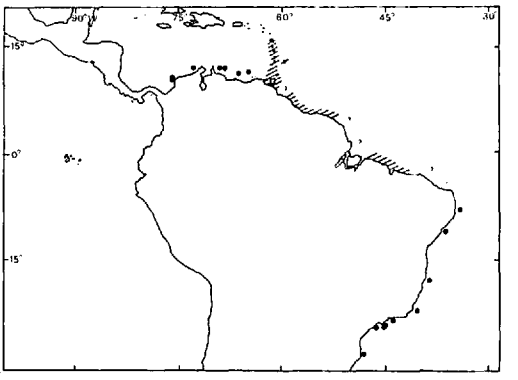

Figure 2. Distribution of *Tropiometra carinata* (Lamarck); a species restricted in the tropical western Atlantic to the southern portion. Hatched areas indicate numerous records.

The PILLSBURY collections have extended the known range of *T. carinata* in the Caribbean along the northern coast of South America as far west as Cartagena, Colombia, and along the Guianas in shallow water. Diving investigations have established the presence of this species along the Antillean Arc as far north as Dominica (Meyer, 1973a) and during this study to Guadeloupe. In view of the extensive trawling and diving investigations elsewhere in the tropical western Atlantic, the range of this species in the region has now probably been established. Its absence from other parts of the Caribbean may possibly be attributed to insufficient time for colonization of suitable habitats. The transoceanic distribution of this species suggests that its larval life can be prolonged and thus the species might be expected to extend its range further northward and westward.

Confirmed: Intertidal–84 m. None of the PILLSBURY records for this species is below 100 m. The single record of 508 m was obtained off St. Lucia by INVESTIGATOR in 1888. Since INVESTIGATOR was a cable re-

pair ship, this record is suspect. Diving investigations have further established the preference of this species for shallow water, particularly that which is wave- or current-agitated (Meyer, 1973a). The species has also been recorded at low tide level in Mozambique (H. L. Clark, 1923, cited in A. H. Clark, 1947). It has been observed on the lee side of the barrier reef crest in less than 1 m of water in Mauritius by Macurda and Meyer (unpublished).

Suborder THALASSOMETRINA
Family THALASSOMETRIDAE

Stylometra spinifera (Carpenter, 1881)

Stylometra spinifera: A. H. Clark, 1950: 30–41.

Material examined.—52 specimens; 16 stations.

Distribution.—Off Cape Canaveral, Florida (questionable); Bahama Islands; Antillean Arc from the north coast of Cuba to Barbados and Grenada; Caribbean coast of Central and South America from Arrowsmith Bank in the Yucatán Channel to Cabo Cordera, Venezuela; north of the Rosalind Bank between Honduras and Jamaica. The GERDA collections extend the range of this species into the Bahamas. The PAWNEE I station listed by Clark (1950, p. 36) as English Cay, Bahamas, is an error for English Cay, Belize (Messing, thesis, p. 179). The PILLSBURY collections provide the first records of *S. spinifera* from the south coast of Hispaniola and from the north coast of South America.

Confirmed: (58.5?) 102–658 m. Possible: 55–658 m. For the PILLSBURY and GERDA material, the confirmed ranges are considerably narrower: 155–296 m and 293–384 m, respectively. The extremes are OREGON stations recorded by Tommasi (1971b:3). Tommasi listed the depth for OREGON station 5190, off Cape Canaveral, Florida, as 42–58 m. The station data list sent to us by the National Marine Fisheries Service indicates 30–32 fm (55–58.5 m) for this station. In either case, the record is unusually shallow and should be verified by further collecting in that area. The record of 658 m, given for OREGON station 5417 south of Great Inagua Island, is unusually deep for this species.

Horaeometra duplex (Carpenter, 1888)

Horaeometra duplex: A. H. Clark, 1950: 186–191.

Material examined.—61 specimens; 15 stations.

Distribution.—Bahama Islands; Antillean Arc from the north coast of Cuba to Grenada.

Confirmed: 159–567 m. Possible: 159–575 m. GERDA material: 403–567 m, confirmed; 384–575 m, possible. The GERDA material represents the first records for this species in the Bahamas and is deeper than previously existing records which were mostly between 300 and 400 m.

Family CHARITOMETRIDAE

Crinometra brevipinna (Pourtalès, 1867)

Crinometra brevipinna: A. H. Clark, 1950: 280–347.

Material examined.—329 specimens; 46 stations.

Distribution.—Northern and eastern Gulf of Mexico; southeastern Florida; Bahama Islands; Antillean Arc from the north and south coasts of Cuba to Barbados and Grenada, including Jamaica; Caribbean coast of central and South America from Arrowsmith Bank in the Yucatán Channel to Venezuela, Trinidad, Tobago, and southward to Rio Grande do Sul, Brazil. St. Helena (Fig. 3).

Meyer identified *C. brevipinna* from material collected by NEKTON GAMMA on the West Flower Gardens Reef in the northern Gulf of Mexico (specimens on loan from Texas A&M) and off Discovery Bay, Jamaica (specimens on loan from the Discovery Bay Marine Laboratory).

The PILLSBURY collections have confirmed the presence of this species along the Venezuelan coast where it was first recorded by Tommasi (1971b) from an OREGON station. Another OREGON station for this species listed by Tommasi established its presence off Surinam, and an additional OREGON sta-

tion extends its occurrence off the mouth of the Amazon. That the species does extend farther south along the Brazilian coast is indicated by its occurrence off Rio Grande do Sul (Tommasi, 1969). The record from St. Helena (Gislèn, 1933, cited from Clark, 1950: 303) shows that this is practically a trans-Atlantic species, and suggests that it might eventually be found along the West African coast. It was not obtained, however, during any of the PILLSBURY work in the Gulf of Guinea.

Observations from NEKTON GAMMA off Discovery Bay, Jamaica showed that *C. brevipinna* sometimes lives with large stalked crinoids of the family Isocrinidae and may even attach by its cirri to their stalks (Macurda and Meyer, 1974). Isocrinids were taken at 12 of the 24 GERDA stations and 6 of the 21 PILLSBURY stations where *Crinometra brevipinna* was taken, indicating the frequent association of these crinoids.

Confirmed: 95–731 m. Possible: 69–1,097 m. In the Straits of Florida, most material was collected between 500 and 600 m. In the Caribbean, most material was collected shallower than 400 m.

Crinometra brevipinna has been called "perhaps the most variable comatulid known" (Clark, 1950, p. 284). The variable characters include brachial ornamentation, nature of the division series, the cirri, and the pinnules—features which "usually are assumed to be reasonably constant in any single species" (Clark, 1950, p. 284). This variability led to a succession of specific and varietal names for these crinoids which Clark (1950) reduced to the synonymy of *C. brevipinna* in a thorough review of its history. He also recognized 19 varietal names which were admitted to be largely intergradational in morphology. In a study of *C. brevipinna* from the Straits of Florida, Messing (thesis) concluded that there is not enough evidence at present for recognition of any of the morphological variants as distinct species or subspecies. In accordance with the International Code of Zoological Nomenclature (1964, Art. 45d(i) and e(i)) Clark's 19 varieties must be considered as subspecies. Nevertheless, following Clark's and Messing's conclusions, we have treated these subspecies as infrasubspecific variants pending a more detailed study of material from the entire region.

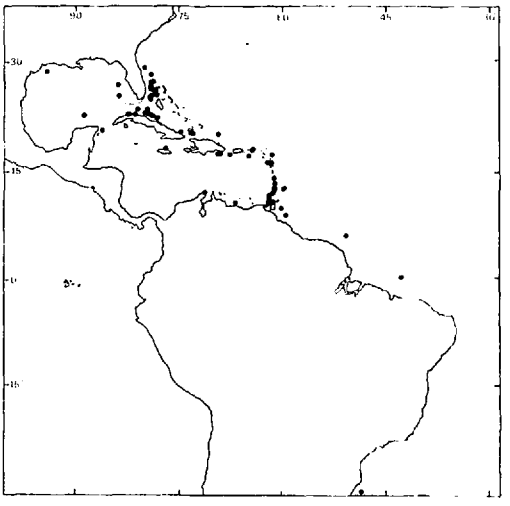

Figure 3. Distribution of *Crinometra brevipinna* (Pourtalès); a species with a broad range in the tropical western Atlantic.

Suborder MACROPHREATINA
Family ANTEDONIDAE

Antedon nuttingi (A. H. Clark, 1936)

Antedon nuttingi: Clark & Clark, 1967: 143–145.

Material examined.—none.

Distribution.—Northern coast of Cuba; Barbados. (Known from 3 specimens.) Possible depth range: 364–429 m.

Antedon duebeni Böhlsche, 1866

Antedon duebeni: Clark & Clark, 1967: 234–236.

Material examined.—none.

Distribution.—St. Thomas, U.S. Virgin Islands; Grenada; northern coast of Venezuela (?); Rio de Janeiro, Brazil.

Possible: Shoreline (?) to 168 m. *Antedon duebeni* is very likely the only comatulid

found in both the tropical western and tropical eastern Atlantic (Gulf of Guinea). Gislén (1955) synonymized *A. bifida moroccana* and *A. hupferi*, both from the eastern Atlantic, with *A. duebeni*. A. M. Clark (in Clark and Clark, 1967, p. 235) was inclined to agree with Gislèn regarding *A. bifida moroccana* and *A. duebeni* but felt that *A. hupferi* is distinct. In view of the paucity of material available for *A. duebeni* from the western Atlantic, she concluded that reduction of the two eastern Atlantic species was premature. Zoppi de Roa (1967) has listed *A. duebeni* from four localities along the Venezuelan coast from depths of 1–20 m. However, a photograph given by Zoppi de Roa (1967, Fig. 3) as *A. duebeni* is not compatible with the character of the cirri as given by Clark and Clark (1967, p. 234) and appears to us to actually be a *Tropiometra carinata*. Thus the identity of the Venezuelan material must be held in question pending further study. Tommasi (1969) listed *A. duebeni* as occurring in Brazilian waters, but gave no indication that any additional material has been collected there since Böhlsche described the type from Rio de Janeiro in 1866 (see Clark and Clark, 1967: 236). Unfortunately, the PILLSBURY and GERDA collections have not added anything to the scant picture of *A. duebeni* in the western Atlantic and the puzzle of this Atlantic *Antedon* must remain unresolved.

Ctenantedon kinziei Meyer, 1972

Ctenantedon kinziei Meyer, 1972: 54–62.

Material examined.—2 specimens; 2 stations.

Distribution.—Northern Gulf of Mexico (questionable); Bahama and Turks and Caicos Islands; Antillean Arc from Anguilla to Barbados; Jamaica (W. D. Liddell, personal communication); Belize; Panamá; Colombia; Curaçao.

Confirmed: 9–49 m. This cryptic comatulid lives primarily within crevices and beneath platelike corals on reefs, particularly along the edge of drop-offs. Despite its wide distribution, its preferred habitat virtually eliminates it from trawl and dredge collections and it must be actively sought using SCUBA. A specimen collected at 85 feet on West Flower Garden Reef in the northern Gulf of Mexico is provisionally referred to this species, although positive identification could not be made (specimen on loan to Meyer from Texas A&M).

Coccometra nigrolineata Clark, 1908

Coccometra nigrolineata: Clark & Clark, 1967: 276–278.

Material examined.—5 specimens; 2 stations.

Distribution.—North of Cuba; Jamaica; Puerto Rico; Arrowsmith Bank in the Yucatán Channel.

Possible: 40–987 m. Six of the nine records with depth data fall between 175 and 400 m. The identifications of GERDA material are tentative. The two stations, both made on the Arrowsmith Bank, are very close in locale and depth to ALBATROSS station 2354 (20°59′30″N, 86°23′45″W, 237 m) where this species was taken in 1885 (Clark and Clark, 1967).

Coccometra guttata Clark, 1918

Coccometra guttata: Clark & Clark, 1967: 278–279.

Material examined.—none.

Distribution.—Santiago de Cuba, ALBATROSS station 2134. This species is known from a single specimen taken in 464 m.

Coccometra hagenii (Pourtalès, 1867)

Coccometra hageni: Clark & Clark, 1967: 279–285.

Material examined.—1,176 specimens; 17 stations.

Distribution.—Off Cape Lookout, North Carolina; Blake Plateau; Pourtalès Terrace south of the Florida Keys; off Havana, Cuba; Campeche Bank; Arrowsmith Bank in the Yucatán Channel (Fig. 4).

Confirmed and possible: 14–1,046 m. For the specimens collected on the Pourtalès Terrace, the confirmed and possible ranges are 110–402 m and 81–411 m, respectively,

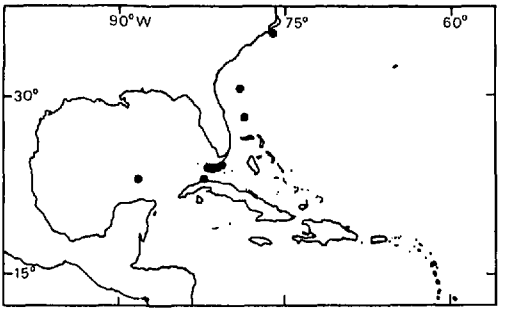

Figure 4. Distribution of *Coccometra hagenii* (Pourtalès); a species restricted to the northern portion of the tropical western Atlantic and the adjacent transitional zone.

with most material taken between 150 and 250 m. A single specimen was collected off Cape Lookout in 14 m. The two Blake Plateau records—805 m and 1,046 m—are the deepest. The records from off Havana are also deeper than most of those from Florida: 323, 373 and 442 m. The great abundance of this species on the Pourtalès Terrace has been known since it was first described in 1867. The 567 specimens collected at one GERDA station represent the greatest number of individuals of any crinoid species taken at any GERDA or PILLSBURY station.

Hypalometra defecta (Carpenter, 1888)

Hypalometra defecta: Clark & Clark, 1967: 488–491.

Material examined.—159 specimens; 16 stations.

Distribution.—Bahama Islands; north coast of Cuba; southeast of Hispaniola; Yucatán Channel; Panamá; north coast of South America from Colombia to French Guiana. This species was previously known only from off Havana, Cuba (see Clark and Clark, 1967). The PILLSBURY and GERDA collections extend the range to north of the Little Bahama Bank, and to the southern Caribbean.

Confirmed and possible: 60–386 m. Thirteen of the 16 new stations are from confirmed depths above 100 m, and all but one of these 13 are from the southern Caribbean.

Zenometra columnaris (Carpenter, 1881)

Zenometra columnaris: Clark & Clark, 1967: 496–499.

Material examined.—10 specimens; 3 stations.

Distribution.—Northeastern Gulf of Mexico; Blake Plateau; northern Straits of Florida; off Navassa Island between Haiti and Cuba; off St. Lucia.

Confirmed and possible: 308–1,034 m. A PILLSBURY station represents the first record of this species from the Greater Antilles and also the deepest known occurrence. The five records from the Blake Plateau fall between 504 and 804 m.

Hybometra senta A. H. Clark, 1913

Hybometra senta: Clark & Clark, 1967: 550–552.

Material examined.—none.

Distribution.—Known from a single specimen collected in 42 m off Recife (Pernambuco), Brazil.

The written description of this species is very similar to that of *Leptometra* and immediately precedes it in Clark and Clark (1967). *Leptometra celtica* has been reported off Sierra Leone in 68 m, across the narrowest neck of the Atlantic from Recife. Although we have not examined the holotype, which lacks cirri and complete P_1, it seems quite possible that *Hybometra senta* and *Leptometra celtica* are congeneric if not conspecific.

Caryometra spp. A. H. Clark, 1936

Caryometra spp.: Clark & Clark, 1967: 595–617.

Material examined.—4 specimens; 2 stations.

Distribution.—The GERDA material was collected off Grand Bahama Island and on Arrowsmith Bank, Yucatán Channel. *Caryometra* has been previously recorded chiefly off the northern coast of Cuba, Puerto Rico,

and possibly from Grenada (Clark and Clark, 1967).

The GERDA material was collected from 241–320 m and 384–403 m. The confirmed depth range for the genus is 338–777 m and the possible range is 165–914 m (Clark and Clark, 1967).

A. M. Clark (in Clark and Clark, 1967, p. 596–597) noted that five of the six species of *Caryometra* fall into a size sequence on some characters, and that *C. monilicirra* Clark, 1940 and *C. atlantidis* Clark, 1940 are the only distinct species. In view of these problems, we have deferred specific determination of the GERDA material until a review of the genus can be made.

Trichometra cubensis (Pourtalès, 1869)

Trichometra cubensis: Clark & Clark, 1967: 671–676.

Material examined.—71 specimens; 33 stations.

Distribution.—Tropical western Atlantic: northeastern Gulf of Mexico; Blake Plateau; Bahama Islands; Antillean Arc from the north coast of Cuba to St. Vincent; Yucatán Channel; off Santa Marta, Colombia. Northern Atlantic: off Nova Scotia and Newfoundland northward to the Davis Strait and eastward to south of Iceland and west of the Faeroe Islands (see Clark and Clark, 1967; A. M. Clark, 1970).

The PILLSBURY and GERDA collections considerably extend the known range of this species. Previous expeditions in this region collected it only on the Blake Plateau, off northern Cuba and in the northeastern Gulf of Mexico. This comatulid ranges farther north than any other species found in the tropical western Atlantic.

Confirmed: 210–2,193 m. Possible: 177–2,193 m. Of the 32 PILLSBURY and GERDA stations at which this species was collected, 18 were made at confirmed depths between 500 and 1,000 m, only two or three were made below 1,000 m and none deeper than 1,200 m. In the Yucatán Channel, however, only one of the seven stations was made in greater than 500 m. Of the nine earlier records from the Blake Plateau southward, all but one (northern Gulf of Mexico, 309 m) fall between about 500 and 800 m. The boreal depth range is 293–2,193 m. No evidence exists for tropical submergence. However, a preliminary examination of material in the National Museum of Natural History indicates that two species-group taxa may exist in the western Atlantic—a northern and a southern, with a possible overlap on the Blake Plateau. A definitive answer awaits a thorough morphological analysis of all material.

Thaumatometra minutissima (A. H. Clark, 1908)

Thaumatometra minutissima: Clark & Clark, 1967: 751–752.

Material examined.—none.

Distribution.—Known from a single specimen collected at ALBATROSS station 2761, east of the Abrolhos Is., Brazil, in 1,495 m.

Family PENTAMETROCRINIDAE

Pentametrocrinus atlanticus (Perrier, 1883)

Pentametrocrinus atlanticus: Clark & Clark, 1967: 790–794.

Material examined.—1 specimen; 1 station.

Distribution.—Tropical western Atlantic: Blake Plateau; off Martinique. Eastern Atlantic: from the Canary Islands and Morocco to the Porcupine Bank southwest of Ireland.

Four additional specimens collected by ATLANTIS at three stations on the Blake Plateau (Messing, in preparation) indicate, with the single GERDA record, that this species is more widespread in the western Atlantic than previously thought. Western Atlantic: 458–779 m, confirmed; 374–779 m, possible. Eastern Atlantic: 650–2,115 m, confirmed and possible. Of the five western Atlantic records, four are shallower than 650 m. Of the 12 eastern Atlantic records, ten are deeper than 1,000 m.

Family ATELECRINIDAE

Atelecrinus balanoides Carpenter, 1881

Atelecrinus balanoides: Clark & Clark, 1967: 823–831.—A. M. Clark, 1970: 49–51.

Material examined.—87 specimens; 27 stations.

Distribution.—Tropical western Atlantic: Blake Plateau; Straits of Florida; Bahama and Turks and Caicos Islands; Antillean Arc from the north and south coasts of Cuba to Grenada, including Jamaica; Caribbean coast of Central and South America from Arrowsmith Bank in the Yucatán Channel to Tobago and south to Recife, Brazil. Northern Atlantic: west of Ireland and southwest of the Faeroe Islands.

Previously published records of this species in the tropical western Atlantic were limited to a few stations on the Blake Plateau, in the Straits of Florida, along the Antillean Arc, and off Brazil. The PILLSBURY and GERDA material extends the known range almost throughout the entire Caribbean. The GERDA collections indicate that this species is particularly abundant in the Straits of Florida. Limited data suggest that this species prefers fine, unconsolidated substrata.

Confirmed: 531–1,527 m. Possible: 458–1,545 m. PILLSBURY, GERDA and ISELIN collected this species at 5 stations above 600 m, 14 stations between 600 and 1,000 m, 7 stations below 1,000 m and one station overlapping the latter two ranges.

Order ISOCRINIDA
Family ISOCRINIDAE

Cenocrinus asterius (Linné, 1775)

Pentacrinus asterius: Carpenter, 1884: 300–305.
Cenocrinus asteria: Clark, 1923a: 44; 1923b: 10.

Material examined.—2 specimens; 2 stations.

Distribution.—Northwest Providence Channel; Antillean Arc from Saba to Barbados, including Jamaica.

Confirmed and possible: 183–585 m. The GERDA collections are the first records of this elusive isocrinid since it was taken off Montserrat by BLAKE in 1877–78 (Carpenter, 1884). In addition, this species was found to be quite common at depths of 183–244 m off Discovery Bay, Jamaica during observations from NEKTON GAMMA in 1972 (Macurda and Meyer, 1974).

Endoxocrinus parrae (Gervais, 1835)

Pentacrinus mülleri: Carpenter, 1884: 306–312 (part).
Endoxocrinus parrae: Clark, 1923a: 44; 1923b: 11.—Tommasi, 1971b: 2.

Material examined.—127 specimens; 27 stations.

Distribution.—Off Cape Canaveral, Florida (questionable); Bahama Islands; Antillean Arc from Cuba to Barbados, including Jamaica; Arrowsmith Bank in the Yucatán Channel; Isla Providencia off Honduras; west of Aruba; off San Luis, Brazil.

The collections made by PILLSBURY, GERDA, and OREGON have provided a wealth of new data on the distribution of *E. parrae*. Clark (1923b) listed its range as northern Cuba to St. Vincent. In 1941, H. L. Clark reported the occurrence of 225 specimens from 11 ATLANTIS stations along the north and south coasts of Cuba. Tommasi (1971b: 2) listed eight OREGON stations for this species, including the northernmost record (off Florida). The Florida stations are anomalously shallow (18, 20–28 m and 55–58.5 m). *E. parrae* was also taken at an exceptionally shallow depth (49 m) at an OREGON station west of Aruba. Since the next shallowest confirmed depth for this species is 154 m, verification of these OREGON records should be sought by further collecting in those areas. The OREGON collections also extended the range of the species westward to the coast of Central America off Isla Providencia and Yucatán, and to the coast of South America off Aruba. An additional OREGON station reported here is the first occurrence of this species off Brazil. GERDA encountered this crinoid frequently in the vicinity of the Little Bahama Bank, Northwest Providence Channel, and elsewhere along the insular margin of the Straits of Florida.

PILLSBURY collected *E. parrae* around the

Greater Antilles and northern part of the Antillean Arc, but turned up no specimens during the extensive work along the north coast of South America, Panamá, and Central America. The Straits of Florida appears to be the area most richly inhabited by *E. parrae* and other isocrinids as well. Of course, it is difficult to know just how adequately its distribution has been sampled, since it may occupy irregular hard-ground topography relatively inaccessible to trawling. Observations of this species and *Cenocrinus asterius* off Discovery Bay, Jamaica from NEKTON GAMMA (Macurda and Meyer, 1974) revealed that these isocrinids were attached to rocks and ahermatypic corals along a sandy carbonate talus slope. Massive rock projections on the slope had fewer isocrinids than the talus itself. Photographs taken from the submersible ALVIN which were loaned to us by A. C. Neumann show *E. parrae* living adjacent to lithified carbonate mounds off the Little Bahama Bank (Macurda and Meyer, 1976). These observations suggest that this species and other isocrinids probably do occur on some substrata inaccessible to trawling, and thus may have even wider distributions than the data show.

Confirmed: 154–971 m. Possible: 18–971 m. Most of the Straits of Florida (chiefly GERDA) material was collected between about 500 and 600 m. PILLSBURY collected no specimens below 500 m in the Caribbean.

Endoxocrinus prionodes Clark, 1941, is probably a synonym of *E. parrae*. Material from PILLSBURY and GERDA collections identifiable as *E. prionodes* based upon the serrate arm profile have been listed here as *E. parrae*.

Neocrinus decorus Wyville Thomson, 1864

Pentacrinus decorus: Carpenter, 1884: 330–337.
Neocrinus decorus: Clark, 1923a: 44; 1923b: 11.—Tommasi, 1971b: 1–2.

Material examined.—106 specimens; 19 stations.

Distribution.—Off Cape Canaveral, Florida (questionable); Bahama Islands; Antillean Arc from Cuba to Barbados, including Jamaica; Arrowsmith Bank in the Yucatán Channel; Isla Providencia, off Honduras; northern coast of Venezuela. The GERDA stations extend the range northward into the Bahamas and Straits of Florida. The PILLSBURY stations extend the range westward to Venezuela; others fill in gaps between stations given by Carpenter (1884). H. L. Clark (1941) reported this species from seven ATLANTIS stations along the north and south coasts of Cuba.

Confirmed: 154–1,220 m. Possible: (55?) 101–1,220 m. Again an anomalously shallow record (55–58.5 m) is one of the OREGON stations off Florida (Tommasi, 1971b), which must be verified. Of the 14 stations at which GERDA took this species in the Straits of Florida, only one was made definitely below 500 m, in contrast with *Endoxocrinus*.

Isocrinus blakei (Carpenter, 1882)

Pentacrinus blakei Carpenter, 1884: 328–330.
Neocrinus blakei: Clark, 1923a: 44; 1923b: 11.
Isocrinus blakei: Rasmussen, 1961: 87.

Material examined.—80 specimens; 20 stations.

Distribution.—Bahama Islands; Antillean Arc from Cuba to Barbados; Arrowsmith Bank in the Yucatán Channel. This species was previously known from four BLAKE stations along the Antillean Arc (Carpenter, 1884) and from four ATLANTIS stations north and south of Cuba (H. L. Clark, 1941). The GERDA stations extend the range northward to the Bahamas. The PILLSBURY stations extend the range westward to the Arrowsmith Bank off Yucatán, and provide additional localities along the Antillean Arc.

Confirmed: 220–650 m. Possible: 220–711 m. All but two of the 14 GERDA Straits of Florida stations at which this species was taken are below 500 m.

Diplocrinus maclearanus (Wyville Thomson, 1877)

Pentacrinus müllerí: Carpenter, 1884: 306–312 (part).

Pentacrinus maclearanus: Carpenter, 1884: 312–313.
Diplocrinus maclearanus: Clark, 1923a: 44; 1923b: 11.

Material examined.—98 specimens; 7 stations.

Distribution.—Northern Straits of Florida; west of Anegada Island; Martinique; Brazil, off San Luis, Barra Grande (off Rio Grande do Sul).

Confirmed: 187–604 m. Possible: 154–910 m. PILLSBURY material: 204–622 m, possible. GERDA material: 512–604 m, confirmed and possible. The GERDA and PILLSBURY collections are the first records of this species in the Bahamas and Caribbean. Tommasi (1969) reported this species from a BESNARD station off Rio Grande do Sul, Brazil. It is identifiable in some of the photographs taken by A. C. Neumann in the Straits of Florida from the submersible ALVIN (Macurda and Meyer, 1976).

The validity of separating *D. carolinae* Clark, 1934 from *D. maclearanus* is open to question and all material examined has been identified as *D. maclearanus*.

Order BOURGUETICRINIDA
Family BATHYCRINIDAE

Democrinus rawsonii (Pourtalès, 1874)

Rhizocrinus rawsoni: Carpenter, 1884: 262–269.
Democrinus rawsonii: Clark, 1923a: 45.—Gislén, 1938: 25, 29.

Material examined.—27 specimens; 8 stations.

Distribution.—Bahama Islands; Antillean Arc from the Dominican Republic to Barbados; Caribbean coast of Central America from the Yucatán Bank to Panamá; off Guyana.

Confirmed: 66–652 m. This species was previously known from the Yucatán Bank, Cuba, and the Bahamas to Barbados (Gislén, 1938). A GERDA station extends the range northward to the northeast Straits of Florida while the PILLSBURY stations extend it to northern South America and to Central America. Most of the PILLSBURY and GERDA material was collected between 100 and 200 m and nothing was taken below 317 m.

Democrinus conifer (Clark, 1909)

Rhizocrinus conifer Clark, 1909: 674.
Bythocrinus conifer Clark, 1923a: 45.
Democrinus conifer: Gislén, 1938: 25, 27.

Material examined.—333 specimens; 46 stations.

Distribution.—Blake Plateau; Bahama Islands; Antillean Arc from Cuba to Grenada, including Jamaica and Navassa Island west of Haiti; Caribbean coast of Central and South America from Honduras to Colombia. Josephine Bank, off Portugal. Gislén (1938) gave the range as being from Cuba to Brazil, and the Josephine Bank off the coast of Portugal. Thus the range is extended northward and westward by the PILLSBURY-GERDA material.

Confirmed: 170–1,750 m. Possible: 119–1,750 m. PILLSBURY: 170–1,650 m, confirmed; 119–1,650 m, possible. All but three of the PILLSBURY stations are from confirmed depths less than 1,000 m. GERDA: 249–787 m, confirmed; 236–824 m, possible. Most of the latter were collected below 300 m.

Democrinus brevis (Clark, 1909)

Rhizocrinus brevis Clark, 1909: 675.
Democrinus brevis: Gislén, 1938: 25, 26.

Material examined.—181 specimens; 20 stations.

Distribution.—Straits of Florida; Caribbean coast of Central and South America from Panamá to Venezuela; off San Luis, Brazil.

Confirmed: 210–878 m. Possible: 165–1,109 m. *D. brevis* was described from a single record at 540 m northeast of Colón, Panamá by Clark (1909). Gislén (1938) continued to recognize a difference between it and *D. conifer*. A preliminary examination of the PILLSBURY and GERDA material by one of us (Macurda) indicates a complete gradation between these two so the records are probably best treated as a single taxon.

Monachocrinus caribbeus (Clark, 1908)

Bathycrinus caribbeus Clark, 1908: 235–237.
Monachocrinus caribbeus Clark, 1923a: 45, 56.—Gislén, 1938: 19, 20.

Material examined.—3 specimens; 2 stations.

Distribution.—Cuba; Bonaire and Curaçao; Colombia. Gislén (1938) indicated it came from the Gulf of Mexico north of the Yucatán Bank to Guadeloupe but the material for these records is fragmentary. H. L. Clark (1941) reported the species from ATLANTIS station 2975 off Oriente Province, Cuba, at 1,857 m. This crinoid is quite rare.

Possible: 421–1,857 m.

Order CYRTOCRINIDA
Family HOLOPODIDAE

Holopus rangii d'Orbigny, 1837

Holopus rangi: Carpenter, 1884: 199–211.
Holopus rangii: Clark, 1923a: 44.

Material examined.—3 specimens; 2 stations.

Distribution.—Bahama Islands; Antillean Arc from Cuba to Barbados, including Jamaica.

Possible: 100–458 m. This crinoid has more external resemblance to a barnacle than an ordinary crinoid. It affixes to rock surfaces and is very difficult to obtain through trawling. Direct observation of suitable rock substrata from the submersible NEKTON GAMMA off Discovery Bay, Jamaica, revealed numerous individuals between 274 and 305 m (Macurda and Meyer, 1974). The new records are from the Northwest Providence Channel and south of Great Inagua Island; Jamaica is from Macurda and Meyer, 1974; the other records are from Clark (1923a). A shallow depth record of 9 m from Barbados is apparently in error (J. Lewis, personal communication). The new records (329–458 m) are deeper than previous occurrences. Minimum depth is apparently below 70 m as this animal has not been observed during extensive research on the shallow-water crinoids of the West Indies using SCUBA.

DISCUSSION

Zoogeography

Forty-four currently recognized species in 31 genera and 11 families compose the crinoid fauna of the tropical western Atlantic Ocean. Recent investigations on shallow-water forms (above 60 m), particularly in the Caribbean Sea, demonstrate that these animals are far commoner and more widespread than previously thought (Meyer, 1973a, b; Macurda, 1973, 1975; Meyer and Macurda, 1976). As the results reported here indicate, the same is true for the deeper water inhabitants of the region. While significant range extensions are reported here for more than half the known species, only one new species has been recently described (Meyer, 1972). In addition, two species-group taxa have been resurrected (Messing, 1978) and several species names have been synonymized. Although further work is necessary, particularly among the Macrophreatina, the taxonomy is fairly stable.

None of the families is restricted to this region. All but the Holopodidae are known from the Indo-West Pacific and all but the Colobometridae, Tropiometridae and Charitometridae occur in the temperate northeastern Atlantic. The latter two of these, however, occur off St. Helena in the southeastern Atlantic. The Antedonidae is the only truly cosmopolitan family and is the only tropical western Atlantic family known from the tropical eastern Pacific.

Seventeen of the 31 genera (12 comatulids, 5 stalked) are at present considered monotypic; of these, only *Crinometra* extends beyond the tropical western Atlantic and the northern transitional zone. Eight more genera are monotypic within the region but have other species in other areas (*Neocomatella*, *Tropiometra*, *Trichometra*, *Pentametrocrinus*, *Atelecrinus*, *Thaumatometra*, *Diplocrinus* and *Monachocrinus*). Six genera (*Neocomatella*, *Antedon*, *Trichometra*, *Pentametrocrinus*, *Atelecrinus* and *Democrinus*) are found in the temperate northeastern Atlantic, and of these, all but *Neocomatella* occur in the Indo-West Pacific. *Tropiometra* is also found in the latter region; it does not occur in the northeastern Atlantic but is found off St. Helena. The lack of generic affinity between the tropical western Atlantic

Table 1. Occurrence of genera and species of tropical western Atlantic crinoids by geographic region

Crinoid species	Warm temperate southeastern U.S. & Blake Plateau	Southern Gulf of Mexico, Straits of Florida and Caribbean Sea	Brazil	Boreal Atlantic	Gulf of Guinea	Temperate N.E. Atlantic	Temperate S.E. Atlantic	Indo-West Pacific
COMATULIDA								
Neocomatella		X	X			X		
pulchella		X	X					
Nemaster		X	X					
grandis		X						
rubiginosa		X	X					
discoidea		X						
Leptonemaster		X						
venustus		X						
Comatilia	X	X						
iridometriformis	X	X						
Microcomatula		X						
mortenseni		X						
Comatonia	X	X						
cristata	X	X						
Comactinia	X	X	X					
echinoptera	X	X	X					
meridionalis meridionalis	X	X	?					
meridionalis hartlaubi		X						
Analcidometra		X						
armata		X						
Tropiometra		X	X				X	X
carinata		X	X				X	X
Stylometra		X						
spinifera		X						
Horaeometra		X						
duplex		X						
Crinometra		X	X				X	
brevipinna		X	X				X	
Antedon		X	X		X	X		X
nuttingi		X						
duebeni		X	X		?			
Ctenantedon		X						
kinziei		X						
Coccometra	X	X						
nigrolineata		X						
guttata		X						
hagenii	X	X						
Hypalometra		X						
defecta		X						
Zenometra	X	X						
columnaris	X	X						
Hybometra			X					
senta			X					
Caryometra		X						
tenuipes		X						
lisa		X						
alope		X						
spinosa		X						

Table 1. Continued.

Crinoid species	Warm temperate southeastern U.S. & Blake Plateau	Southern Gulf of Mexico, Straits of Florida and Caribbean Sea	Brazil	Boreal Atlantic	Gulf of Guinea	Temperate N.E. Atlantic	Temperate S.E. Atlantic	Indo-West Pacific
monilicirra		X						
atlantidis		X						
Trichometra	X	X		X		X		X
cubensis	X	X		X		X		
Thaumatometra			X	X				X
minutissima			X					
Pentametrocrinus	X	X				X		X
atlanticus	X	X				X		
Atelecrinus	X	X	X			X		X
balanoides	X	X	X			X		
ISOCRINIDA								
Cenocrinus		X						
asterius		X						
Endoxocrinus		X	X					
parrae		X	X					
Neocrinus		X						
decorus		X						
Isocrinus		X						
blakei		X						
Diplocrinus		X	X					X
maclearanus		X	X					
MILLERICRINIDA								
Democrinus	X	X	X			X	X	X
rawsonii		X						
conifer	X	X	X			X		
brevis		X	X					
Monachocrinus		X				X		X
caribbeus		X						
CYRTOCRINIDA								
Holopus		X						
rangii		X						

and Indo-West Pacific may be artificial. According to A. H. Clark (1911: 10), "very closely related, . . . corresponding East Indian genera" exist for 10 tropical western Atlantic comatulid genera. Although more recent inquiries (Messing, unpublished thesis and 1978; Macurda and Meyer, unpublished) also acknowledge these relationships, further detailed analyses are needed to confirm or deny the identity of the genera in question. Close familial and generic relationships between the tropical western Atlantic and Indo-West Pacific faunas exist for many other groups of marine invertebrates and most likely stem from the closer association of these regions prior to Tertiary continental drift and the disappearance of the Tethys Sea.

Tables 1 and 2 indicate that the Straits of Florida, Bahamas and Caribbean Sea constitute by far the area richest in crinoid species in this region. The Gulf of Mexico, southeastern United States, Blake Plateau and Brazil are clearly depauperate in comparison.

Table 2. Numbers of genera and species of tropical western Atlantic crinoids shared with other regions

	Comatulids		Stalked	
	Genera	Species	Genera	Species
TOTAL TROPICAL WESTERN ATL. (SE Florida, Southern Gulf of Mex. and Bahamas to Brazil)	23	34	8	10
(No. Carolina, northern Gulf of Mex. to Brazil)	23	34	8	10
STRAITS OF FLORIDA, BAHAMAS AND CARIBBEAN SEA	21	32	8	10
WARM TEMPERATE SOUTHEASTERN U.S. AND BLAKE PLATEAU	8	9	1	1
GULF OF MEXICO	8(9?)	9(10?)	1(2?)	1(2?)
BRAZIL	9	9(10?)	3	4
BOREAL NORTHERN ATLANTIC	4	2	1	0
TEMPERATE N.E. ATLANTIC	6	2	2	1
SOUTHEASTERN ATLANTIC (ST. HELENA)	2	2	1	0
INDO-WEST PACIFIC	6	1	3	0
TROPICAL EASTERN PACIFIC	0	0	0	0
ENDEMIC TO TROPICAL WESTN. ATL. (SE Fla., southn. Gulf of Mex. and Bahamas to Brazil)	9(10?)(39–43%)	21(22?)(62–65%)	5(63%)	9(90%)
(No. Carolina, northern Gulf of Mex. to Brazil)	15(65%)	29(85%)	5(63%)	9(90%)
ENDEMIC TO STRAITS OF FLA., BAHAMAS AND CARIBBEAN SEA	6(7?)(29–33%)	15(16?)(47–50%)	4(50%)	6(60%)
ENDEMIC TO BRAZIL	1(11%)	2(20–22%)	0	0

Several species previously known only from the Antillean Arc occur in the Bahamas (Messing, unpublished thesis) and along the Central and South American coasts. These include *Neocomatella pulchella*, *Analcidometra armata*, *Crinometra brevipinna*, *Hypalometra defecta*, *Endoxocrinus parrae* and *Neocrinus decorus*. A characteristic coral reef fauna comprised of *Nemaster rubiginosa*, *N. discoidea*, *Comactinia echinoptera*, *A. armata* and *Ctenantedon kinziei* has been found throughout the Bahamas and Caribbean (Macurda, 1975; Macurda and Meyer, unpublished). Nevertheless, only five species are at present known to extend from the Gulf of Mexico or transitional warm temperate zone southward to Brazil. Though several species do have restricted ranges (e.g., *Coccometra hagenii*, *Comatonia cristata* and *Comatilia iridometriformis* in the north; *Nemaster grandis* and *Tropiometra carinata* in the south), none warrants recognition of subregions within the tropical western Atlantic. H. L. Clark (1919) placed the southern limit for Antillean littoral echinoderms at Tobago, but the ranges of almost one-third of the crinoids of the region (including all of those he mentioned) overlap this point.

Table 2 also indicates the high levels of generic and specific endemism exhibited by crinoids of the region. At these levels, endemism among both comatulids and stalked forms greatly exceeds that of echinoderms in general, of which 67% and 6% of the species and genera, respectively, are endemic (Ekman, 1953). Ekman's figures include forms found in the warm temperate transitional zone but almost certainly do not include deep-water forms, which are less likely to be endemic. Endemism among the 6 genera and 9 species regularly found above 100 m is 83% and 89%, respectively. Comparison

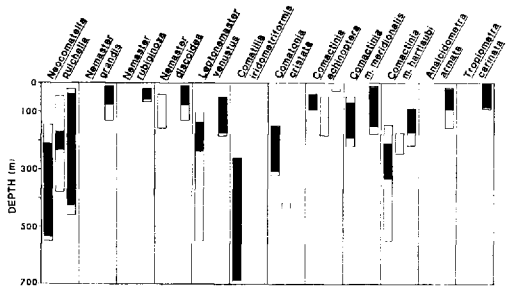

Figure 5. Possible (open bar) and confirmed (solid bar) depth ranges; PILLSBURY and GERDA records only. Comatulids collected only above 1,000 m (Comasterina and Mariametrina). The three bars under each species, when present, represent the following geographic areas (from left to right): (1) Straits of Florida, (2) Yucatán Channel, (3) Caribbean Sea and Antillean Arc.

with Indo-Pacific forms could reduce the generic endemism of the region by almost one-half.

The two species supposedly endemic to Brazil (*Hybometra senta* and *Thaumatometra minutissima*) are each known only from single damaged specimens and their identities are thus suspect.

Regarding other regions of the Atlantic, the tropical western Atlantic has more genera

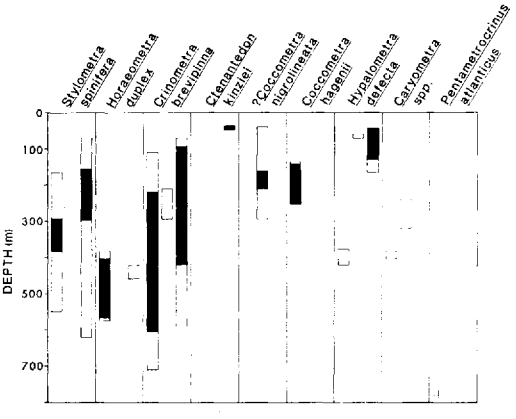

Figure 6. Possible (open bar) and confirmed (solid bar) depth ranges; PILLSBURY and GERDA records only. Comatulids collected only above 1,000 m (Thalassometrina and Macrophreatina). + indicates a single station at a single depth.

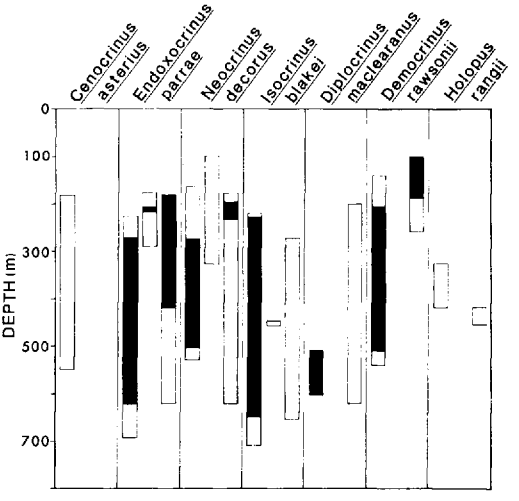

Figure 7. Possible (open bar) and confirmed (solid bar) depth ranges; PILLSBURY and GERDA records only. Stalked crinoids collected only above 1,000 m.

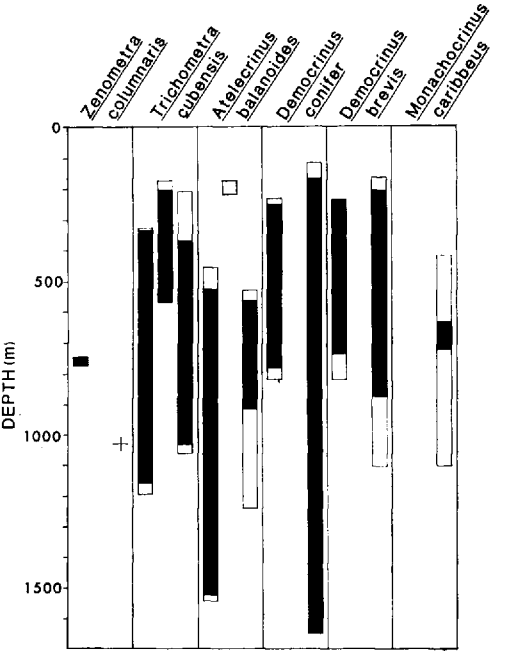

Figure 8. Possible (open bar) and confirmed (solid bar) depth ranges; PILLSBURY, GERDA and ISELIN. Crinoids collected with ranges at least possibly extending below 1,000 m. + indicates a single station at a single depth.

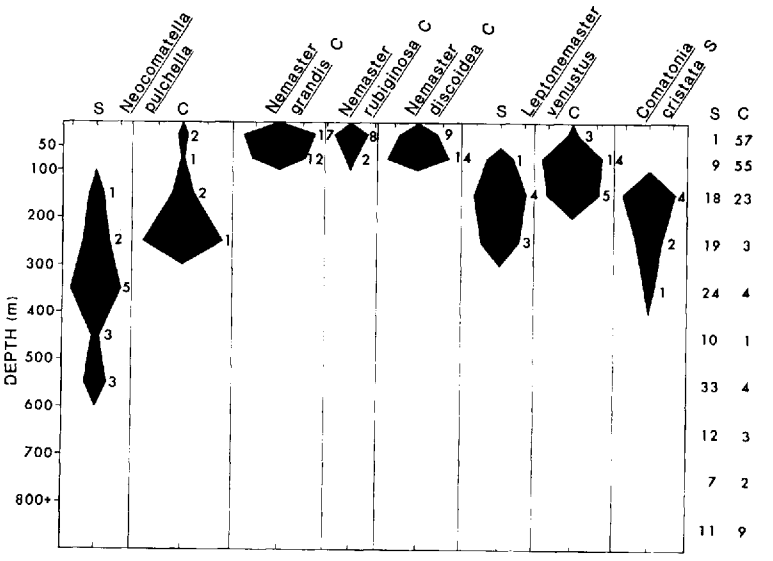

Figure 9. Depth distribution for most frequently collected species; PILLSBURY, GERDA and ISELIN records only; comatulids. The width of each diagram represents the number of stations at which a species was collected as a percentage of all stations at which crinoids were taken within specified depth intervals (0–49 m, 50–99 m, 100–199 m, 200–299 m, etc.) and geographic areas (S = Straits of Florida, C = Caribbean Sea and Antillean Arc as in Figs. 5–8; too few stations were made in the Yucatán Channel for inclusion). All stations below 800 m are taken together as 1 interval. Marks along upper margin of figures denote 10% intervals. Numbers beside each diagram indicate number of stations for that species in the particular depth interval and geographic area. Columns at right indicate total stations (at which crinoids were collected) per depth interval and area. Stations with depth ranges strongly overlapping the intervals used here have been omitted.

and species in common with the boreal northern, temperate northeastern and southeastern (St. Helena) regions than with the tropical eastern Atlantic. The shared taxa occur almost uniformly in deep water. None of the comatulids that dominate the shallow-water, tropical western fauna are found in the tropical eastern Atlantic. The one species that may possibly occur in both tropical regions, *Antedon duebeni*, is very rare in the west. (*Antedon* is the only tropical, amphi-Atlantic genus.) The single, shallow-water crinoid found on both sides of the Atlantic, *Tropiometra carinata*, occurs at St. Helena and is unreported north of the Cape of Good Hope on the eastern coast. One chiefly Indo-West Pacific comatulid genus, *Comanthus*, has been collected on the Vema Seamount off southwestern Africa (A. M. Clark, 1974: 480), but the species, *C. wahlbergi*, is endemic to southern Africa. The narrow, tropical eastern Atlantic region, with its poorly developed reef environment, has few shallow-water crinoid species. The tropical eastern Pacific, similarly limited and isolated by a broad, deep-oceanic barrier, has none. The 5 crinoid species that occur in the latter region (4 antedonids and 1 hyocrinid) all live in deep water. Recent investigations of eastern Pacific coral reefs have failed to report any crinoids (Glynn et al., 1972; Birkeland et al., 1975).

Zoobathymetry

Many species of tropical western Atlantic crinoids occur in shallower water in the Caribbean Sea than in the Straits of Florida and Bahamas (Figs. 5–12). Wind- and

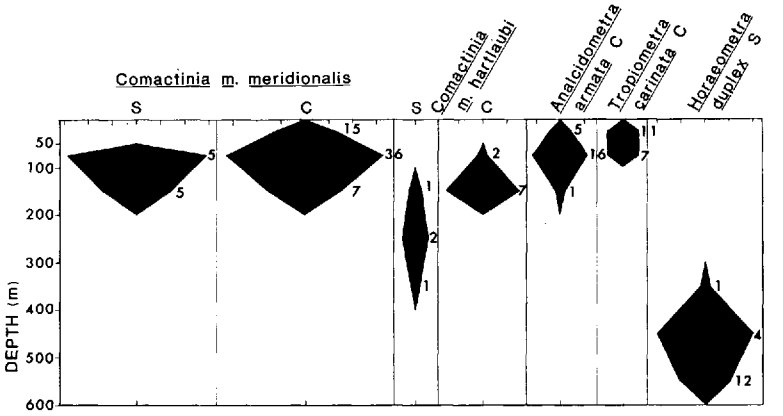

Figure 10. Depth distributions for most frequently collected species; PILLSBURY, GERDA and ISELIN records only; comatulids, continued. (For explanation, see legend for Fig. 9.)

current-induced variations in vertical temperature profiles appear to be governing factors, although not enough data exist to assign different species to specific temperature ranges. Along the Caribbean coast of South America, trade wind-induced upwelling of cold water (Claes Rooth, personal communication) may restrict many crinoid species to relatively shallow water. In the Yucatán Channel and Straits of Florida, isothermal surfaces tilt steeply across the strong, prevailing currents; warm water penetrates to greater depths on the insular side and is restricted to a relatively thin superficial layer along the continental side of both channels (Cairns, 1976; Wüst, 1964).

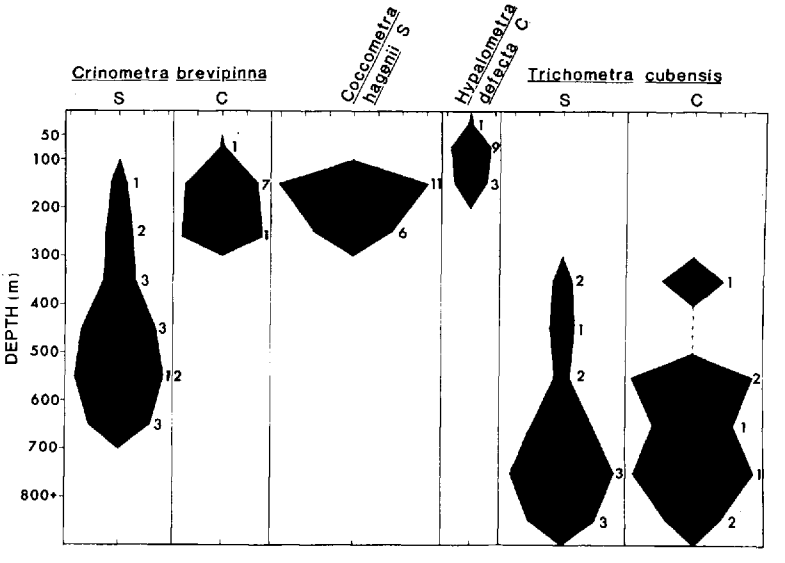

Figure 11. Depth distributions for most frequently collected species; PILLSBURY, GERDA and ISELIN records only; comatulids, continued. (For explanation, see legend for Fig. 9.)

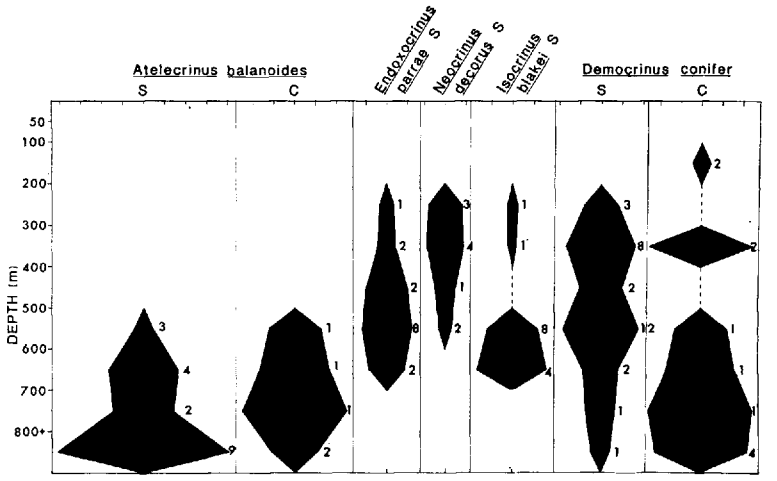

Figure 12. Depth distributions for most frequently collected species; PILLSBURY, GERDA and ISELIN records only; comatulids, concluded, and stalked species. (For explanation, see legend for Fig. 9.)

In the Yucatán Channel, GERDA and PILLSBURY collected crinoids only along the continental margin (chiefly, Arrowsmith Bank), thus accounting for the shallow records characteristic of this area. In the Straits of Florida, however, most species are restricted to insular slopes and, thus, occur in deeper water here than elsewhere.

Sixteen comatulid and five stalked species collected during this study (at more than 3 stations each) have maximum confirmed depths above about 600 m—the greatest depth of the 10°C isotherm in the Straits of Florida (Cairns, 1976). All but two of these comatulids (88%) are restricted to confirmed ranges narrower than 200 m. The other two comatulids (*Neocomatella pulchella* and *Crinometra brevipinna*) and the five stalked species (all isocrinids) either have similarly restricted depth distributions in part of their geographic ranges (any one of the three areas in Figs. 5–8) or the great majority of material was collected over a confirmed range narrower than 200 m, or both.

Four species, collected at more than three stations each (*Trichometra cubensis*, *Atelecrinus balanoides*, *Democrinus conifer* and *D. brevis*), penetrate below 1,000 m. All four have broad depth distributions—the narrowest about 600 m and the broadest about 1,500 m. With the exceptions of the shallow records for the two comatulids in the Yucatán Channel, the variations in depth distribution with geographic area and hydrography characteristic of the shallower water crinoids do not exist for these four species.

In addition to the five species that are widespread on western Atlantic coral reefs (see above), four additional comatulids (*Nemaster grandis*, *Comactinia meridionalis meridionalis*, *Tropiometra carinata* and *Hypalometra defecta*) generally occur above 100 m as well, although some of these nine range deeper. Most of the comatulids, all of the isocrinids and *Holopus rangii* generally occur between 100 and 700 m. The bathycrinids and a few comatulids (*Trichometra*, *Atelecrinus* and *Zenometra columnaris*) comprise a third group that occurs below 1,000 m but that may be found considerably shallower than this. Messing (unpublished thesis) discussed the bathymetry of comatulids in the Straits of Florida and Macurda and Meyer (1974) observed parts of these three depth groupings from NEKTON GAMMA off Discovery Bay, Jamaica. These bathymetric groups are not mutually exclusive (see also

Macurda and Meyer, 1976) but do suggest a general pattern related to the hydrographic and substrate requirements of the various species.

Taxonomic Changes

The list below summarizes the taxonomic changes suggested for tropical western Atlantic crinoids herein or by Messing (unpublished thesis):

Analcidometra caribbea Clark, 1908 is synonymous with *Analcidometra armata* (Pourtalès, 1869).

Democrinus brevis Clark, 1909 is synonymous with *Democrinus conifer* Clark, 1909?

Diplocrinus carolinae Clark, 1934 is synonymous with *Diplocrinus maclearanus* (Wyville Thomson, 1877)?

Endoxocrinus prionodes Clark, 1941 is synonymous with *Endoxocrinus parrae* (Gervais, 1835)?

Nemaster mexicanensis Tommasi, 1966 is synonymous with *Nemaster rubiginosa* (Pourtalès, 1869).

Neocomatella alata (Pourtalès, 1878) is synonymous with *Neocomatella pulchella* (Pourtalès, 1878) (Messing, unpublished thesis).

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ADDRESSES: *(D.L.M.) Department of Geology, University of Cincinnati, Cincinnati, Ohio 45221; (C.G.M.) Rosenstiel School of Marine and Atmospheric Science, Division of Biological Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149; (D.B.M.) Museum of Paleontology, University of Michigan, Ann Arbor, Michigan 48109.*

APPENDIX 1

Material Examined[1]

Neocomatella pulchella.—PILLSBURY stations: 209-2, 211-4, 594-2, 596-1, 736-25, 745-8, 757-1, 856-1, 875-2, 876-6, 907-3, 931-1, 1140-2, 1141-61, 1157-2, 1425-3. GERDA stations: 234-1, 246-2, 251-35, 493-3, 503-1, 509-7, 510-18, 522-2, 692-4, 697-3, 698-1, 725-11, 879-1, 893-13, 894-1, 897-10, 899-10, 1275-8, 1312-1, 1314-1, 1329-30. OREGON station: 4225-2.

Nemaster grandis.—PILLSBURY stations: 324-1, 330-23, 365-2, 376-1, 409-1, 412-1, 419-1, 422-3, 425-6, 430-4, 434-1, 619-1, 623-6, 624-7, 625-21, 626-1, 627-2, 628-4, 629-1, 746-1, 751-1, 759-1, 767-1, 772-3, 793-1, 795-1, 1149-1, 1198-1, 1336-1, 1366-2, 1369-1.

Nemaster rubiginosa.—PILLSBURY stations: 324-fragments, 341-1, 442-fragments, 443-1, 630-1, 1191-3, 1196-4, 1198-2, 1286-1, 1366-13.

Nemaster discoidea.—PILLSBURY stations: 324-2, 330-5, 365-2, 392-1, 396-5, 402-1, 422-1, 425-7, 430-11, 434-2, 436-1, 629-3, 773-1, 792-1, 853-1, 856-1, 857-1 (+2?), 887-4, 912-1, 1149-3, 1190-1, 1252-1, 1298-3, 1317-4, 1369-4. GERDA stations: 391-2, 636-1, 887-15.

Leptonemaster venustus.—PILLSBURY stations: 330-6, 372-1, 392-2, 396-1, 403-2, 422-1, 424-1, 425-4, 430-2, 433-1, 434-1, 707-3, 708-10, 709-1, 734-1, 736-32, 737-24, 837-8, 840-9, 1186-1, 1303-3, 1369-1, 1386-7, 1393-1, 1421-1. GERDA stations: 392-6, 493-5, 681-1, 683-1, 713-1, 724-11, 725-13, 984-1, 1329-1.

Comatilia iridometriformis.—GERDA stations: 170-10, 177-4, 849-15, 1327-7.

Comatonia cristata.—GERDA stations: 220-1, 589-1, 840-1, 865-1, 885-1, 977-3, 978-1, 1102-4.

Comactinia echinoptera.—PILLSBURY stations: 439-1, 900-3. GERDA stations: 412-1, 423-2, 582-1, 600-3, 956-5.

Comactinia meridionalis meridionalis.—PILLSBURY stations: 324-3, 330-44, 341-1, 365-33, 372-11, 392-41, *394-1*, 396-20, 397-30, 398-1, 401-2, 402-21, 403-3, 412-3, *413-1*, 415-1, 422-1, 425-7, 430-53, 433-48, 434-16, 436-1, 437-5, 444-1, 614-1, 625-4, 629-6, 650-117, 652-1, 657-3, 658-36, 671-113, *672-1*, 684-26, 699-1, 707-7, 708-28, 709-195, 736-81, 737-224, 749-9, 768-14, 773-4, 791-5, 792-4, 835-1, 837-24, 838-32, 842-8, 848-2, 854-3, 887-14, 952-1, 1143-1, *1187-1*, 1317-22, 1327-11, 1331-47, 1332-30, 1333-2, 1365-46, 1368-1, 1369-12, *1384-6*, 1386-10, 1393-5. GERDA stations: 391-1, 392-34, 393-1, 562-1, 564-11, 600-4, 636-1, 713-8, 724-6, 1246-1. OREGON station: 4165-1; (see Tommasi, 1971b; additional OREGON material identified as "*Comactinia echinoptera*" which may be referable to *Comactinia meridionalis* listed here).

Comactinia meridionalis hartlaubi.—PILLSBURY stations: 375-1, 400-1, 403-1, 592-3, 783-2, 786-16, 875-3, 907-2, 1303-7, 1393-5, 1395-7. GERDA stations: 493-16, 510-1, 526-1, 692-1, 693-1, 698-2, 725-16, 1329-1.

Analcidometra armata.—PILLSBURY stations: 324-3, 331-17, 403-1, 417-4, 418-1, 422-1, 425-1, 428-1, 444-4, 691-6, 692-1, 709-28, 736-22, 737-13, 749-47, 773-9, 842-2, 853-1, 855-3, 910-3, 1317-2, 1366-1, 1386-6.

Tropiometra carinata.—PILLSBURY stations: 650-17, 654-16, 655-64, 669-3, 684-9, 686-2, 687-89, 688-1, 695-71, 696-29, 701-2, 773-2, 791-14, 792-7, 840-2, 887-1, 895-1, 912-1. OREGON stations: 4165-2, 4166-1, 4170-1, 4215-13, 4216-17, 4217-1, 4221-3, 4229-10, 4232-3.

Stylometra spinifera.—PILLSBURY stations: 211-2, 610-3, 736-5, 907-12, 969-1, 991-1, 1140-4, 1303-1, 1395-1. GERDA stations: 251-2, 493-2, 503-8, 533-6, 692-2, 698-1, 897-1.

Horaeometra duplex.—PILLSBURY stations: 209-3, 1141-3. GERDA stations: 234-5, 241-10, 242-2, 246-11, 247-1, 252-1, 261-3, 533-1, 695-1, 706-13, 1125-3, 1312-1, 1314-3.

Crinometra brevipinna.—PILLSBURY stations: 197-1, 209-3, 211-13, 478 or 479-4, 736-1, 739-3, 838-4, 848-8, 904-10, 944-1, 969-1, 991-1, 1141-2, 1143-108, 1303-11, *1384-10*, 1386-3, 1387-15, 1393-35, 1395-8, 1410-1. GERDA stations: 132-1, 169-4, 234-1, 242-2, 246-15, 247-2, 251-6, 252-1, 261-4, 386-9, 503-9, 510-3, 663-1, 678-1, 679-5, 688-1, 693-2, 707-1, 715-1, 897-3, 936-1, 1012-2, 1125-1, 1314-4. OREGON station: 4225-6.

[1] Anomalous records, particularly those few listing shelf and slope species from the bottom of the Puerto Rico Trench, are italicized. They are probably the result of mislabelling.

Ctenantedon kinziei.—PILLSBURY stations: 935-1, 983-1.

Coccometra nigrolineata.—GERDA stations: 897-4, 899-1.

Coccometra hagenii.—GERDA stations: 457-8, 589-1, 841-frags., 842-26, 862-1, 863-1, 864-11, 865-1, 972-196, 974-146, 975-51, 976-101, 977-5, 978-9, 1028-37, 1035-15, 1102-567.

Hypalometra defecta.—PILLSBURY stations: 392-1, 424-12, 650-1, 707-13, 708-9, 709-7, 728-4, 736-1, 737-5, 749-25, 766-50, 768-8, 775-20, 1387-1. GERDA stations: 882-1, 934-1.

Zenometra columnaris.—PILLSBURY station: 1187-2. GERDA stations: 181-8, 808-arms only.

Caryometra spp.—GERDA stations: 533-1, 893-3.

Trichometra cubensis.—PILLSBURY stations: 105-9, 585-1, 587-12, 602-1, 781-5, 881-1, 919-1, 923-6, 930-1, 944-1, 1187-1, 1225-5, 1256-1, 1262-1, 1356-1. GERDA stations: 169-2, 181-1, 182-1, 190-2, 235-1, 241-1, 357-1, 386-4, 672-1, 815-1, 828-1, 859-1, 879-1, 889-2, 897-1, 936-1, 1286-1. COLUMBUS ISELIN station: 140-1.

Pentametrocrinus atlanticus.—GERDA station: 181-1.

Atelecrinus balanoides.—PILLSBURY stations: 636-2, 740-3, 754-1, 781-30, 847-1, 920-4, 946-1, 1261-3, 1438-1, 1441-1. GERDA stations: 93-2, 112-1, 146-1, 182-1, 242-1, 289-12, 362-7, 374-2, 403-1, 439-2, 448-2, 861-1, 889-2, 963-1. COLUMBUS ISELIN stations: 27-2, 60-1, 103-1.

Cenocrinus asterius.—GERDA stations: 493-1, 693-1.

Endoxocrinus parrae.—PILLSBURY stations: 944-2, 984-2, 991-1, 1141-23, 1171-1, 1186-1. GERDA stations: 168-1, 169-3, 242-2, 246-14, 247-2, 251-14, 261-1, 386-4, 398-1, 503-8, 526-1, 533-1, 694-3, 697-2, 707-1, 889-1, 897-1, 1125-4, 1312-17, 1314-8. OREGON station: 4226-8.

Neocrinus decorus.—PILLSBURY stations: 210-stem(?), 739-7, 991-19, 1410-1, 1439-3. GERDA stations: 168-2, 261-1, 270-1, 503-50, 526-2, 533-1, 692-1, 693-1 stems(?), 696-2, 697-8, 698-1, 705-2, 706-2, 880-1.

Isocrinus blakei.—PILLSBURY stations: 197-2, 587-5, 861-2, 877-7, 889-6, 891-9, 944-16. GERDA stations: 158-1, 169-2, 179-1, 246-3, 386-11, 503-2, 664-2, 679-3, 694-3, 707-1, 708-1, 972-1, 1312-2.

Diplocrinus maclearanus.—PILLSBURY stations: 891-38, 991-1. GERDA stations: 169-18, 246-1, 386-32, 936-6. OREGON station: 4226-2.

Democrinus rawsonii.—PILLSBURY stations: 200-6, 697-1, 1303-5, 1354-2, *1384-1*, 1387-1. GERDA station: 725-9. COLUMBUS ISELIN station: 37-2.

Democrinus conifer.—PILLSBURY stations: 105-3, 198-3, 340-1, *341-1*, 364-9, 388-2, 394-6, 399-5, 447-18, 797-49, 850-1, 861-11, 881-26, 1187-2, 1225-1, 1261-4, 1356-1, 1435-1. GERDA stations: 56-1, 62-8, 66-9, 76-15, 77-4, 122-4, 146-1, 154-1, 197-3, 222-1, 265-3, 289-5, 439-15, 472-8, 474-3, 475-9, 476-4, 830-3, 915-9, 966-22, 967-3, 999-1, 1008-1, 1018-2, 1099-21, 1101-8, 1102-3, 1329-22.

Democrinus brevis.—PILLSBURY stations: 753-2, 754-13, 781-10, 785-2, 846-1, 1306-5, 1309-2. GERDA stations: 15-5, 67-24, 112-11, 126-6, 266-1, 478-27, *825-5*, 828-4, *834-4*, 845-5, 861-1, 930-1. OREGON station: 4226-52.

Monachocrinus caribbeus.—PILLSBURY stations: 394-1, 754-2.

Holopus rangii.—PILLSBURY station: 1141-2. GERDA station: 692-1.

Station Data List

PILLSBURY stations.—BLAKE PLATEAU AND NORTHERN STRAITS OF FLORIDA: P-105, 30°58′N, 79°42′W, 388–403 m, 27 July 1964.—P-197, 27°59′N, 79°20′W, 567–586 m, 11 Aug 1964.—P-198, no locality, position is for P-201, same date, 27°30′N, 79°10′W, 256–265 m, 11 Aug 1964.—P-200, no locality, position is for P-201, same date, 27°30′N, 79°10′W, 329–348 m, 11 Aug 1964.—P-209, 26°58.5′N, 79°15.5′W, wire length 1,000 m, 12 Aug 1964.—P-210, 26°40′N, 79°07′W, 503–531 m, 12 Aug 1964.—P-211, 26°41′N, 79°05′W, 384–403 m, 12 Aug 1964. PANAMA: P-324, 9°42.5′N, 79°30.5′W, 55–64 m, 7 July 1966.—P-330, 9°37′N, 78°52.5′W, 64–128 m, 8 July 1966.—P-331, 9°31.5′N, 78°55.2′W, 33–46 m, 8 July 1966.—P-340, 9°13.5′N, 77°46′W, 307–366 m, 9 July 1966.—P-341, 9°01.8′N, 77°41′W, 33–55 m, 9 July 1966. COLOMBIA: P-364, 9°20.2′N, 76°34.2′W, 933–961 m, 13 July 1966.—P-365, 9°32.5′N, 76°17′W, 56–58 m, 13 July 1966.—P-372, 9°48′N, 76°09.6′W, 82–101 m, 13 July 1966.—P-375, 9°59′N, 75°59.7′W, 130–135 m, 14 July 1966.—P-376, 9°53.9′N, 75°50.2′W, 51–64 m, 14 July 1966.—P-388, 10°10.4′N, 76°08.8′W, 824–1,061 m, 15 July 1966.—P-392, 9°45.4′N, 76°10.8′W, 75–79 m, 16 July 1966.—P-394, 9°27.4′N, 76°29′W, 421–641 m, 16 July 1966.—P-396, 9°17.6′N, 76°25′W, 68–70 m, 17 July 1966.—P-397, 9°11′N, 76°27.8′W, 62–66 m, 17 July 1966.—P-398, 9°07.2′N, 76°30.9′W, 117–176 m, 17 July 1966.—P-399, 9°00.1′N, 76°38.5′W, 119–179 m, 17 July 1966.—P-400, 8°52.4′N, 76°51.5′W, 92–99 m, 17 July 1966.—P-401, 8°50.7′N, 77°01.9′W, 73–79 m, 17 July 1966.—P-402, 8°49.1′N, 77°04.1′W, 73 m, 17 July 1966.—P-403, 8°47.6′N, 77°14.2′W, 97–99 m, 17 July 1966.—P-409, 8°51.2′N, 77°28.1′W, 55 m, 18 July 1966.—P-412, 8°41.6′N, 77°13′W, 55–60 m, 18 July 1966. PANAMA: P-415, 9°22.4′N, 78°08.4′W, 60 m, 19 July 1966.—P-417, 9°24.8′N, 78°12.7′W, 51 m, 19 July 1966.—P-418, 9°26.8′N, 78°17′W, 57–59 m, 19 July 1966.—P-419, 9°29.2′N, 78°21.7′W, 51–55 m, 19 July 1966.—P-422, 9°34.7′N, 78°36.7′W, 70–73 m, 19 July.—P-424, 9°

37.5'N, 78°52.2'W, 110–119 m, 19 July 1966.—P-425, 9°40.2'N, 79°17.4'W, 64–70 m, 19 July 1966.—P-428, 9°43.7'N, 79°22.2'W, 46 m, 20 July 1966.—P-430, 9°30.5'N, 79°52.5'W, 60–64 m, 20 July 1966.—P-433, 9°19.6'N, 80°15.5'W, 64–68 m, 20 July 1966.—P-434, 9°13.5'N, 80°22.8'W, 48–49 m, 20 July 1966.—P-436, 9°07'N, 80°40.3'W, 55–59 m, 20 July 1966.—P-437, 8°59.7'N, 80°46.7'W, 55 m, 20 July 1966.—P-439, 8°51.3'N, 81°03.4'W, 18–22 m, 20 July 1966.—P-442, 8°49.6'N, 81°13'W, 18 m, 21 July 1966.—P-443, 8°49.9'N, 81°21.5'W, 31 m, 21 July 1966.—P-444, 8°57.5'N, 81°31'W, 73 m, 21 July 1966.—P-447, 9°04.0'N, 81°13.8'W, 664–681 m, 21 July 1966.—P-478, 11°32'N, 62°07.2'W, 586–608 m, 2 Aug 1966.—P-479, 11°19.7'N, 62°01.2'W, 123–134 m, 3 Aug 1976. YUCATAN CHANNEL: P-585, 21°02'N, 86°29'W, 567–571 m, 23 May 1967.—P-587, 21°17'N, 86°13'W, 448–458 m, 14 March 1968.—P-592, 21°00'N, 86°23'W, 174–243 m, 15 March 1968.—P-594, 21°00.5'N, 86°23'W, 329 m, 15 March 1968.—P-596, 21°04'N, 86°22'W, 229–254 m, 15 March 1968.—P-602, 20°22.5'N, 87°11.5'W, 412–457 m, 16 March 1968. BELIZE: P-610, 17°03'N, 87°38.5'W, 296–311 m, 18 March 1968. HONDURAS: P-614, 16°03.8'N, 88°34.1'W, 18–31 m, 19 March 1968.—P-619, 15°56'N, 87°33.5'W, 27–55 m, 20 March 1968.—P-623, 15°59.6'N, 86°07'W, 51 m, 21 March 1968.—P-624, 15°59.5'N, 86°04'W, 40–48 m, 21 March 1968.—P-625, 15°59.5'N, 86°02.5'W, 27–37 m, 21 March 1968.—P-626, 15°57.6'N, 86°09'W, 40 m, 21 March 1968.—P-627, 15°56.5'N, 86°14'W, 46 m, 21 March 1968.—P-628, 15°57'N, 86°15.2'W, 46–48 m, 21 March 1968.—P-629, 15°58.2'N, 86°09'W, 40 m, 21 March 1968.—P-630, 15°59.2'N, 86°02'W, 37 m, 21 March 1968. STRAITS OF FLORIDA: P-636, 23°54'N, 81°27'W, 1,003–1,336 m, 25 March 1968. GUIANAS: P-650, 6°07'N, 52°19'W, 84–91 m, 8 July 1968.—P-652, 6°20'N, 52°34'W, 62 m, 8 July 1968.—P-654, 6°08.5'N, 53°21.5'W, 31 m, 9 July 1968.—P-655, 6°07'N, 53°41'W, 26 m, 9 July 1968.—P-657, 7°01'N, 53°15'W, 128–132 m, 9 July 1968.—P-658, 7°10'N, 53°36'W, 126–135 m, 9 July 1968.—P-669, 6°43'N, 55°20'W, 33 m, 10 July 1969.—P-671, 7°07'N, 55°05'W, 64 m, 11 July 1969.—P-672, 7°37'N, 55°27'W, 1,179–1,336 m, 11 July 1969.—P-684, 7°19'N, 56°51'W, 55–59 m, 14 July 1968.—P-686, 7°00'N, 57°08'W, 26–27 m, 15 July 1968.—P-687, 7°13'N, 57°36'W, 27 m, 15 July 1968.—P-688, 07°42'N, 57°32'W, 57 m, 15 July 1968.—P-691, 8°25'N, 58°08'W, 82–88 m, 15 July 1968.—P-692, 8°26'N, 58°10'W, 86–88 m, 15 July 1968.—P-695, 8°04'N, 58°35'W, 37 m, 16 July 1968.—P-696, 8°35'N, 58°51'W, 55–59 m, 16 July 1968.—P-697, 9°02'N, 59°06'W, 106–108 m, 16 July 1968. TRINIDAD: P-699, 9°30'N, 60°15'W, 64 m, 16 July 1968.—P-701, SW corner Maracas Bay, N. coast, ~2 m, 18 July 1968. VENEZUELA: P-707, 11°23.5'N, 62°23.0'W, 78 m, 19 July 1968.—P-708, 11°26.6'N, 62°40.5'W, 69–73 m, 19 July 1968.—P-709, 11°12.9'N, 62°45.5'W, 46 m, 19 July 1968.—P-728, 10°25.7'N, 65°21.6'W, 86 m, 21 July 1968.—P-734, 11°01.0'N, 65°36.3'W, 60–68 m, 22 July 1968.—P-736, 11°03'N, 65°59'W, 69–155 m, 22 July 1968.—P-737, 10°45'N, 66°08'W, 60–73 m, 22 July 1968.—P-739, 10°57.6'N, 66°18'W, 234–280 m, 23 July 1968.—P-740, 11°28'N, 66°10'W, 732–924 m, 23 July 1968.—P-745, 11°59.5'N, 66°49'W, 64–66 m, 24 July 1968.—P-746, 11°54.5'N, 66°54.5'W, 23–27 m, 24 July 1968.—P-749, 10°40.3'N, 67°57.9'W, 59 m, 25 July 1968.—P-751, 10°45.3'N, 68°08.3'W, 44–46 m, 26 July 1968.—P-753, 11°31.9'N, 68°25'W, 384–607 m, 26 July 1968.—P-754, 11°36.9'N, 68°42'W, 728–1,109 m, 26 July 1968.—P-757, 11°42'N, 69°20'W, 161–187 m, 27 July 1968.—P-759, 12°09'N, 69°49'W, 35–37 m, 27 July 1968.—P-766, 12°16.9'N, 70°39.9'W, 64 m, 28 July 1968. COLOMBIA: P-767, 12°16.1'N, 71°03.3'W, 24 m, 28 July 1968.—P-768, 12°34.5'N, 71°10.6'W, 64–66 m, 28 July 1968.—P-772, 12°21.2'N, 71°54'W, 11 m, 29 July 1968.—P-773, 12°18'N, 72°13.8'W, 60–64 m, 29 July 1968.—P-775, 12°06'N, 72°37'W, 78–82 m, 29 July 1968.—P-781, 11°34.5'N, 73°20'W, 531–567 m, 30 July 1968.—P-783, 11°22'N, 73°44'W, 143–174 m, 31 July 1968.—P-785, 11°19.7'N, 74°14.4'W, 210–165 m, 31 July 1968.—P-786, 11°07.6'N, 74°19.3'W, 101–165 m, 31 July 1968.—P-791, 10°56.9'N, 75°26.9'W, 42–44 m, 1 Aug 1968.—P-792, 10°49.9'N, 75°23.6'W, 11–13 m, 1 Aug 1968.—P-793, 10°40'N, 75°31'W, 26–29 m, 1 Aug 1968.—P-795, 10°31.8'N, 75°34.9'W, 27–64 m, 1 Aug 1968.—P-797, 10°20.2'N, 75°44'W, 150–170 m, 1 Aug 1968. TRINIDAD: P-835, 9°36'N, 60°10'W, 48 m, 30 June 1969.—P-837, 10°10.3'N, 60°33.2'W, 55 m, 30 June 1969.—P-838, 10°32'N, 60°23'W, 93–95 m, 30 June 1969.—P-840, 10°40.5'N, 60°37.5'W, 33–37 m, 1 July 1969.—P-842, 11°10.9'N, 60°32.3'W, 68 m, 1 July 1969. LESSER ANTILLES: P-846, 11°38.8'N, 60°37.5'W, 878–942 m, 2 July 1969.—P-847, 11°41'N, 61°01.3'W, 920–1,244 m, 2 July 1969.—P-848, 11°23.8'N, 61°25.8'W, 146 m, 2 July 1969.—P-850, 11°46.5'N, 61°29'W, 897–924 m, 3 July 1969.—P-853, 11°55'N, 61°43.5'W, 15–20 m, 3 July 1969.—P-854, 12°02'N, 61°35.7'W, 73–77 m, 3 July 1969.—P-855, 12°07'N, 61°32.5'W, 27 m, 3 July 1969.—P-856, 12°17.5'N, 61°29'W, 35 m, 3 July 1969.—P-857, 12°23.5'N, 61°21.6'W, 37–251 m, 3 July 1969.—P-861, 12°42.5'N, 61°07.3'W, 357–659 m, 4 July 1969.—P-875, 13°10.2'N, 61°05.5'W, 108–159 m, 6 July 1969.—P-876, 13°13.9'N, 61°04.7'W, 242–262 m, 6 July 1969.—P-877, 13°18.6'N, 61°06.1'W, 348–466 m, 6 July 1969.—P-881, 13°20.8'N, 61°02.5'W, 659–842 m, 6 July 1969.—P-887, 14°10.5'N, 60°56.1'W, 73–77 m, 7 July 1969.—P-889, 14°06.3'N, 60°51'W, 371–402 m, 7 July 1969.—P-891, 14°07.8'N, 60°50.7'W, 274–567 m, 7 July 1969.—P-895, 14°05.7'N, 61°00.8'W, 18 m, 8 July 1969.—P-900, 13°38.5'N, 60°58.3'W, 18–27 m, 9 July 1969.—P-904, 13°45.5'N, 61°05.7'W, 417–589 m, 9 July 1969.—P-907, 14°26.8'N, 60°58.3'W, 170–214 m, 9 July 1969.—P-910, 14°33'N, 61°06.3'W, 51–82 m, 10 July 1969.—P-912, 14°37.8'N, 61°09.1'W, 51–91 m, 10 July 1969.—P-919, 16°05.6'N, 61°19'W, 704–732 m, 12 July 1969.—P-920, 16°06.5'N, 61°22.1'W, 631–704 m, 12 July 1969.—P-923, 16°06.2'N, 61°22.7'W, 549–686 m, 14 July 1969.—P-930, 15°30.3'N, 61°12.4'W, 210–399 m, 15 July 1969.—P-931, 15°32'N, 61°13.1'W, 174–357 m, 15 July 1969.—P-935, 15°36.5'N, 61°18.8'W, 37 m, 15 July 1969.—P-944, 16°34.4'N, 61°37.2'W, 382–421 m, 17 July 1969.—

P-946, 16°45.1'N, 61°56.5'W, 732–832 m, 17 July 1969.—P-952, 16°51.8'N, 62°11.7'W, 27 m, 18 July 1969.—P-969, 17°27.8'N, 61°41.1'W, 70–220 m, 20 July 1969.—P-983, 18°20'N, 62°38.5'W, 49 m, 22 July 1969.—P-984, 18°28'N, 63°11.1'W, 421–439 m, 22 July 1969.—P-991, 18°47'N, 64°46.8'W, 204–622 m, 23 July 1969. BAHAMAS: P-1140, 20°49.7'N, 73°36.2'W, 284 m, 13 Jan 1970.—P-1141, 20°50'N, 73°19'W, 421–458 m, 13 Jan 1970.—P-1143, 20°54.5'N, 73°28.2'W, 110–220 m, 13 Jan 1970. HISPANIOLA: P-1149, 19°58.7'N, 71°33.7'W, 22–33 m, 15 Jan 1970.—P-1157, 19° 06.3'N, 69°01'W, 18–40 m, 16 Jan 1970. SANTAREN CHANNEL: P-1171, 23°34'N, 79°20' W, 516–522 m, 27 June 1970. HISPANIOLA: P-1186, 18°29.7'N, 74°38.7'W, ~183 m, 2 July 1970.—P-1187, 18°17'N, 75°07'W, 1,034 m, 2 July 1970. JAMAICA: P-1190, 17°40'N, 75°42'W, 31 m, 2 July 1970.—P-1191, 17°41'N, 75°41'W, 33 m, 2 July 1970.—P-1196, 17°27.5'N, 75°57'W, 26 m, 3 July 1970.—P-1198, 17°49.4'N, 76°12.3'W, 29–37 m, 4 July 1970.—P-1225, 17°47'N, 77°55.8' W, 530–558 m, 6 July 1970.—P-1252, 17°09'N, 78°57'W, 26 m, 14 July 1970.—P-1256, 17°27'N, 78°10'W, 603–655 m, 14 July 1970.—P-1261, 17° 18'N, 77°45'W, 722–769 m, 15 July 1970.—P-1262, 17°21.4'N, 77°34.8'W, 915–1,065 m, 15 July 1970. HISPANIOLA: P-1286, 17°53'N, 71°13'W, 18–37 m, 19 July 1970.—P-1298, 18°19'N, 70°46'W, 22–24 m, 20 July 1970.—P-1303, 18°21'N, 69°14.3'W, 170–176 m, 21 July 1970. SOUTHEASTERN FLORIDA: P-1306, 25°44.5'N, 79°50.0'W, 302–366 m, 4 Dec 1970.—P-1309, off Miami, 311 m, 5 Dec 1970. COSTA RICA: P-1317, 9°59'N, 82° 55'W, 55–69 m, 27 Jan 1971. NICARAGUA: P-1327, 11°09'N, 83°41'W, 37 m, 27 Jan 1971.—P-1331, 11°51.2'N, 83°35.3'W, 20 m, 28 Jan 1971.—P-1332, 12°06'N, 83°34'W, 18 m, 28 Jan 1971.—P-1333, 12°15.8'N, 83°31.1'W, 11–13 m, 28 Jan 1971.—P-1336, 12°42'N, 82°47'W, 38–46 m, 29 Jan 1970.—P-1354, 14°21'N, 81°55'W, 192–263 m, 31 Jan 1970. HONDURAS: P-1356, 14°53.9'N, 81°23.2'W, 296–375 m, 31 Jan 1970.—P-1365, 16° 00.5'N, 84°19.5'W, 38 m, 1 Feb 1971.—P-1366, 16°04'N, 84°44'W, 51 m, 2 Feb 1971.—P-1368, 16°03.2'N, 85°12'W, 117–124 m, 2 Feb 1971.—P-1369, 16°07'N, 85°38'W, 55–57 m, 2 Feb 1971. HISPANIOLA: P-1386, 18°22.8'N, 69°06.6'W, 92–148 m, 9 July 1971.—P-1387, 18°21.4'N, 69° 08.7'W, 130–165 m, 9 July 1971.—P-1393, 18° 21.7'N, 69°18.4'W, 150 m, 10 July 1971.—P-1395, 18°20.9'N, 69°11.8'W, 165–167 m, 10 July 1971.—P-1410, 20°11'N, 68°52.9'W, ~180 m, 17 July 1971. BAHAMA AND TURKS AND CAICOS ISLANDS: P-1421, 21°36.1'N, 71°01'W, 71–95 m, 19 July 1971.—P-1425, 20°56.5'N, 71°34'W, 403–430 m, 19 July 1971.—P-1435, 21°58'N, 73°41.5' W, 1,650 m, 22 July 1971.—P-1438, 22°27.3'N, 73°10.1'W, 742–770 m, 23 July 1971.—P-1439, 22° 35.5'N, 73°32'W, 200 m, 23 July 1971.—P-1441, 22°25.1'N, 73°52'W, 855 m, 23 July 1971.

GERDA stations.—STRAITS OF FLORIDA: G-15, 25°45'N, 80°00'W, 275–302 m, 30 May 1962. —G-56, 25°31'N, 79°20'W, 458 m, 28 Aug 1962.—G-62, 25°30.5'N, 80°00'W, 384–403 m, 29 Aug 1962.—G-66, 25°25.5'N, 79°59'W, 366 m, 26 Sept 1962.—G-67, 25°31'N, 79°57'W, 351 m, 26 Sept 1962.—G-76, 25°28'N, 80°00'W, 344–348 m, 28 Sept 1962.—G-77, 25°33'N, 80°02'W, 329–339 m, 28 Sept 1962.—G-93, 25°08'N, 79°44'W, 732 m, 19 April 1963.—G-112, 24°14'N, 82°56'W, 641–686 m, 18 June 1963.—G-122, 24°11'N, 81°57'W, 686–769 m, 19 June 1963.—G-126, 24°06'N, 81° 33'W, 741–824 m, 20 June 1963.—G-132, 24°29' N, 80°50'W, 275–302 m, 21 June 1963.—G-134, 24°30'N, 80°51'W, 190–201 m, 21 June 1963.—G-146, 24°45'N, 80°09'W, 622–686 m, 23 June 1963.—G-154, 26°29'N, 79°20'W, 549 m, 25 June 1963.—G-158, 26°36'N, 79°24'W, 531–540 m, 25 June 1963.—G-168, 27°01.5'N, 79°11.5'W, 229–275 m, 29 June 1963.—G-169, 27°04'N, 79°21'W, 522–567 m, 29 June 1963.—G-170, 27°11'N, 79° 30'W, 659–677 m, 29 June 1963.—G-177, 27°20' N, 79°34'W, 686 m, 30 June 1963. BLAKE PLATEAU: G-179, 27°51'N, 79°14'W, 512–567 m, 1 July 1963.—G-181, 27°57'N, 78°56'W, 779 m, 2 July 1963.—G-182, 27°57'N, 78°40'W, 860–897 m, 2 July 1963. NORTHWEST PROVIDENCE CHANNEL: G-190, 25°57'N, 78°07'W, 732–897 m, 4 July 1963. STRAITS OF FLORIDA: G-197, 25°45'N, 79°51.5'W, 329 m, 10 Sept 1963.—G-220, 24°33'N, 80°31'W, 304–320 m, 22 Jan 1964.—G-222, 24°29'N, 80°18'W, 787–824 m, 22 Jan 1964.—G-234, 25°44'N, 79°22'W, 452–474 m, 30 Jan 1964.—G-235, 25°46.5'N, 79°22'W, 531 m, 30 Jan 1964.—G-241, 25°33'N, 79°21'W, 494–502 m, 30 Jan 1964.—G-242, 25°38'N, 79°22'W, 458–531 m, 30 Jan 1964.—G-246, 27°00'N, 79°12.5'W, 512 m, 5 Feb 1964.—G-247, 27°10'N, 79°20'W, 567 m, 5 Feb 1964. BLAKE PLATEAU: G-251, 27°25' N, 78°37.5'W, 293–311 m, 5 Feb 1964.—G-252, 27°29.5'N, 78°37.5'W, 485–496 m, 5 Feb 1964. STRAITS OF FLORIDA: G-261, 27°24'N, 79° 32'W, 494–512 m, 7 Feb 1964.—G-265, 25°41'N, 79°59'W, 329–335 m, 29 March 1964.—G-266, 25° 45'N, 79°57'W, 339–342 m, 29 March 1964.—G-270, 25°32'N, 79°21'W, 311–329 m, 30 March 1964.—G-289, 24°15'N, 81°20'W, 549–604 m, 3 April 1964.—G-357, 25°33'N, 79°31'W, 842 m, 25 Aug 1964.—G-362, 24°10'N, 81°42'W, 625–641 m, 15 Sept 1964.—G-374, 23°50'N, 81°37'W, 1,208–1,241 m, 17 Sept 1964.—G-386, 27°09.5'N, 79°17.5'W, 604 m, 19 Sept 1964.—G-391, 27°21' N, 79°11'W, 46–92 m, 19 Sept 1964.—G-392, 27° 21.5'N, 79°11'W, 124–137 m, 19 Sept 1964.—G-393, 27°22'N, 79°11'W, 165–174 m, 19 Sept 1964. BLAKE PLATEAU: G-398, 27°33'N, 79°04'W, 403 m, 20 Sept 1964.—G-403, 27°49'N, 78°50'W, 824 m, 20 Sept 1964. STRAITS OF FLORIDA: G-412, 26°36'N, 79°59'W, 37 m, 22 Sept 1964.—G-423, 26°08'N, 80°04'W, 55 m, 22 Sept 1964.—G-439, 24°14'N, 82°23'W, 565–584 m, 29 Nov 1964.—G-448, 23°54'N, 82°21'W, 1135–1184 m, 1 Dec 1964.—G-457, 24°38'N, 80°46'W, 174–183 m, 23 Jan 1965.—G-472, 24°14'N, 82°56'W, 549–567 m, 25 Jan 1965.—G-474, 24°15'N, 82°52'W, 576 m, 25 Jan 1965.—G-475, 24°14'N, 82°35'W, 549–555 m, 26 Jan 1965.—G-476, 24°15'N, 82°17'W, 512–549 m, 26 Jan 1965.—G-478, 24°15'N, 82°08'W, 348–543 m, 26 Jan 1965. NW PROVIDENCE CHANNEL: G-493, 26°29'N, 78°52'W, 183–549 m, 3 Feb 1965.—G-503, 26°28.5'N, 78°45.5'W, 366 m, 4 Feb 1965. STRAITS OF FLORIDA: G-509, 26°08'N, 79°11'W, 311–329 m, 2 March 1965.—

G-510, 26°10'N, 79°08.4'W, 311–329 m, 2 March 1965. NW PROVIDENCE CHANNEL: G-522, 26°08.9'N, 78°50'W, 322–366 m, 3 March 1965.—G-526, 26°28'N, 78°40.5'W, 278–329 m, 3 March 1965.—G-533, 26°27.5'N, 78°44.5'W, 384–403 m, 4 March 1965. STRAITS OF FLORIDA: G-562, 24°32'N, 83°18'W, 71 m, 12 April 1965.—G-564, 24°32'N, 83°15'W, 68 m, 12 April 1965.—G-582, 24°31'N, 81°23'W, 92 m, 14 April 1965.—G-589, 24°39'N, 80°45'W, 148–152 m, 14 April 1965.—G-600, 25°02.5'N, 80°18.8'W, 71–73 m, 15 April 1965.—G-636, 26°04'N, 79°13'W, 46–128 m, 30 June 1965. BLAKE PLATEAU: G-663, 27°34'N, 79°22'W, 569–576 m, 17 July 1965.—G-664, 27° 38'N, 79°22'W, 564–567 m, 17 July 1965.—G-672, 27°52.7'N, 79°03'W, 796 m, 18 July 1965. NW PROVIDENCE CHANNEL: G-678, 25°56'N, 78° 09'W, 540–576 m, 20 July 1965.—G-681, 25°52'N, 77°53.5'W, 198–223 m, 20 July 1965.—G-683, 25° 51'N, 77°51.5'W, 225–227 m, 20 July 1965.—G-688, 26°35'N, 78°16'W, 472–512 m, 21 July 1965. —G-692, 26°34'N, 78°26.2'W, 329–421 m, 21 July 1965.—G-693, 26°34'N, 78°25'W, 275–293 m, 21 July 1965.—G-694, 26°27.1'N, 78°42.5'W, 622–695 m, 21 July 1965.—G-695, 26°28'N, 78°43'W, 555–575 m, 22 July 1965.—G-696, 26°29'N, 78°39' W, 458–467 m, 22 July 1965.—G-697, 26°29'N, 78°44'W, 247–373 m, 22 July 1965.—G-698, 26° 29'N, 78°40'W, 165–329 m, 22 July 1965.—G-705, 26°28'N, 78°43'W, 362–393 m, 22 July 1965.—G-706, 26°28'N, 78°40'W, 489–522 m, 22 July 1965.—G-707, 26°26.8'N, 78°42.3'W, 514–586 m, 22 July 1965.—G-708, 26°27'N, 78°47.2'W, 650 m, 22 July 1965. STRAITS OF FLORIDA: G-725, 26°00.8'N, 79°09.8'W, 143–210 m, 3 Aug 1965.—G-808, 26°38'N, 79°33'W, 750 m, 13 Sept 1966.—G-815, 24°08'N, 79°48'W, 619 m, 22 June 1967.—G-828, 25°34'N, 79°57'W, 333–340 m, 7 July 1967.—G-830, 25°43'N, 79°59'W, 342 m, 7 July.—G-834, 25°15'N, 80°10'W, 79–86 m, 10 July 1967.—G-840, 24°24'N, 80°41'W, 289–296 m, 11 July 1967.—G-841, 24°39'N, 80°44'W, 179 m, 11 July 1967.—G-842, 24°38'N, 80°42'W, 179 m, 11 July 1967.—G-845, 25°36'N, 80°01'W, 296–318 m, 12 July 1967.—G-849, 25°55'N, 80°00'W, 256 m, 2 Aug 1967.—G-859, 24°01'N, 81°53'W, 1,162–1,200 m, 29 Aug 1967.—G-861, 24°08'N, 81°36'W, 514–558 m, 29 Aug 1967.—G-862, 24°19'N, 81° 07'W, 242–247 m, 29 Aug 1967.—G-863, 24°19'N, 81°07'W, 234 m, 29 Aug 1967.—G-864, 24°18'N, 81°07'W, 223 m, 29 Aug 1967.—G-865, 24°31'N, 80°58'W, 174 m, 29 Aug 1967. YUCATAN CHANNEL: G-879, 21°03'N, 86°25'W, 210 m, 9 Sept 1967.—G-880, 21°04'N, 86°25'W, 101–329 m, 9 Sept 1967.—G-882, 21°12'N, 86°20'W, 64–73 m, 9 Sept 1967.—G-885, 21°14'N, 86°27'W, 419–434 m, 9 Sept 1967.—G-887, 21°05'N, 86°28'W, 37–157 m, 9 Sept 1967.—G-889, 20°55'N, 86°28' W, 178–220 m, 10 Sept 1967.—G-893, 21°10'N, 86°21'W, 241–320 m, 10 Sept 1967.—G-894, 21° 11.5'N, 86°19'W, 174–207 m, 10 Sept 1967.—G-897, 20°59'N, 86°24'W, 210–293 m, 10 Sept 1967. —G-899, 20°57'N, 86°34'W, 40–165 m, 10 Sept 1967. NW PROVIDENCE CHANNEL: G-915, 25°54'N, 78°12'W, 439 m, 26 Sept 1967. BLAKE PLATEAU: G-930, 27°25'N, 79°10'W, 238 m, 30 Sept 1967.—G-934, 27°32'N, 78°44'W, 375–421 m, 30 Sept 1967. STRAITS OF FLORIDA: G-936, 26°35'N, 79°20'W, 604 m, 1 Oct 1967. YUCATAN CHANNEL: G-956, 20°50'N, 86°30'W, 46–183 m, 29 Jan 1968. STRAITS OF FLORIDA: G-963, 23°41'N, 82°16'W, 1,442–1,455 m, 1 Feb 1968.—G-966, 24°10'N, 82°22'W, 553–558 m, 2 Feb 1968.—G-967, 24°15'N, 82°26'W, 500–503 m, 2 Feb 1968.—G-972, 24°24'N, 80°52'W, 221–231 m, 3 Feb 1968.—G-974, 24°22'N, 80°57'W, 251–252 m, 3 Feb 1968.—G-975, 24°27'N, 81°15'W, 181–183 m, 3 Feb 1968.—G-976, 24°30'N, 81°13' W, 183 m, 3 Feb 1968.—G-977, 24°32'N, 81°08'W, 183 m, 3 Feb 1968.—G-978, 24°32'N, 81°07'W, 183 m, 3 Feb 1968.—G-984, 24°05'N, 80°20'W, 156–231 m, 5 March 1968.—G-999, 27°18'N, 79° 39'W, 530–551 m, 21 May 1968.—G-1008, 24°00' N, 79°42'W, 540–576 m, 14 June 1968. SANTAREN CHANNEL: G-1012, 23°37'N, 79°32'W, 509–531 m, 14 June 1968.—G-1018, 24°00'N, 79° 26'W, 556 m, 15 June 1968. STRAITS OF FLORIDA: G-1028, 24°28.4'N, 81°24.3'W, 137–143 m, 25 Feb 1969.—G-1035, 24°34.7'N, 80°58.6'W, 150–183 m, 26 Feb 1969.—G-1099, 24°12.5'N, 82° 50'W, 619–622 m, 28 April 1969.—G-1101, 24° 10'N, 82°51.5'W, 787 m, 28 April 1969.—G-1102, 24°15.5'N, 81°34'W, 249 m, 29 April 1969.—G-1125, 26°45'N, 79°05'W, 494–531 m, 13 June 1969. —G-1246, 23°57.7'N, 80°28.6'W, 65 m (SCUBA), 11 March 1970. YUCATAN CHANNEL: G-1275, 21°02'N, 86°29'W, 225–375 m, 21 Aug 1970.—G-1286, 21°06'N, 86°28'W, 210–348 m, 23 Aug 1970. STRAITS OF FLORIDA: G-1312, 26° 38.4'N, 79°02.5'W, 505–527 m, 31 March 1971. —G-1314, 26°52.4'N, 79°11.8'W, 531–540 m, 31 March 1971. NW PROVIDENCE CHANNEL: G-1327, 25°59.5'N, 78°33'W, 421–426 m, 11 Dec 1971.—G-1329, 25°50'N, 78°22'W, 236–265 m, 11 Dec 1971.

COLUMBUS ISELIN stations.—BAHAMAS: CI-27, 25°24.9'N, 78°05.4'W, 658–666 m, 7 July 1972.—CI-37, 25°09.3'N, 77°11.25'W, 512–540 m, 9 July 1972.—CI-60, 24°26.1'N, 77°29'W, 1,527–1,545 m, 28 Feb 1973.—CI-103, 24°06.2'N, 77°22'W, 1,423–1,450 m, 21 Sept 1973. STRAITS OF FLORIDA: CI-140, 26°27'N, 79°36.4'W, 732–738 m, 28 Sept 1973.

OREGON stations.—GUIANAS: O-4165, 7°57'N, 58°00'W, 59 m, 18 Feb 1963.—O-4166, 7°34'N, 57°26'W, 47 m, 18 Feb 1963.—O-4170, 6°23'N, 56° 05'W, 31 m, 19 Feb 1963. BRAZIL: O-4215, 0° 27'S, 47°09'W, 22 m, 8 March 1963.—O-4216, 0° 15'S, 46°45'W, 27 m, 8 March 1963.—O-4217, 0°14'S, 46°40'W, 27 m, 8 March 1963.—O-4221, 0°08'N, 45°33'W, 72 m, 8 March 1963.—O-4225, 0°18'N, 44°23'W, 183 m, 9 March 1963.—O-4226, 0°18'N, 44°17'W, 274 m, 9 March 1963.—O-4227, 01°24'S, 43°11'W, 73 m, 10 March 1963.—O-4229, 1°50'S, 43°06'W, 65 m, 10 March 1963.—O-4232, 2°00'S, 42°45'W, 50 m, 10 March 1963.