CHAPTER VIII

SPONGES, COELENTERATES, AND CTENOPHORES

THE PORIFERA OF THE GULF OF MEXICO[1]

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Sponges are one of the dominant sessile invertebrate groups in the Gulf of Mexico: they extend from the intertidal zone down to the deepest parts of the basin, and almost all of the firm or rocky sections of the bottom provide attachment for them.

Members of the class Hyalospongea (Hexactinellidea) are, almost without exception, limited to the deeper waters of the Gulf beyond the 100-fathom curve. These sponges possess siliceous spicules in which (typically) six rays radiate from a central point; frequently, the spicules are fused together forming a basket-like skeleton. Spongin is never present in this group.

In contrast to the Hyalospongea, representatives of the class Calcispongea are seldom, if ever, found in deep water. These sponges, unique in having spicules of calcareous material, are usually restricted to shallow water. They are not conspicuous; typically, they are encrusting forms or tubiform in shape but only a few centimeters in height.

The major sponge group in the Gulf of Mexico, both from number of genera and from the range of distribution, is the class Demospongea. Possessing more or less spongin, and when spicules are present having unfused spicules of siliceous material, these sponges occur throughout the Gulf extending from the shallow coastal waters down to the deepest off-shore sections of the basin.

The sponge bars or reefs of the eastern Gulf are quite typical of the habitat and ecology of the sponges in shallow to moderate depths. These so-called reefs are sections of rocky outcroppings that are elevated a few inches to a few feet above the general bottom profile. They are more or less densely covered with commercial and non-commercial sponges, coral (usually *Oculina*), and Alcyonaria. The other bottom-dwelling marine groups (such as mollusks, annelids, Crustacea, ascidians) are associated with the dominant groups. The floor of the Gulf between the bars is sparsely populated. The majority of the animals and plants are concentrated on the rocky ledges and outcroppings.

The most abundant sponges on these reefs are of several genera representing most of the orders of the class Demospongea. Several species of *Ircinia* are quite common as are *Verongia, Spheciospongia,* and several Axinellid and Ancorinid sponges; *Cliona* is very abundant, boring into molluscan shells, coral, and the rock itself. The sponge population is rich both in variety and in number of individuals; for this reason no attempt is made to discuss it in taxonomic detail in this résumé.

Some of the sponges of the Gulf are of world-wide distribution, i. e., *Dysidea fragilis*, while others are typically West Indian, and a few are probably restricted to the Gulf. The West Indian sponge fauna may be a single regional population with only minor locational differences. Water currents of the Caribbean, the Gulf, and the southern portion of the western Atlantic off Florida and the Bahama Islands have been shown to to carry a sponge disease from one point to many others in this region; it is therefore permissible to suggest that the same currents would be equally effective in distributing sponge larvae.

The commercial sponges of Florida, the Bahamas, Cuba, and British Honduras are all quite similar: the sheepswool sponge, *Hippiospongia lachne*, is the most valuable sponge now available for the market. Reef, glove, yellow, and grass sponges, all members of the genus *Spongia*, are of less value and are therefore less eagerly sought by the sponge fishermen.

Two methods, in general, are used in the West Indian region for the collection of commercial sponges. Hooking is practiced in waters of less than 7 or 8 fathoms throughout the entire zone, and light-weight, full diving rigs are used in the Gulf of Mexico in depths of less than 20 fathoms.

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In addition to these two major methods a few native islander fishermen skin-dive for sponges in shallow water, and a few Florida sponge fishermen have begun in the past few years to drag tines and other types of dredges in order to obtain more sponges with less work.

As a result of the constantly decreasing supply of natural sponges there have been repeated attempts in the past half century to establish sponge farms in the shallow coastal waters of Florida and the other Caribbean sponge producing areas. Practical as they now are from a biological point of view, these farms have always failed because of economic difficulties. It is now entirely possible, however, to produce artificially propagated sponges as a sound commercial venture.

In addition to the biological studies on the distribution and growth of the Gulf of Mexico porifera, there have been biochemical studies carried out on the lipids, the carbohydrates, and the general chemical constitution of several of the more common marine sponges of this region.

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BIOLOGY OF THE COMMERCIAL SPONGES[1]

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All commercial sponges of the Gulf of Mexico belong to the family Spongiidae. They are characterized by a lack of spicules and by the presence of a skeleton consisting of a network of anastomosing spongin fibers. The canal system is of the leucon type. Subdermal cavities which act as vestibules to either the incurrent or excurrent canal systems, or both, are present to a varying degree and are particularly noticeable in the velvet sponge, *Hippiospongia gossypina*.

The external form is roughly subspherical in the case of sheepswool sponge, *Hippiospongia lachne*, the yellow sponge, *Spongia zimocca* ss. *barbara*, hard head, *Spongia officinalis* ss. *dura*, and the velvet sponge. The grass sponge, *Spongia graminea*, may be in the form of an upright cylinder, somewhat wider and slightly concave in the upper surface. Large sponges of this type in the Gulf of Mexico waters, however, are usually cup-shaped. Other sponges sometimes found are the reef sponge, *Spongia officinalis* ss. *obliqua*. These are small sponges somewhat cylindrical in general shape but with lobes terminated by oscula on the upper surface. The glove sponge, assigned to *Spongia graminea*, is stoutly columnar with fluted sides. The shape and appearance varies considerably according to the environment. Detailed descriptions of the various forms are given by Moore (1910).

The outer surface is covered with a thin but tough skin which is usually dense black in color. Portions of the sponge buried in mud and the basal portions are more or less deficient in pigment. The flagellated chambers of all commercial sponges are small in size and are pyriform or subspherical in shape with a diameter of no more than 0.03 mm. The choanocytes are approximately 4 microns in cross section.

Spongin fiber has been analyzed by Block and Bolling (1939). It is composed of keratin, an inert product related to the collogens. Keratin contains iodine and the amino acids lysine, arginine, cystine, phenylalanine, and glycine. Very small amounts of histidine and tyrosine are also present.

Sexual reproduction takes place at all times of the year but most intensively during April, May, and June, and in November and December, according to observations made by the author in the Bahamas Islands. Eggs are found in sponges as small as 2 inches in diameter. They are imbedded in the tissues between the flagellated chambers and are about .0.25 cm. in diameter. In their early stages of development they are white but become a dark olive green as the embryo develops. Whereas eggs are easily visible to the naked eye when a sponge is sliced open, the spermatozoa are not recognizable except under the microscope. No information is available as to whether spermatozoa and eggs are produced by the same sponge at different times. Since they have not been observed in the same sponge at the same time, it is possible that commercial sponges are dioecious.

Toward the end of embryonic development the embryo develops a circle of cilia at the anterior, less strongly pigmented end. The larva then escapes into the excurrent canal system and thence to the exterior. Further development has not been observed in detail in commercial sponges.

There is little definite evidence as to the food of sponges. Ingestion of carmine particles by the choanocytes has been observed by Bidder (1896) and subsequent authors, in the non-commercial sponges. According to Bidder, the flagellated cells of *Sycon raphanus*, which are 5 microns in width, contain rod-shaped bodies similar to bacilli between 1 and 2 microns long. Pourbaix (1931) describes the transference of carmine grains from choanocytes to adjacent amoebocytes. Pourbaix (1931) also states that after feeding with carmine, granules of this appeared in the amoebocytes of the Tunisian commercial sponge.

[1] Contribution No. 109 from the Marine Laboratory, University of Miami.

It seems fairly certain that any solid food used by the sponge must be very small in size and that it is carried into the flagellated chambers by the internal water circulation. The large quantities of bacteria found in the calcareous muds of the Bahamas in the vicinity of commercial sponges suggests that these organisms may be an important constituent of the food of these sponges. It has been suggested, however, that sponges may also be able to absorb dissolved organic nutrients.

Very little is known about the physiology of commercial sponges. Bidder (1923), Parker (1914), and others have studied the water currents. These are set up by movements of the flagella of the choanocytes. These appear to operate independently of each other. The enormous number of flagellated chambers provides the energy whereby a considerable volume of water is pumped through the sponge. In noncommercial species, such as *Spinosella*, it has been shown that although the volume of water is great, the pressure does not amount to more than 5 mm. in height of water. The jet stream leaving the osculum may be detected at several inches distance and is sufficient so that on a calm day a distinct disturbance of the water surface may be seen above commercial sponges which are near to the surface. The oscula may be closed by muscular action when stimulated locally.

Bergmann (1949) and his associates have described in a series of papers the extraction of sterols from sponges. There is a considerable degree of specificity in the type of sterol found in various sponges, and this bears a close relation to taxonomic classification. Although the commercial sponges so far investigated have a high fat content, the sterol content of the unsaponifiable matter is lower than the average. The sterols of commercial sponges have not yet been analyzed in detail.

Commercial sponges are typically found associated with muddy bottom sediments, particularly where rocky outcrops or reefs provide a suitable substrate upon which the larva can settle without being destroyed by silt. They are sometimes found growing attached to dead corals or gorgonians and may occasionally grow upon living green algae, such as *Penicillus*. Under these conditions the alga may eventually become completely imbedded in the sponge except for the lower portion of its stalk.

Commercial sponges appear to flourish where there is a good flow of water but not under very exposed conditions. They are rarely found upon bottoms consisting entirely of rock or, of course, sediments. In the Gulf of Mexico they are found down to a depth of at least 150 feet and in water close to low tide mark. They are not tolerant to reduced salinity except for short periods. They appear to be more resistant to temperature changes, however.

A considerable number of other organisms are associated with sponges. The surface is frequently covered with encrusting Bryozoa and colonial tunicates. All species of the piling fauna normally found in the vicinity may be epizoic upon commerical sponges. The green alga, *Batophora oerstedi*, and species of *Acetabularia* also become attached to the sponge surface. The starfish, *Echinaster*, is sometimes observed upon sponges which have lesions of the outer skin, but it is not certain to what extent the damage is caused by this animal. Nudibranchs are sometimes found in small pits or irregularities of the surface, and it is possible that they may feed upon the sponge tissue. Larger holes may be inhabited by various species of small crabs. *Dromia* is often a permanent inhabitant of such places. The green alga, *Dictyosphaeria favulosa*, grows in convenient niches and may become almost enclosed by the subsequent growth of the sponge. A number of the smaller and commoner gastropods are also found inhabiting cavities of the sponge surface which may have been caused by local necrosis, the activities of carnivores or overgrowth of the sponge around sedentary organisms. The barnacle, *Balanus declivis*, which is more commonly found in noncommercial species of sponges, is occasionally seen imbedded in the surface of commercial types.

A considerable fauna inhabits the larger passages of the canal system. Pearse (1934) lists a large number of organisms inhabiting a reef sponge at Dry Tortugas. The most commonly found in all commercial sponges are the snapping shrimp, *Synalpheus brooksi*, and the polychaete worm, *Leodice spongicola*. Other species of polychaetes are also found, particularly syllids and occasionally *Amphitrite*.

Among other Crustacea occurring here are the pontonid shrimp, *Coralliocaris pearsei*, and numerous amphipods of the genera, *Leucothoe* and

Colomaestix. The stomatopod, *Gonodactylus oerstedi*, and small crabs may inhabit the larger passages.

Ophiuroids, particularly *Ophiactis savigny*, are found both in surface depressions and in the larger portions of the canal system. The anemone, *Aiptasia*, appears to form depressions in the surface of sponges into which it is able to retreat.

The most destructive organism is apparently a species of fungus which caused widespread and intensive mortality among the Gulf of Mexico and Caribbean sponges in 1939. Galtsoff (1940) tentatively identifies the organism as *Spongiophaga communis* which was first observed to be parasitic upon sponges by Carter (1878). Since it was not possible to culture the organism, it cannot definitely be assigned to any particular group of fungi. Further accounts of this sponge disease are also given by Walton Smith (1941) and by Osorio-Tafall (1945).

A number of observations have been made by Galtsoff, Wilson, and others, upon the ability of disassociated sponge cells to re-aggregate. This earlier work is also referred to by de Laubenfels (1934) in experiments upon the regeneration of *Iotrochota*.

The growth rate of sponges has been measured by Crawshay (1939) who measured the increase in size of small cuttings sliced from commercial sponges. He found that the velvet sponge grows at such a rate as to approximately double or treble its volume in the period of a year. Extensive unpublished series of measurements by the present author have shown that the growth expressed as a percentage of size diminishes with increasing size in the case of both sheepswool and velvet sponges. When these sponges reach approximately 12 inches in diameter the central portion of the upper surface begins to undergo local necrosis so that the larger sizes become somewhat doughnut-shaped. This is apparently due to the loss of efficiency in respiratory, excretory, and nutritive exchanges related to a diminution in the surface/volume ratio.

The increase in percentage growth rate with decreasing size makes it possible to cultivate sponges by cutting them into small pieces and by planting each piece upon a stone or cement base. Regeneration of the cut surfaces takes place rapidly, and the sponge quickly attaches itself to the stony surface. Other methods used in sponge cultivation are described by Smith (1949), Moore (1910b), Crawshay (1939), and Cahn (1948).

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HYDROIDS OF THE GULF OF MEXICO

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The life cycle of hydroids "typically" alternates between a sessile, asexually reproducing polyp or hydroid stage and a free-swimming sexual medusa stage. One generation or the other may be reduced, however, or even suppressed entirely. Because of this fact and because hydroids are obtained by shore collectors or by dredging, whereas medusae form part of the plankton and are studied by different zoologists, the taxonomy of the group is in an unhappy state.

Closely related types may differ in a respect that at first sight would appear fundamental: the polyp may produce free-living medusae, or the medusa may remain permanently attached to the polyp, even degenerating completely except for its sex products, which then appear to be the sex products of the polyp. This distinction, far from being of subordinal rank, may split a genus down the middle or, at most, may divide closely related genera from each other, according to one's view of what constitutes a generic character. That is, unless the structural characters of the hydroid are to be given no weight whatever, the mode of reproduction cannot provide the basis for erecting taxonomic categories higher than the genus.

Thus, the hydrozoan systematist faces a real dilemma, and he is not helped by the fact that many typically reproducing species have received different names as medusae and as polyps and must continue to bear them until proof of their identity is obtained. The writer is not a student of medusae, and in fact his knowledge of hydroids is largely confined to specimens preserved in alcohol. He is in no position to do anything about the fact that even the families are differently constituted in hydroid and medusa systematics, and the task of fusing the two systems awaits an abler zoologist. This chapter deals exclusively with hydroids.

The hydroid fauna of the Gulf of Mexico is little known, and the chief purpose of this account is to document this fact. A treatise on the Gulf of Mexico is a peculiarly appropriate setting for such a catalog of ignorance, for what we do not know about Gulf hydroids should be especially obvious against the massive backdrop of what we know about the biology of the Gulf.

COLLECTING

Hydroid collecting in the Gulf of Mexico has been chiefly undertaken in the Tortugas and the Florida Keys, but if we except the work of Mayer (1910) as dealing almost entirely with medusae, the only paper specifically discussing the Tortugas fauna is that of Wallace (1909). Gulf of Mexico records are scattered through many papers (Fraser 1943, 1945; Jäderholm 1896, 1903, 1920; Leloup 1935, 1937; Perkins 1908; Pourtalès 1869; Stechow 1912, 1919, 1923, 1926) and through the monographs of Nutting (1900, 1904, 1915), but systematic dredging in the region has not been undertaken since the days of the *Corwin* and the *Blake*. The collections of L. de Pourtalès on the former vessel were reported by Allman (1877), and those of A. Agassiz on the latter were published by Clarke (1879) and Fewkes (1881).

The monograph of Fraser (1944) recapitulates all the earlier records and adds many more, for Fraser examined the large collections in the U. S. National Museum and the Museum of Comparative Zoology whither most of the American hydroids collected in the nineteenth century eventually made their way. It is possible to extract from Fraser's book an essentially complete picture of the hydroid fauna of the Gulf as far as it is known. In fact, this procedure is the basis of the present account. Fraser's list has been expanded in only one noteworthy respect. The survey of fouling on navigation buoys, conducted by the Woods Hole Oceanographic Institution during World War II, yielded several hundred records of hydroids from the Bahamas, both coasts of Florida, and Texas. Most of these are still unpublished, but those that are new records from the Gulf proper are starred in the check list. The Texas records are of exceptional interest, however, as only three hydroids had previously been recorded from those waters; they were included in the writer's account of the hydroids of Louisiana and Texas (Deevey 1950), a zoogeographic discussion that was founded primarily on a small collection made by J. W. Hedgpeth.

ZOOGEOGRAPHY

The list of 183 species looks impressive, but it would be idle to pretend that the hydroids of the Gulf are well-known. Tropical regions generally have a wealth of species, but hydroid habitats are probably no more extensive in the tropics than elsewhere. The rarity of the rarest species is correspondingly greater, and it is unlikely that more than half the hydroids living in the Gulf have yet been found there. Partly because of inadequate collecting and partly because shallow water hydroids are always under suspicion as fouling organisms, little can be said about the meaning of their geographic distribution.

Of the total of 183 hydroid species known from the Gulf of Mexico, 95 are also found in the Caribbean and another 18, though not yet recorded from the Caribbean, are known from the eastern tropical Pacific. The remaining 70 species include some of the most interesting.

Some of the 70, of course, are known only from the Gulf, but while a few true endemics are to be expected it is too early to say which ones they are; at any rate, no common species is known to be endemic. The interesting members of the group of 70 are those whose main range is otherwise boreal. The boreal species among the hydroids of Texas and Louisiana have already been discussed (Deevey 1950). They include several, such as *Podocoryne carnea*, that are unknown in the warmer parts of the Gulf, and at least one, *Tubularia crocea*, whose ecology is well enough understood to indicate that it could not flourish in southern Florida. To the list of supposed relicts of a glacial age of the Pleistocene given in the earlier paper may be added the name of *Cladocarpus flexilis*, a moderately deep water species taken at three stations off Mobile but not otherwise known south of Cape May. In several other cases we have the familiar phenomenon of a shallow water boreal species occurring at considerable depths in the Gulf (and Caribbean): *Eudendrium tenellum*, *Lafoea dumosa*, *L. gracillima*.

Another way of looking at the facts is this: of 156 species known from the Caribbean, 61 are not known from the Gulf; 29 of them, at least, are common enough in the Caribbean to have been taken at more than one station. Hydroid statistics are scarcely necessary to prove the point, but it is obvious that the Gulf is not a strictly tropical body of water. Low winter temperatures and low and variable salinity, particularly along the northwestern shore, are only some of the factors that must be responsible for maintaining a different "fauna" in the Gulf of Mexico.

The 95 species that are common to the Gulf and the Caribbean present different problems. Most of them are definitely warm water types, although a high proportion belong to the tropical flotsam (especially sargassum) fauna and so may not be true residents of the Gulf. Seventy of the Gulf hydroids and 59 of the 156 Caribbean species are represented in the much larger list of 312 species recorded from the eastern tropical Pacific. The richness of the Pacific fauna, which is known almost exclusively from the Allan Hancock collection (Fraser 1948), is another indication that the Caribbean hydroids have been inadequately collected; it is surely correct to suppose that the 18 species common to the Gulf and the eastern tropical Pacific will appear in the Caribbean, along with many others. What is surprising is that nearly half of the tropical Atlantic hydroids cross the Isthmus of Panama without undergoing specific differentiation. If one cares for statistical statements, the "strength of the relationship" between the Gulf and Pacific faunas is nearly as great (38 percent) as is that between the Gulf and Caribbean faunas (52 percent).

The Isthmus of Panama is not very old, and many biogeographers have supposed that it is younger than most of the species of marine organisms (Schuchert 1935). The problem is related to that of Tethyan distributions; pan-tropical species (more usually genera) are supposed to have had their ranges established in the Tethys Sea, of Cretaceous and early Tertiary age, only to have them sundered by the rise of central Asia (see Ekman 1934, 1935, for review). If disjunct distributions in the Mediterranean and the

Indian western Pacific regions have had this origin, there is no reason to doubt that the Isthmus of Panama was crossed about the same time by the same species, or some of them. The species that are perhaps most likely to have spread so widely and to have crossed modern land barriers so freely are now truly pan-tropical species, but the evidence they provide, according to the conventional canons of biogeography, is ruled invalid by the possibility that they are spreading today. Unhappily, if one chooses to follow the rules and exclude the pan-tropical species, it can only be said that the remaining species prove nothing, at least as far as hydroids are concerned. The reason is not so much biogeographic as taxonomic.

The number of hydroids common to the two sides of Central America is large, but an even larger number is common to the two coasts of North America taken as a whole. According to Fraser's tabulation (1944), 123 species are known from east and west coasts of the Americas, and by no means all of these are circumpolar. Neither are the tropical species all pan-tropical. The "American" distribution pattern is far too common to be accidental, but its commonness raises doubts about the taxonomy. Fraser was a sound, careful worker with a "good eye" for specific differences. However, his experience, though enormous, was largely confined to the Americas. When one remembers that the hydroids of the East Indies are poorly known (only three families of the *Siboga* hydroids having been reported by Billard before his death), one cannot escape the suspicion that many species apparently endemic to the American tropics are still to be collected, or are already known under other names, from other parts of the world. Apart from this taxonomic difficulty, inadequate knowledge of the hydroids of the western Pacific and Indian Oceans imposes another limitation on the case for Tethyan paleogeography, for western Atlantic–western Pacific disjunctions have often been used (however unwisely) in building such a case, and we know of no certain examples among hydroids.

Until the hydroids of the world have been given much more study and some monographic revision, then, it is unsafe to use them for many zoogeographic purposes.

CHECK LIST OF GULF OF MEXICO HYDROIDS

Geographic distribution is indicated by the following symbols:

K, Florida Keys, including Cay Sal Bank and southern Florida as far east as Miami, but not the Bahamas.

T, Tortugas.

C, Cuba.

Y, Yucatán.

NW, northwestern Gulf (Texas, Louisiana).

NE, northeastern Gulf (including Tampa Bay).

Ca, Caribbean Sea.

EP, eastern tropical Pacific Ocean, south of United States-Mexico boundary, and including the oceanic islands.

*, starred names are new records for the Gulf of Mexico, found in the Woods Hole Oceanographic Institution fouling collection.

Suborder GYMNOBLASTEA (Anthomedusae), athecate hydroids

Cordylophora lacustris Allman, 1844. NW; Ca.
Turritopsis fascicularis Fraser, 1943. K.
**Turritopsis nutricula* McCrady, 1856. K; Ca, EP.
Syncoryne eximia [1] (Allman, 1859). NW.
Syncoryne mirabilis L. (Agassiz), 1862. K; EP.
Zanclea costata Gegenbaur, 1856. T, NW; Ca, EP.
Zanclea gemmosa McCrady, 1858. T; EP.
Bimeria franciscana Torrey, 1902. NW; B.
Bimeria humilis Allman, 1877. T, NW; Ca.
Bougainvillia carolinensis (McCrady, 1858). T, NW.
Bougainvillia inaequalis Fraser, 1944. NW.
Bougainvillia rugosa Clarke, 1882. NW; Ca.
Eudendrium album Nutting, 1898. K; EP.
Eudendrium attenuatum Allman 1877. T; EP.
Eudendrium carneum Clarke, 1882. T; Ca, EP.
Eudendrium distichum Clarke, 1879. K.
Eudendrium exiguum Allman, 1877. K; Ca, EP.
Eudendrium eximium Allman, 1877. K, NE; EP.
Eudendrium fruticosum Allman, 1877. K.
Eudendrium gracile Allman, 1877. K.
Eudendrium hargitti Congdon, 1906. T.
Eudendrium laxum Allman, 1877. K; Ca.
Eudendrium speciosum Fraser, 1945. NE.
Eudendrium tenellum Allman, 1877. K; Ca, EP.
Eudendrium tenue A. Agassiz, 1865. NW?; Ca, EP.
Hydractinia echinata Fleming, 1828. K, NW.
Podocoryne carnea Sars, 1846. NW.
Pennaria tiarella (Ayres, 1854). K, T, C; Ca, EP.

[1] N. J. Berrill, in a letter to the author, has given good reasons for suspecting that the species reported under this name from Texas and from western Florida (Deevey 1950), is an undescribed species.

Ectopleura grandis Fraser, 1944. K, NW.
Tubularia crocea (L. Agassiz, 1862). NW; EP.
Cladonema mayeri Perkins, 1906. T.

Suborder CALYPTOBLASTEA (Leptomedusae), thecate hydroids

Family CAMPANULARIDAE

Campanularia amphora (L. Agassiz, 1862). T?
Campanularia (?) *brevicaulis* Nutting, 1915. Y.
Campanularia flexuosa (Hincks, 1861). T?
**Campanularia* (?) *hummelincki* (Leloup, 1935). K; Ca.
Campanularia (?) *macroscypha* Allman, 1877. K, T, Y.
Campanularia marginata (Allman, 1877). K, T, C; Ca.
Clytia coronata (Clarke, 1879). K, NW; Ca, EP.
Clytia cylindrica L. Agassiz, 1862. K, NW; Ca, EP.
Clytia fragilis Congdon, 1907. T, NW; Ca.
Clytia johnstoni (Alder, 1856). K, T; EP.
Clytia longicyatha (Allman, 1877). K, T, NW; Ca, EP.
Clytia macrotheca (Perkins, 1908). K, T; Ca.
Clytia minuta (Nutting, 1901). T?
Clytia noliformis (McCrady, 1858). T, NW; Ca, EP.
**Clytia raridentata* (Alder, 1862). K; Ca, EP.
Gonothyraea gracilis (Sars, 1851). K, NW; Ca, EP.
Obelia bicuspidata Clark, 1876. K, NW, NE; Ca.
Obelia commissuralis McCrady, 1858. T?; EP.
Obelia dichotoma (Linnaeus, 1758). K, T, C, NW, NE; EP.
Obelia equilateralis Fraser, 1938. NW; Ca, EP.
Obelia geniculata (Linnaeus, 1758). NW; Ca, EP.
Obelia hyalina Clarke, 1879. K, C; Ca, EP.
Obelia obtusidens (Jäderholm, 1904). NW; EP.

Family CAMPANULINIDAE

**Cuspidella costata* Hincks, 1868. K.
Cuspidella humilis (Alder, 1862). NW; EP.
Eucuspidella pedunculata (Allman, 1877). T.
**Lafoeina tenuis* Sars, 1873. K, NE.
Oplorhiza parvula Allman, 1877. K.
Stegopoma fastigiata (Alder, 1860). T.
Thyroscyphus ramosus Allman, 1877. K, T; Ca.

Family HALECIDAE

Halecium bermudense Congdon, 1907. K, T, NE; Ca, EP.
Halecium dyssymetrum [2] Billard, 1929. K, T.
Halecium filicula Allman, 1877. K.
Halecium gracile Verrill, 1874. K; EP.
Halecium macrocephalum Allman, 1877. K, T; EP.
Halecium nanum Alder, 1859. K, T, NW; Ca, EP.
Halecium tenellum Hincks, 1861. T, NE; Ca, EP.

Family HEBELLIDAE

Hebella calcarata (A. Agassiz, 1865). NE; Ca, EP.
Scandia mutabilis (Ritchie, 1907). T; Ca, EP.

[2] Preliminary study of this species in the Woods Hole Oceanographic Institution fouling collection indicates that it is probably the *H. dyssymetrum* of Leloup (1935) but not of Billard, and that it needs a new name.

Family LAFOEIDAE

Acryptolaria abies (Allman, 1877). K; Ca.
Acryptolaria conferta (Allman, 1877). T, C; Ca, EP.
Acryptolaria elegans (Allman, 1877). K, T; Ca.
Acryptolaria longitheca (Allman, 1877). K, T; Ca.
Acryptolaria pulchella (Allman, 1888). K; EP.
Eucryptolaria pinnata Fraser, 1938. C; Ca, EP.
Filellum serpens (Hassall, 1852). T, NW; Ca, EP.
Filellum serratum (Clarke, 1879). C; Ca.
Lafoea coalescens Allman, 1877. K.
Lafoea dumosa (Fleming, 1828). T; Ca, EP.
Lafoea gracillima (Alder, 1857). T; Ca, EP.
Lafoea tenellula Allman, 1877. K; Ca.
Lafoea venusta Allman, 1877. K, T, C; Ca.
Lictorella convallaria (Allman), 1877. K, T, C; Ca, EP.
Zygophylax rigida (Fraser, 1940). Y.

Family SYNTHECIDAE

Synthecium ? gracile Fraser, 1937. T; Ca, EP.
Synthecium ? marginatum (Allman, 1877). K; Ca.
Synthecium ? nanum Fraser, 1943. T; Ca.
Synthecium ? rectum Nutting, 1904. C.
Synthecium tubithecum (Allman), 1877. K, T, C; Ca.

Family SERTULARIDAE

Diphasia digitalis (Busk, 1852). K, T, C; Ca.
Pasya quadridentata (Ellis and Solander, 1786). T, NW; Ca, EP.
Sertularella amphorifera Allman, 1877. K, T, C, Y; Ca, EP.
Sertularella areyi Nutting, 1904. C.
Sertularella conica Allman, 1877. K, T, NW, NE; Ca, EP.
Sertularella distans (Allman, 1877). T, C, Y; Ca.
Sertularella formosa Fewkes, 1881. C; Ca, EP.
Sertularella gayi (Lamouroux, 1821). K, C, Y, NW; Ca.
Sertularella humilis Fraser, 1943. K.
Sertularella megastoma Nutting, 1904. Y; Ca.
Sertularella pinnigera Hartlaub, 1900. K; Ca.
Sertularella quadrata Nutting, 1904. C; Ca.
Sertularella sieboldi Kirchenpauer, 1884. C.
Sertularella speciosa Congdon, 1907. K; Ca.
Sertularella tenella (Alder, 1856). C; Ca, EP.
Sertularia cornicina (McCrady, 1858). K?, Y; Ca, EP.
Sertularia dalmasi (Versluys, 1899). T, NW, NE; Ca, EP.
Sertularia exigua Allman, 1877. K; Ca, EP.
Sertularia flowersi Nutting, 1904. C.
Sertularia inflata (Versluys, 1899). K, T, NW, NE; Ca, EP.
Sertularia mayeri Nutting, 1904. K, T; Ca, EP.
Sertularia pourtalesi Nutting, 1904. K, T; Ca, EP.
Sertularia stookeyi Nutting, 1904. K; EP.
Sertularia tumida Allman, 1877. T.
Sertularia turbinata (Lamouroux, 1816). K, T; Ca.
Thuiaria crisioides (Lamouroux, 1824). K; Ca, EP.
Thuiaria tropica (Stechow, 1926). T.
Idiella pristis (Lamouroux, 1816). K, T; Ca.

Family PLUMULARIDAE

Aglaophenia allmani Nutting, 1900. K, T; Ca.
Aglaophenia aperta Nutting, 1900. C, NE.
Aglaophenia bicornuta Nutting, 1900. C.
Aglaophenia ? constricta Allman, 1877. K.
Aglaophenia cristifrons Nutting, 1900. C, NW.
? *Aglaophenia dichotoma* Kirchenpauer, 1872. NE.
Aglaophenia dubia Nutting, 1900. K, T, C; Ca, EP.
Aglaophenia elongata Meneghini, 1845. NE.
Aglaophenia flowersi Nutting, 1900. K; Ca.
Aglaophenia late-carinata Allman, 1877. K, T, NW; Ca.
Aglaophenia longiramosa Fraser, 1945. NE.
Aglaophenia lophocarpa Allman, 1877. K, T, C, NE; Ca, EP.
Aglaophenia ? mercatoris Leloup, 1937. NE.
Aglaophenia perpusilla Allman, 1877. K, T, NW; Ca.
Aglaophenia raridentata Fraser, 1944. K.
Aglaophenia rhynchocarpa Allman, 1877. K, T, C; Ca.
Aglaophenia rigida Allman, 1877. K, NW; Ca, EP.
Aglaophenia tridentata Versluys, 1899. K, T; Ca.
Aglaophenoides mammillata (Nutting, 1900). T.
Aglaophenopsis hirsuta Fewkes, 1881. K.
Antennella gracilis Allman, 1877. K, C; Ca, EP.
Antennella quadriaurita Ritchie, 1909. K, C.
Antennella secundaria (Gmelin, 1788). T; Ca.
Antennopsis distans Nutting, 1900. C.
Antennopsis hippuris Allman, 1877. K.
Antennopsis longicorna Nutting, 1900. C.
Antennopsis nigra Nutting, 1900. C.
Antennularia simplex Allman, 1877. K, C.
Cladocarpus carinatus Nutting, 1900. T.
Cladocarpus dolichotheca Allman, 1877. K, T.
Cladocarpus flexilis Verrill, 1885. NE.
Cladocarpus flexuosus Nutting, 1900. NE.
Cladocarpus longipinna Fraser, 1945. NE.
Cladocarpus obliquus Nutting, 1900. C.
Cladocarpus paradisea Allman, 1877. K.
Cladocarpus sigma (Allman, 1877). K, C.
Cladocarpus tenuis Clarke, 1879. T; Ca.
Cladocarpus ventricosus Allman, 1877. K.
Diplopteron longipinna Nutting, 1900. K.
Diplopteron quadricorne Nutting, 1900. C; Ca.
Halicornaria sinuosa Fraser, 1925. K, NE.
Halicornaria speciosa Allman, 1877. K; Ca.
Halopteris carinata Allman, 1877. K, T; Ca.
Lytocarpus clarkei Nutting, 1900. C, Y; Ca.
Lytocarpus grandis (Clarke, 1879). K; Ca.
Lytocarpus philippinus (Kirchenpauer, 1872). K, T; Ca, EP.
Monostaechas quadridens (McCrady, 1858). K, T, Y; NW, NE; Ca, EP.
Plumularia attenuata Allman, 1877. K; Ca, EP.
Plumularia clarkei Nutting, 1900. C.
Plumularia diaphana (Heller, 1868). K, T, NW; Ca, EP.
Plumularia filicula Allman, 1877. K; EP.
Plumularia floridana Nutting, 1900. K, T, NW; EP.
Plumularia geminata Allman, 1877. K; Ca.
Plumularia inermis Nutting, 1900. T; Ca, EP.
Plumularia macrotheca Allman, 1877. C.
Plumularia margaretta (Nutting, 1900). K, T; Ca, EP.
Plumularia megalocephala Allman, 1877. K, C; Ca, EP.
Plumularia paucinoda Nutting, 1900. C.
Plumularia setacea (Ellis, 1755). K, T, NW, NE; EP.
Plumularia setaceoides Bale, 1882. K, Ca.
Plumularia strictocarpa Pictet, 1893. K; Ca.
Schizotricha dichotoma Nutting, 1900. K.
Schizotricha tenella (Verrill, 1874). NW?; Ca, EP.
Thecocarpus bispinosus (Allman, 1877). K.
Thecocarpus distans (Allman, 1877). K, T.

SUMMARY

A total of 183 species of hydroids, 31 athecate and 152 thecate, are known from the Gulf of Mexico, mostly from the Tortugas and the Florida Keys. Medusae are not considered. The Gulf and the Caribbean have 95 species in common, but 61 Caribbean species are unknown in the Gulf. Seventy Gulf species also occur in the eastern tropical Pacific, including 18 not yet known from the Caribbean. Taxonomic difficulties, as well as inadequate collecting, make hydroid geography an unsatisfactory subject, and it is uncertain how far the apparently common "American" distribution pattern should be taken seriously. What is especially interesting is the occurrence in the Gulf of a significant number of boreal species, some of them seemingly disjunct in the northwestern Gulf.

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HYDROMEDUSAE OF THE GULF OF MEXICO

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So few plankton collections have been made in the Gulf of Mexico and so few of these have been studied by hydromedusae specialists that it is necessary to rely almost entirely on Mayer's (1900, 1904, 1910) reports from the Tortugas. It is to be noted that most names listed in Mayer's first (1900) paper were reduced to the synonomy of other species in his monograph of 1910. Subsequent writers, expecially Bigelow (1913, 1918, 1919, 1938, 1940), Kramp (1919, 1920, 1926, 1930, 1932, 1933, 1939, 1942, 1947, 1948), and Ranson (1936) have also made certain revisions resulting in a slight reduction in the number of species originally enumerated by Mayer in his monograph (1910).

In comparing the resulting list with that in the section on the hydroids it is striking to note that few species (i. e., *Turritopsis nutricula* McCrady, *Zanclea costata* Gegenbaur, *Bougainvillia carolinensis* McCrady, *Pennaria tiarella* McCrady, and *Cladonema mayeri* Perkins among the Anthomedusae) appear on both lists. In large part this is due to the fact that many hydroids do not liberate free-swimming medusae, and that many medusae have very much reduced hydroid stages. Indeed, in many instances the hydroid stage is completely unknown, if it exists.

Insofar as it has been possible to determine only about 70 species have been recorded (30 Anthomedusae, 34 Leptomedusae, 5 Trachymedusae, and 3 Narcomedusae) from the Gulf of Mexico region. Some of these, not already mentioned above, are good species also known elsewhere:

Corymorpha nutans Hartlaub; *Hybocodon forbesii* Mayer; *Sarsia mirabilis* L. Agassiz; *Ectopleura minerva* Mayer; *Dipurena ophiogaster* Haeckel; *Zancleopsis dichotoma* Mayer; *Amphinema dinema* Péron et LeSueur; *A. octaedra* Haeckel; *A. rugosa* Mayer; *A. turrida* Mayer; *Merga violacea* Agassiz and Mayer; *Podocoryne minuta* Trinci; *Lymnorea alexandri* Mayer; *Bougainvillia niobe* Mayer; *Köllikerina elegans* Mayer; *Proboscidactyla ornata* McCrady, among the Anthomedusae; *Laodicea cruiciata* Forskål; *Phalidium discoida* Mayer; *Phialucium carolinae* Mayer; *Eucheilota ventricularis* McCrady; *E. duodecimalis* A. Agassiz; *Eutima mira* McCrady; *E. elephas* Haeckel; *Eutimalphes coerulea* L. Agassiz; *Phortis pyramidalis* L. Agassiz; *P. lactea* Mayer; *Aequorea floridana* Mayer, among the Leptomedusae; *Geryonia proboscidalis* Forskål; *Liriope tetraphylla* Chamisso and Eysenhardt; *Olindias phosphorica tenuis* Fewkes; *Rhopalonema velatum* Gegenbaur, among the Trachymedusae; and *Aeginura grimaldii* Maas; *Cunoctantha octonaria* McCrady; *Solmundella bitentaculata* Quoy and Gaimard (using the names which appear to conform with present usage).

A goodly number of species, however, do not appear to have been subject to critical review in recent years, so that it is uncertain whether they are good species or merely synonyms of others. Hence, they are not listed at this time.

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SIPHONOPHORES IN THE GULF OF MEXICO

By MARY SEARS, *Woods Hole Oceanographic Institution*

The siphonophores most often recorded from the Gulf of Mexico are the two large conspicuous species with floats above the surface of the water, *Physalia physalis* L. and *Velella velella* L. Possibly *Porpita umbella* O. F. Muller [1] should also be included with these (Whitten, Rosene, and Hedgpeth, 1950). As early as 1886, Fewkes wrote, "I have many new localities for this medusa [i. e., *Velella*] in the Gulf of Mexico." The *Atlantis* in the winter of 1951 sailed through swarms of *Physalia* together with large quantities of *Velella* some miles in extent (Stetson, personal communication) out in the Gulf off the northwest coast of Florida, and newspapers give frequent account of the contamination of west Florida bathing beaches.

The smaller, more common species, however, have scarcely been noted in the Gulf except at a few localities around its periphery, chiefly at the Tortugas (Mayer 1900) and in adjacent bodies of water such as the Straits of Florida (Bigelow 1918), the Caribbean (Fewkes 1889), and the Gulf Stream proper (Bigelow 1918; Fewkes, 1882, 1886, 1889). These records are indicative that about 25 of the better known species in all probability occur in the Gulf of Mexico proper:

Abyla carina Haeckel; *Abylopsis tetragona* Otto; *A. eschscholtzii* Huxley; *Agalma okeni* Eschscholtz; *Amphicaryon acaule* Chun; *Bassia bassensis* Quoy and Gaimard; *Ceratocymba sagittata* Quoy and Gaimard; *Chelophyes appendiculata* Eschscholtz; *Diphyes bojani* Chun; *Diphyes dispar* Chamisso and Eysenhardt; *Enneagonum hyalinum* Quoy and Gaimard; *Eudoxoides spiralis* Bigelow; *Galetta australis* Quoy and Gaimard; *Hippopodius hippopus* Forskål; *Lensia fowleri* Bigelow; *Rhizophysa eysenhardti* Gegenbaur; *Rhizophysa filiformis* Forskål; *Sphaeronectes truncata* Will; *Stephanomia rubra* Vogt; *Sulculeolaria monoica* Chun; *Sulculeolaria quadridentata* Quoy and Gaimard; *Vogtia glabra* Bigelow; *Vogtia pentacantha* Kölliker (as they are now named).[2]

In the Gulf of Mexico, one might expect to find possibly 50 other species of Calycophorae, which have been taken in the tropical Atlantic and perhaps as many more among the Physophorae, Rhizophysaliae, and Chondrophorae combined. Most of these species have been taken at one time or another in the tropical Atlantic and might be expected to be carried by the currents into the Gulf of Mexico. The depth of the sill at the entrances to the Caribbean and Gulf of Mexico is sufficiently great to permit entry of even the species that live at considerable depths, a factor which, for example, apparently prevents some siphonophore species from entering the Mediterranean (Bigelow and Sears 1937).

In short, it would not be surprising to find any one of the 140 or more siphonophore species, now known, in the Gulf of Mexico.

[1] See Bigelow and Sears (1937) for use of this name.

[2] References which are especially helpful and readily accessible in establishing the accepted names are: Bigelow, 1911a, 1911b, 1913, 1918, 1919, 1931; Bigelow and Sears, 1937; Sears, in press; Totton, 1932, 1941, in press.

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SCYPHOZOA

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With the exception of Mayer's studies at Tortugas nearly 50 years ago there has been no serious attempt to study the medusae of the Gulf of Mexico. While there are a few scattered records of medusae along the coast, little is available on the occurrence of jellyfish in the pelagic regions of the Gulf or of the deep-water forms.

There are a few large medusae which characteristically occur in the neritic waters of the Gulf of Mexico from Florida to the Rio Grande. Foremost of these is *Stomolophus meleagris*, the cabbagehead. This rhizostome often occurs in vast numbers in lower bays and around passes at the end of the summer. Such swarms were observed at Port Aransas, Texas, on August 4–5, 1947, and September 20, 1948. The latter swarm was estimated to be drifting through the channel on an incoming tide at the rate of 2 million an hour. The bobbing white domes of these jellyfish seemed to be packed almost solidly across the 800-yard width of the channel. Occasionally, *Stomolophus* is caught by the ton in shrimp trawls, and there has been some speculation about a possible economic use for these animals. Mayer mentions several oriental species which are pickled, but such a specialty delicatessen use would hardly cut into the unwanted surplus. With the possible exception of a few hypersensitive individuals, *Stomolophus* is not a dangerous species to bathers and may be handled with impunity. It is a fine animal for physiological experimentation.

Another rhizostome, *Rhopilema verrilli*, may be more common than suspected. Specimens have been taken from Mobile Bay, and one was collected at Port Aransas. This is a much larger medusa than *Stomolophus*, and Mayer suggested that it is a southern form which occasionally extends as far north as Long Island. Burkenroad (personal communication) considers it common in Chandeleur Sound.

One of the most common jellyfish in the bays, especially during the summer months, is *Dactylometra quinquecirrha*, a semaeostome medusa. This medusa may cause a mild rash or unpleasant sting,[1] but severe cases of jellyfish poisoning by this species are rarely reported (Hedgpeth 1945).

An occasional denizen of bay waters is the moon jelly, *Aurellia aurita*. While it is usually more a frequenter of the lower bays and gulf waters, it at times outnumbers *Dactylometra* in the bays.

Another large Medusa in Gulf waters is the lion's mane, *Cyanaea capillata* var. *versicolor*. Mayer gives the southern limit of this variety as Cape Canaveral, Florida, and did not find it at Tortugas. R. O. Christenson, of Alabama Polytechnic Institute, identified this medusa from Mobile Bay, on February 20, 1938. A large, reddish, striped medusa was observed on an outgoing tide at Port Aransas, Texas, on March 16, 1948, which appeared to be this species. It is of interest to note that both these records are toward the end of the Gulf coast winter. Burkenroad (personal communication) considers it common in Louisiana waters.

According to Mayer, some 75 species of medusae occur at Tortugas. Nine of these are scyphozoans, and the great majority are hydromedusae, more properly considered under hydroids (p. 267). There are probably more species to be found in the Gulf. Following is a list of the Scyphomedusae known to occur in the Gulf of Mexico, principally at Tortugas. This list includes the 9 species discussed by Mayer and the 2 species whose occurrence in the Gulf was not known to him:[2]

Carybdaea aurifera Mayer, pp. 510, fig. 328.
A rare form taken only twice at Tortugas.

[1] The Portuguese Man-of-War, *Physalia*, is more dangerous and probably causes some distress to unwary bathers every season. This siphonophore is often washed up on the outer beaches in great numbers, and its stranded pneumatophores are heard popping under the wheels by motorists driving on the beach. Two smaller siphonophores, *Porpita linneana* and *Velella velleta*, are often stranded on the beach.

[2] All page and figure numbers given after the name of the species refer to Mayer's publication, 1910.

Nausithoë punctata Kölliker, pp. 554–556, pl. 60, figs. 4–5, text fig. 352.[1]

This medusae is noteworthy for the peculiar, branched scyphistoma which lives commensally in sponges. Found in all tropical and warm seas.

Linuche unguiculata Eschscholtz, pp. 558–559, pl. 59, figs. 1–10.

A West Indian species. Forms vast swarms in spring in the Florida-Bahama region according to Mayer.

Dactylometra quinquecirrha L. Agassiz, pp. 585–588, pls. 62–64a, text figs. 370–372.

Widely distributed from New England to the tropics; possibly also Pacific. Abundant in Tampa Bay in August (p. 586).

Cyanaea capillata var. *versicolor* L. Agassiz, pp. 600–601, pl. 65, figs. 1–2.

Western Atlantic and Gulf, south of Cape Hatteras.

Aurellia aurita Lamarck, pp. 623–626, pl. 67, figs. 1–4, fig. 4; 68.

In east American waters, common from Greenland to West Indies. World wide.

[1] See footnote 2, page 277.

Cassiopea xamachana R. P. Bigelow, pp. 641–646, pls. 69–72. *C. frondosa* Lamarck. Pp. 647–648, pl. 69 and 72.

These interesting medusae are the subject of several papers in the Tortugas Laboratory series. The first is known from Tortugas and Jamaica; the second is more widely distributed throughout the West Indies.

Rhopilema verrillii (Fewkes), pp. 707–709, pl. 7, fig. 1, text fig. 424.

From New Haven to Port Aransas, but not (?) Tortugas.

Stomolophus meleagris L. Agassiz, pp. 710–711, pls. 75–76.

Abundant along southern Atlantic and Gulf of Mexico (not north of Chesapeake Bay), and West Indies. Also on Pacific side of Isthmus, and north at least to San Diego.

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ANTHOZOA: ALCYONARIA [1]

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The Alcyonaria of the Gulf of Mexico [2] are little known. No systematic work treats them in detail, and the preparation of such an account must await more extensive collections from the entire region. Even papers mentioning occasional Gulf species are few and, with perhaps two or three exceptions, deal only with those found in the extreme southeastern part (i. e., the Straits of Florida, the Florida Keys, and Dry Tortugas). Notable among these is the series of reports by Bielschowsky (1929), Kükenthal (1916), Kunze (1916), Riess (1929), and Toeplitz (1929), published under the general title, Die Gorgonarien Westindiens in the supplement volumes 11 and 16 of the Zoologische Jahrbucher. Professor A. E. Verrill (1864, 1869, 1883) early recorded the presence, mostly in the lower Gulf, of a few alcyonarians; and some later work by Stiasny, especially the two *Siboga* supplements (1935, 1937), adds to the list of species known from the Tortugas area.

Explorations in the Gulf of Mexico have not been extensive, and collections are correspondingly inadequate. The exploratory vessels, *Albatross, Fish Hawk, Pelican, Blake, Bibb,* and *Bache* have all made dredge hauls in the Gulf, but the records of only the last three have been published, these in the classic monograph on the alcyonarians of the western Atlantic by Dr. Elisabeth Deichmann (1936). Exploratory trawling is currently being carried on by the U. S. Fish and Wildlife Service M/V *Oregon*, but very few alcyonarians have so far been seen.

Present knowledge of the alcyonarians of the Gulf of Mexico is summarized in the accompanying table (table 1), which also indicates the distribution outside of the Gulf of the species concerned.

Table 1.—*Geographical distribution of alcyonarians known from the Gulf of Mexico*

A. Arctic to Cape Cod.
B. C. Cod to C. Hatteras.
C. C. Hatteras to C. Canaveral.
D. Bermuda.
E. C. Carnaveral to Sombrero Key.
a. Low water to 10 fathoms.
b. 10–99 fathoms.
1. Bayer 1949.
2. Bayer 1952.
3. Bielschowsky 1929.
4. Cary 1906.
5. Cary 1918.
6. Deichmann 1936.
7. Gordon 1925.
8. Heilprin 1890.
9. Kükenthal 1916.
F. Sombrero Key to Tortugas Bank; Straits of Florida; N. W. coast of Cuba.
G. C. Sable to Apalachee Bay.
H. Apalachee Bay to Galveston.
c. 100–499 fathoms.
d. 500–999 fathoms.
10. Kükenthal 1919.
11. Kükenthal 1924.
12. Kunze 1916.
13. Moser 1921.
14. de Pourtalès 1868.
15. Riess 1929.
16. Stiasny 1935.
17. Stiasny 1937.
18. Stiasny 1941a.
19. Stiasny 1941b.
I. Galveston to Veracruz.
J. Vera Cruz to C. Catoche.
K. Central Gulf Basin.
L. West Indies.
M. Caribbean Sea.
N. Brazil.
e. 1000 fathoms and deeper.
x. No depth given.
20. Stiasny 1941c.
21. Stiasny 1941d.
22. Thomson 1927.
23. Toeplitz 1929.
24. Verrill 1864.
25. Verrill 1869.
26. Verrill 1883.
27. Verrill 1907.

Species	Arctic to Sombrero Key					Gulf of Mexico						West Indies to Brazil		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Order TELESTACEA														
TELESTIDAE														
Telesto flavula, 2, 6						b		b						
Telesto sanguinea, 2, 6					b	b		b						
Order ALCYONACEA														
ALCYONIIDAE														
Nidalia occidentalis, 2, 6			b		b	b						b		
NEPHTHYIDAE														
Eunephthya nigra, 2, 6, 14			c		b	c								
Neospongodes agassizii, 6						c						b, c		
Neospongodes portoricensis, 2, 6						c						b, c		

[1] Published with the permission of the Secretary of the Smithsonian Institution.

[2] For the purposes of this summary, the geographical boundaries of the Gulf of Mexico will be taken to include, in addition to the usual land masses, a line drawn from Cape Sable, Fla., due south to the coast of Cuba, and another from Cape San Antonio, Cuba, to Cape Catoche, Yucatán. This delimitation is purely arbitrary and does not coincide with faunistic boundaries.

TABLE 1.—*Geographical distribution of alcyonarians known from the Gulf of Mexico*—Continued

Species	Arctic to Sombrero Key					Gulf of Mexico						West Indies to Brazil		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
ORDER GORGONACEA														
SUBORDER SCLERAXONIA														
BRIAREIDAE														
Briareum asbestinum, 5, 6					b	a						a	a	
Diodogorgia ceratosa, 11							"Gulf of Mexico"							
Diodogorgia nodulifera, 2, 6					b	b						b		
Iciligorgia schrammi, 2, 6, 18					b	b						b		
Solenopodium polyanthes, 6, 17						a						a		
Titanideum suberosum, 6			b			b								
SUBORDER HOLAXONIA														
ACANTHOGORGIIDAE														
Acanthogorgia aspera, 2, 6, 26			d			c						b, c		
MURICEIDAE														
Bebryce cinerea, 2, 6						c						b, c		
Bebryce grandis, 2, 6						c		b				b, c	c	
Echinomuricea atlantica, 6						b						b, c		
Muricea laxa, 2, 6					a	b	a, b						c	
Muricea muricata, 6, 11, 15, 27				x	x	a						a		
Muricea pendula, 2, 6, 24			a				b	b						
Muricea spicifera, 6, 7						a						a	a	
Placogorgia mirabilis, 2, 6						c							b	
Placogorgia tenuis, 6, 26						c						b, c		
Scleracis guadalupensis, 2, 6, 15						b		b				b, c		
Scleracis petrosa, 6						c						d		
Swiftia casta, 2, 6, 14, 26			c			c		b						
Swiftia exserta, 2, 6					b			b				b	b	
Swiftia koreni, 2, 6					c	d						c		
Thesea citrina, 6						b								
Thesea grandiflora, 6						b						b		
Thesea plana, 2, 6						b		b	b					
Thesea solitaria, 6, 14					c	c								
Trachymuricea hirta, 6, 11						c						b		
Villogorgia nigrescens, 6						b, c						b, c	c	
PLEXAURIDAE														
Eunicea asperula, 12						a						a	x	
Eunicea calyculata, 12						a						a		
Eunicea lugubris, 16				a		a						a		
Eunicea mammosa, 11, 12, 16						a						a	a	
Eunicea multicauda gordoni, 16						a							a	
Eunicea succinea, 2, 12, 16				a		a	a					a	a	
Eunicea tournefortі, 7, 12, 16, 27				a		a						a	a	
Plexaura dubia, 2, 11				a			a					a		
Plexaura edwardsi, 11, 16				a		a						a		
Plexaura flexuosa, 6, 8, 16, 20, 27				a		a				a		a	a	
Plexaura hartmeyeri, 13						a								
Plexaura porosa, 2, 7, 11							a					a	a	
Plexaurella dichotoma, 11, 12, 16, 27				a		a						x		x
Plexaurella dubrovskyi, 16						a								
Plexaurella heteropora, 12, 16						a						x		
Plexaurella kunzei, 2, 11							a					a		
Plexaurella minuta, 11									"Mexico"					
GORGONIIDAE														
Antillogorgia acerosa, 2, 10, 27				x	a	a	a			b		a	a	
A. acerosa elastica, 3, 21						a							x	
Antillogorgia bipinnata, 3, 6, 24						a						b	a	a
Antillogorgia americana, 2, 6, 27				a		a	a					a		
Gorgonia flabellum, 5, 6, 7, 24, 27				a		a			?			a, b	a	
Eugorgia euryale, 2								b						
Eugorgia medusa, 2								b						
Eugorgia stheno, 2					b			b						
Eugorgia virgulata, 2, 4, 6, 20		a	a				a	a	b					
Leptogorgia hebes, 2, 6, 25			a			a	a		a					
Leptogorgia miniata, 2, 6					b	b	b						a	
Leptogorgia setacea, 6, 20			a						a			a		
Pterogorgia anceps, 2, 5, 8, 11, 24					a	a	a			a		a		
Pterogorgia citrina, 5, 11, 27				a	a, b	a						a		
Pterogorgia guadalupensis, 2						a						a		
GORGONELLIDAE														
Nicella guadalupensis, 6						c						b, c	c	
Scirpearia barbadensis, 6						c						b, c		
Scirpearia funiculina, 2, 6						b		b				b, c	b	
Scirpearia grandis, 6, 23, 27				b		b								
CHRYSOGORGIIDAE														
Chalcogorgia pellucida, 1						c								
Chrysogorgia desbonni, 6, 26						c						b, c		
Chrysogorgia elegans, 2, 6, 26						d		c	c			c, d		
Chrysogorgia elissabethae, 2						x						c		
Trichogorgia viola, 6						b								

TABLE 1.—*Geographical distribution of alcyonarians known from the Gulf of Mexico*—Continued

Species	Arctic to Sombrero Key					Gulf of Mexico						West Indies to Brazil		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
SUBORDER HOLAXONIA—Continued														
PRIMNOIDAE														
Caligorgia gracilis, 6						c						b, c		
Caligorgia verticillata, 6, 14						c	b			c		c		
Calyptrophora trilepis, 6, 14						c								
Plumarella pourtalesii, 6, 26			c		b	c						x	c	
Stenella imbricata, 6						d						d		
Thouarella aurea, 6						c								
Thouarella goësi, 6						c						c		
ISIDIDAE														
Acanella eburnea, 2, 6, 26						d		d				c, d	c, d	c
Order PENNATULACEA														
RENILLIDAE														
Renilla reniformis, 4, 24			x					a						
Renilla mülleri, 2, 6, 24								a	a			a	a	a
FUNICULINIDAE														
Funiculina quadrangularis, 2, 6, 26	c	c	d					c			e	c, d		
PROTOPTILIDAE														
Protoptilum sp. cf. thomsoni, 2								c	c					
UMBELLULIDAE														
Umbellula güntheri, 2, 6		e									e	d		
Umbellula lindahlii, 6	x	d, e									e	e		
VIRGULARIIDAE														
Virgularia mirabilis, 2, 6	x								a					

This table has been compiled from the literature and from collections in the U. S. National Museum, including unpublished records from the *Albatross*, *Fish Hawk*, and *Pelican* expeditions. Published locality records within the Gulf of Mexico as defined above have been located for 72 species; records of only 9 species from Gulf localities exclusive of the lower Florida Keys and Tortugas have been found. Another 19 species have been added by records in the collections of the U. S. National Museum, bringing the total number of species to 91. These species represent 18 families in 4 of the 6 known orders.

Although little is known of the physiology of the alcyonarians, it is clear that bottom conditions, temperature, salinity, available oxygen, and sedimentation play important parts in limiting their distribution. Limits of tolerance are apparently quite narrow but not equally so for all factors. A solid substrate providing satisfactory conditions for the attachment of larvae is almost universally required among all alcyonarian groups excepting the pennatulids. A very few gorgonacean species are able to live unattached, and a number, especially of the families Chrysogorgiidae and Isididae, can adapt themselves to live on either hard or soft bottom. The few gorgonian species which have been investigated in regard to temperature tolerance (L. R. Cary, Papers from the Dept. of Marine Biology, Carnegie Institution of Washington, v. 12, No. 9, 1918) can withstand from 5° to 9° C. (approximately) above the average maximum surface temperature of the area (at the Tortugas, about 29° C.), but it is unlikely that colonies would establish or thrive outside of a rather limited temperature range. In the absence of experimental evidence, it is impossible to state the limits of the salinity and oxygen variation which the alcyonarians can tolerate. A few species can live in situations where the salinity is occasionally somewhat reduced, but most, including the West Indian reef-dwelling forms, are never found where appreciable dilution regularly occurs. Certain species are limited to outer reef situations, and oxygen may be the critical factor in such cases. As a rule, alcyonarians are not found in continuously muddy waters, but some can tolerate very muddy conditions for short periods.

The reef areas of the Tortugas and lower Florida Keys support a typically West Indian gorgonian assemblage. The predominant families are the

Plexauridae and the Gorgoniidae; while not all of the known West Indian members of these families have been recorded from this area, most are to be expected. This community does not extend northward undiminished for any appreciable distance, although a few of the hardier species range about halfway up the Florida west coast. The scarcity of suitable reef-like situations along this coast seems to account in part for their reduction in numbers, and temperature may be of equal importance in limiting the northward distribution of shallow-water gorgonians. *Antillogorgia acerosa*, *A. americana*, and *Pterogorgia anceps* are characteristic reef forms which extend some distance up the west coast of Florida, and they probably occur wherever there is solid bottom suitable for attachment and permanent support. The predominant West Indian genera of reef-dwelling gorgonians, *Plexaurella*, *Eunicea*, *Antillogorgia*, *Gorgonia*, *Pterogorgia*, and *Phyllogorgia*, are restricted to the warm western Atlantic, while a few, such as *Pacifigorgia* and *Muricea*, are most numerous on the Pacific coast of the middle Americas, and at least one, *Leptogorgia*, is found also in the eastern Atlantic, the Mediterranean, east Africa, and the East Indies.

The alcyonarian fauna of the lower west coast of Florida is thus a decimated West Indian assemblage. To the northward it merges with and soon, perhaps near Tampa, is replaced by a distinctly temperate fauna the predominant gorgonians of which are *Leptogorgia virgulata* and *L. setacea* (both of which are referable (Bayer 1952) to Verrill's genus *Eugorgia*), and *Muricea pendula*. These species are especially abundant along the coast of the Carolinas and south perhaps to northern Florida; *L. virgulata* extends north to New York in moderately deep water, but all three seem to be lacking from the lower east coast of Florida. The short-stemmed sea pansy, *Renilla mülleri*, is common in the northern Gulf and extends southward to Brazil; it likewise occurs along the Pacific Coast from Central America to Chile. It has not been recorded from the Atlantic coast of North America where the only species appears to be *Renilla reniformis*, the common long-stemmed sea pansy. The latter species occurs also in the Gulf of Mexico with a variety extending south to the Straits of Magellan and another in California.

The shallow-water gorgonian fauna of the northern Gulf of Mexico is clearly identical with but discontinuous from that of the Carolina coast. This interrupted distribution pattern has been pointed out by Deevey (Ecology, vol. 31, No. 3, pp. 334–367, 1950) for some hydroids and other invertebrates and is described for fishes in this volume (Rivas, p. 503). Deevey suggests that reduced temperature during periods of glaciation permitted continuity of the cool-water fauna around south Florida, but it would seem fully as plausible that this continuity existed when Florida was submerged and that subsequent dispersal around the peninsula has been prevented by a thermal barrier. Since apparently favorable situations exist all along the east coast of Florida, the southward dispersal of these discontinuously distributed gorgonians is probably not limited by bottom conditions but by some other environmental factor of which temperature seems to be the most likely. In any event, it can hardly be doubted that the present-day distribution reflects a former continuity of the Gulf and Carolina faunas, but a satisfactory explanation must await the study of some group with an extensive fossil record.

Although its southern limit is not known, the shallow water temperate assemblage is probably present along most of the Texas coast, somewhere along the coast of Mexico mingling with and giving way to the hardier elements of the West Indian fauna which encroach upon it from the south. At least one gorgonacean, *Leptogorgia setacea*, extends as far south as the Guianas and Trinidad.

The presence of actively growing coral reefs at Veracruz and along the coast of Yucatán has long been recognized, but the composition of their fauna is little known. Heilprin (1890) reports only one species of gorgonian from the Veracruz reefs and remarks that the vast gorgonian sea gardens so typical of the Bermudas are lacking. The single species that he records, *Plexaura flexuosa*, belongs to the West Indian fauna, and it seems likely that other West Indian species occur there. Heilprin notes further that *Xiphigorgia* (now *Pterogorgia*) *anceps* was found at Progreso, Yucatán, another record indicative of the West Indian fauna. The occurrence of the West Indian reef species *Gorgonia flabellum* on the Texas coast (one unpublished record in the U. S. National Museum) needs to be verified.

In the deeper waters (10–500 fathoms) of the southeastern Gulf, practically all of the alcyonarians are West Indian species belonging to genera of wide distribution. The Gorgonellidae, Chrysogorgiidae, Primnoidae, and Muriceidae replace in predominance the plexaurids and gorgoniids of very shallow water. Most of the species are widespread throughout the Antilles and probably also in the Caribbean. From the occurrence of such characteristic forms as *Bebryce grandis* and *Scleracis guadalupensis* in the extreme northern Gulf, it is probably safe to assume that a good proportion of the West Indian species are present throughout the Gulf of Mexico wherever bottom conditions permit. There is no evidence as to the composition of the alcyonarian fauna of this bathymetric range in the western part of the Gulf, and intensive collecting should be done in that region to clarify the distribution patterns of the West Indian species as they enter the Gulf of Mexico.

The limited deep-sea dredging which has been done in the Gulf of Mexico has resulted in very few alcyonarian records. The isidid gorgonian, *Acanella eburnea*, which was taken in depths ranging from less than 200 to above 950 fathoms in the Gulf of Mexico, is also known from the northwestern Atlantic, the West Indies and Caribbean, the coast of Brazil, and the eastern Atlantic, always at considerable depths. Beyond the 1,000-fathom contour, three pennatulid species have been dredged: *Umbellula güntheri*, *U. lindahlii*, and *Funiculina quadrangularis*, all of which also occur at extreme depths in the northern and eastern Atlantic.

There seems to be no truly endemic element in the alcyonarian fauna of the Gulf of Mexico. The strictly shallow-water forms of the northern half are also the predominant species along the Carolina-Georgia coast, while those of the southern part are typically West Indian. The species of moderate depths throughout the Gulf are West Indian, and a northern element does not appear to be present. Finally, the characteristically deep-sea forms thus far known from the Gulf are of wide distribution at similar depths throughout the Atlantic and are possibly even cosmopolitan.

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ANTHOZOA: THE ANEMONES

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There is as yet no systematic study of the anemones of the entire Gulf of Mexico including the Tortugas region. The papers of McMurrich, especially 1889, and Watzl (1922) on Bahamas actinians, together with Duerden's (1902) report on Porto Rican species, are useful aids to the study of the Tortugas anemone fauna which apparently is about the same as that of the Bahamas. For the Gulf of Mexico proper there is only the recent paper by Carlgren and Hedgpeth (1952) on species from Texas and Louisiana. The collections reported in this work indicate a mixture of tropical, West Indian forms and species of the Middle Atlantic coast. Of particular interest is the finding of *Aiptasiomorphia luciae* at Port Aransas, adding yet another locality for that ubiquitous species. The accompanying table, (table 1), compiled principally from the literature, indicates the affinities of the common species found at Bahamas and Tortugas. This is supplemented by brief notes on some of the more interesting forms.

TABLE 1.—*Synopsis and known distribution of anemones in Bahamas, Tortugas, and the Gulf of Mexico*

[Compiled from the literature; synonymy (in parentheses), after Carlgren, 1949]

Species	Woods Hole	Beaufort	Bermuda	Bahamas	West Indies	Gulf of Mexico			Depth	Remarks
						Tortugas (or Keys)	Louisiana	Texas		
Order CORALLIMORPHARIA										
CORALLIMORPHIDAE										
Corynactis bahamensis Watzl				X					Shore	
Ricordea florida Duch. et Mich. (*Heteranthus floridus*)				X	(*)				do	*St. Thomas and Jamaica.
ACTINODISCIDAE										
Paradiscosoma neglecta (Duch. et Mich.)				X	(*)				do	*St. Thomas, Haiti, Jamaica.
Paradiscosoma carlgreni (Watzl) (*Rhodactis carlgreni*)				X					do	
Rhodactis sancti thomae (Duch. et Mich.) (*Actinothrix sancti thomae*)			X	X	(*)				do	*Jamaica.
Order ACTINIARIA; Suborder ENDOCOELANTHEAE										
HALCURIIDAE										
Halcurias pilatus McMurrich						X			100 fathoms	
Suborder NYNANTHEAE										
ALICIIDAE										
Lebrunia danae (Duch. et Mich.) (*L. neglecta; Cradactis variabilis*)			X	X	(*)	X			Shore	*Curaçao, St. Thomas, Jamaica.
ACTINIIDAE										
Actinia bermudensis (McMurrich) (*Diplactis bermudensis*)			X	X	(*)					*Curaçao?
Actinia grobbeni Watzl				X						
?*Anemonia elegans* Verrill			X	X						
Anemonia sargassensis Hargitt	X	X						X	Pelagic, on sargassum.	
Bunodosoma cavernata (Bosc)		X			X		X	X		
Leipsiceras pollens (McMurrich) (*Bolocera pollens*)						X			+100 fathoms	
Anthopleura krebsi (Duch. et Mich.)					(*)			X	Shore	St. Thomas, Jamaica.
Anthopleura varioarmata Watzl				X					do	
Condylactis gigantea (Weiland) (*C. passiflora*)			X	X	X	X				
Bunodactis stelloides (McMurrich) (*Aulactinia stelloides*)			X	X	(*)					Curaçao, Jamaica.

TABLE 1.—*Synopsis and known distribution of anemones in Bahamas, Tortugas, and the Gulf of Mexico*—Continued

Species	Woods Hole	Beaufort	Bermuda	Bahamas	West Indies	Gulf of Mexico			Depth	Remarks
						Tortugas (or Keys)	Louisiana	Texas		
ORDER CORALLIMORPHARIA—Con.										
ACTINIIDAE—Continued										
Phyllactis flosculifera (Le Sueur) (*Asteractis flosculifera; Oulactis fasciculata* McM.)			X	X	(*)					St. Thomas.
Phyllactis conquilegia (Duch. et Mich.) (*Asteractis expansa* Duerden)					X					
MINYADIDAE										
Minyas olivacea (LeSueur)					X		X	X	Pelagic	
STOICHACTIIDAE										
Stoichactis helianthus (Ellis) (*Discosoma anemone*)			X	X	X	X				
PHYMANTHIDAE										
Phymanthus crucifer (Le Sueur)			X	X	X					
ACTINOSTOLIDAE										
Paranthus rapiformis (LeSueur) (*Ammophilactis rapiformis*)	New Haven	X					X	X	Shallow water +10 faths. ?	
Subtr. Acontiaria										
ISOPHELLIDAE										
Telmatactis roseni (Watzl) (*Phellia roseni*)				X						
HORMATHIIDAE										
Actinauge longicornis Verrill	X	X			X	X			100–250 faths	
Calliactis tricolor (Le Sueur)		X			X	?		X	Shore-10/20 faths	
Stephenauge spongicola (Verrill) (*Sagartia spongicola*)	X					X			100 faths	
AIPTASIIDAE										
Aiptasia pallida (Verrill)		X	?				X	X		
Aiptasia tagetes (Duch. et Mich.)			X	X	(*)					Curaçao, Jamaica.
Bartholomea annulata (Le Sueur) (*Aiptasia annulata; Carlgreniella robusta* Watzl)			X	X	X			X		
Bartholomea werneri Watzl				X						
Heteractis lucida (Duch. et Mich.) (*Aiptasia lucida*)				X	(*)					St. Thomas, Jamaica.
AIPTASIOMORPHIDAE										
Aiptasiomorpha luciae (Verrill) (*Sagartia, Diadumene, luciae*)	X	X						X		
DIADUMENIDAE										
Diadumene leucolena (Verrill) (*Sagartia leucolena*)	X	X						?	Shore	
Order CERIANTHIARIA										
Ceriantheopsis americanus Verrill		X					?		Shallow water to about 10 faths.	
Cerianthromorphe brasiliensis (Carlgren)									10–14 faths.	Brazil. New Mexico

NOTE: The following species, so far known only from the northwestern Gulf of Mexico, have recently been described by Carlgren and Hedgpeth (1952): Andwakiidae, *Andwakia isabellae;* Actiniidae, *Bunodactis texaensis;* Aiptasiomorphidae, *Aiptasimorpha texaensis;* Sagartiidae?, *Botryon tuberculatus;* Zoantharia, Zoanthidae, *Palythoa texaensis*.

Of all the animals living in the sea the anemones are at the same time among the most beautiful and most difficult to study. A sound basis for the study of anemones is a detailed series of notes on the living animals including color sketches or photographs, measurements, and descriptions of the nematocysts, and a set of well-prepared slides of various parts of each species. Each marine laboratory or station should compile a set of color photographs, camera lucida drawings of the nematocysts (under oil immersion) making up the cnidom, and serial sections for each species in its fauna. A collection of huddled lumps of coelenterate flesh is almost useless to all but the most thorough-going specialist in this group, and in the absence of satisfactory material our knowledge of Gulf coast actinians will remain in its present fragmentary state.

NOTES ON COMMON SPECIES

***Lubrunia danae* (Duchassaing and Michelotti).**

This anemone is conspicuous for the large, branched outgrowths ("pseudotentacles" or "fronds") at the top of the column just below the tentacles. The animal is brownish and lives in hollows in coral rock. It is common at Tortugas and was described from there by Hargitt (1911) as *Cradactis variabilis*. McClendon (1911), in a paper on habits of several invertebrates, provides a color plate.

***Anemonia sargassensis* Hargitt.**

A well characterized anemone both in habit and appearance. Originally described from sargassum drifting into Woods Hole, it is found on that plant as it drifts ashore along the Texas coast and is recorded from Beaufort by Field (1949). It is a small, rather squat, velvet-brown species.[1] The tentacles may be tinted green and are occasionally branched (fig. 60).

***Bunodosoma cavernata* (Bosc).**

The common jetty form of the Texas coast, especially at Port Aransas and Port Isabel. Cary (1906) found it common on the Cameron jetties. It was originally described from the Carolina coast and is a characteristic member of the Beaufort fauna. It is a muddy to dull brown colored anemone with pearl gray vesicles on the column, with reddish to brownish or bluish tentacles, but usually with a red stripe on the back of the larger tentacles (fig. 60). Some specimens are entirely cherry red. The West Indian *B. granulifera* is considered to be a synonym of this species (Carlgren 1952).

***Anthopleura krebsi* (Duchassaing and Michelotti).**

Previously known from St. Thomas and Jamaica, a colony of small individuals occurs on the Port Isabel jetties. The column and tentacles are white, with rows of bright red verrucae which are larger and more regular toward the top of the column (fig. 60).

[1] M. D. Burkenroad contends (in litteris) that there is another common species on Gulf *Sargassum*, smaller than *Anemonia*, and reproducing commonly by longitudinal fission. Carlgren (in litteris) thinks it possible that this may be a *Bundeopsis*. This problem cannot be clarified until the anemones of the Atlantic Sargassum are critically studied.

***Bunodactis texaensis* Carlgren and Hedgpeth.**

A conspicuous gray anemone, superficially resembling *Bunodosoma cavernata*, but with verrucae instead of vesicles on the column and a pattern of darker gray or greenish to light brown splotches on the disc (see color plate, Calgren and Hedgpeth). It occurs on the jetties at Galveston and offshore near Port Aransas.

***Minyas olivacea* (LeSueur.)**

A pelagic antillean species which occasionally drifts ashore on the coasts of Texas and Louisiana, sometimes in considerable numbers. The animal is an olive brown color, with the tentacles apparently reduced to knoblike processes. The animal remains at the surface by means of a float in the pedal disc. According to observations of M. D. Burkenroad, *Minyas* will shed its float in an aquarium, but does not produce a new one under these conditions. It may be that the mature *Minyas* (as yet unknown) is a sessile form.

***Condylactis gigantea* (Weinland).**

The "passion flower" anemone is common at Tortugas, the Bahamas, Miami, and various places in the West Indies. The color of the column varies from bright scarlet to brownish, the tentacles are brownish or paler than the column and usually tipped with scarlet.

***Stoichactis helianthus* (Ellis).**

The "sun flower" anemone is a characteristic West Indian species common in the Bahamas and at Tortugas. It is easily identified by the broad, incompletely retractile disc with its large number of short, stubby tentacles. The disc is greenish or with green patches, and the peristome is usually bright yellow. The tentacles are greenish to yellow.

***Paranthus rapiformis* (LeSueur).**

A characteristic member of the shallow water bottom assemblage along the Texas coast. Cary found it washed ashore along the Cameron beach. It is found off Beaufort and along the coast northward to New Haven. Although this species has a moderately well developed basal disc, it is a burrowing form. The column is whitish, the disc green with faint salmon markings (fig. 60). Specimens brought on deck in a trawl or dredge contract to a spherical shape resembling peeled onions.

***Calliactis tricolor* (LeSueur).**

Common on the shells of the gastropod *Rehderia* off the southern Atlantic coast and sometimes

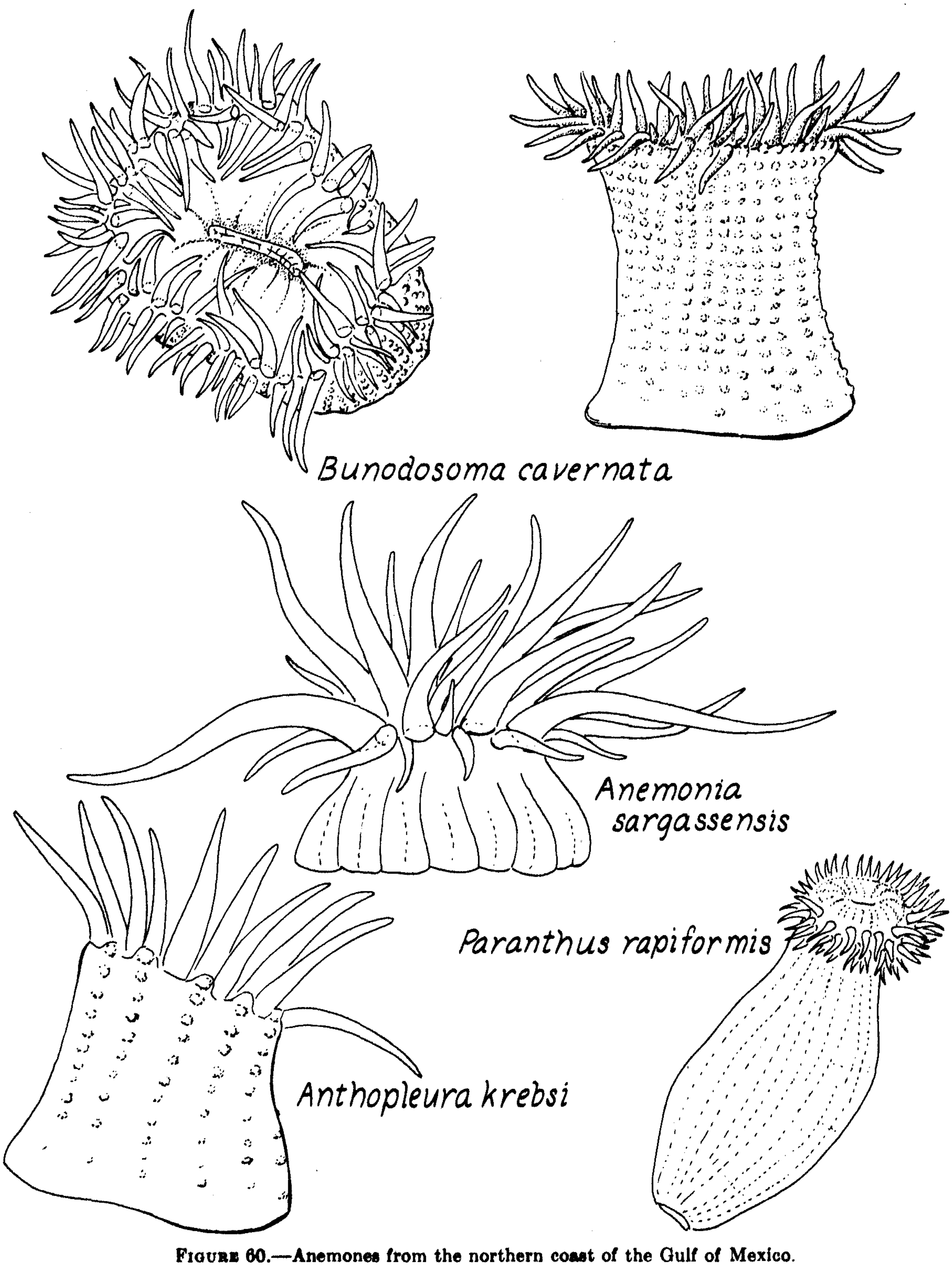

FIGURE 60.—Anemones from the northern coast of the Gulf of Mexico.

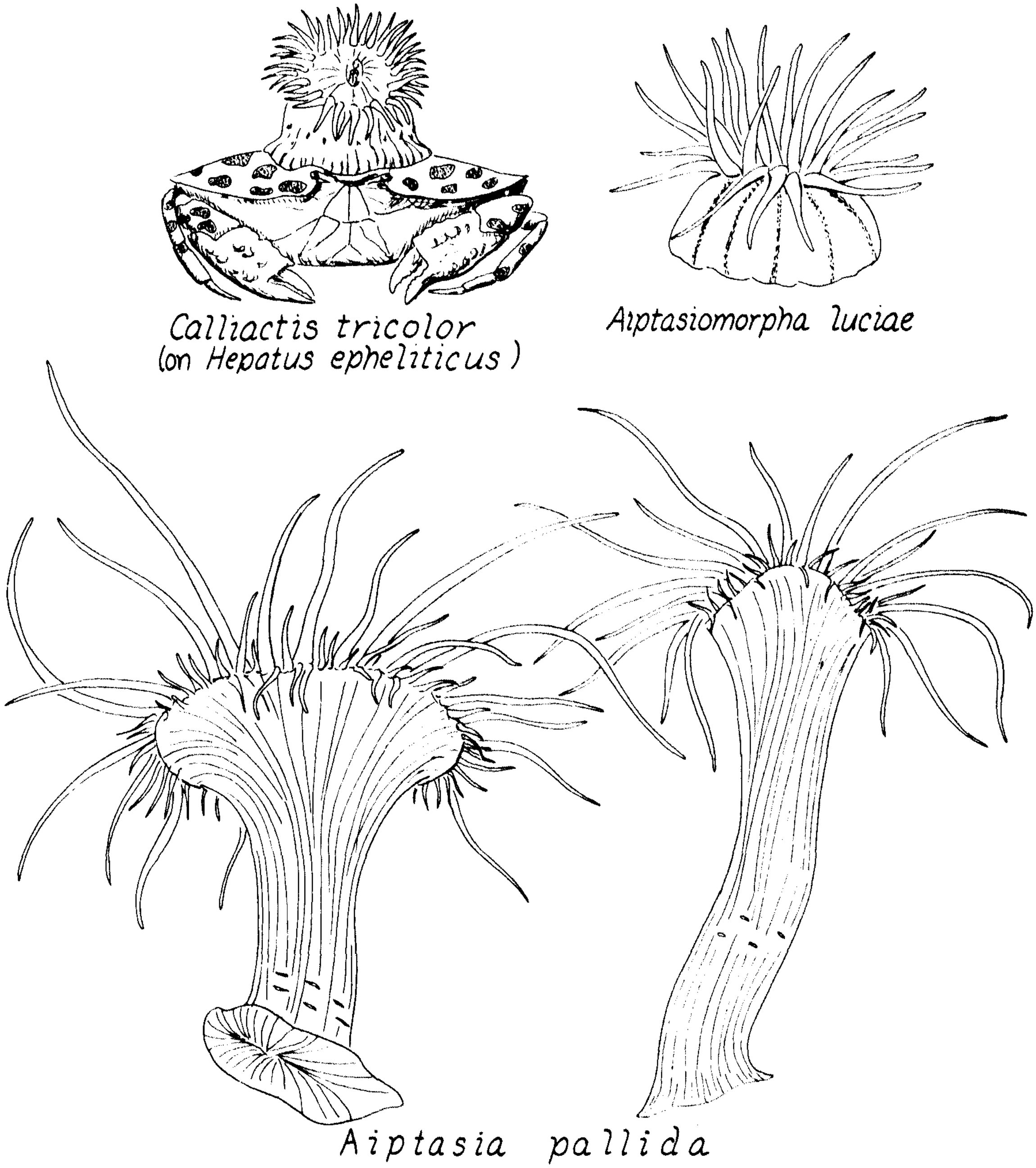

FIGURE 61.—Anemones from the northern coast of the Gulf of Mexico.

abundant on hermit crab shells and oxystome crab carapaces (fig. 61) in comparatively shallow water along the Texas coast. Occasionally, a specimen is found living in shallow water attached to some immobile substrate. The column is whitish, cream colored or brownish with darker vertical stripes and darker brown spots marking the cinclides at the base of the column; the acontia are bright orange; the tentacles are pinkish to red with darker bandings. The directives are often more deeply colored than the other tentacles. This is a common West Indian species.

***Aiptasia pallida* (Verrill).**

According to Cary, this species (fig. 61) was common on the jetties at Cameron in 1906; I have not seen it on Texas jetties but found it commonly on oysters near Port Isabel. It is usually rich brown with darker stripes. The tentacles may be solid brown, or whitish. The brown color is due mainly to zooxanthellae. Offshore, in about 10 fathoms, there is a pale powder blue phase found in old Pinna shells. The species is known from the Carolina coast, especially at Beaufort, where it occurs in large colonies (Carlgren 1952).

***Bartholomea annulata* (LeSueur).**

The tentacles appear to be ringed because of the annular swellings or incomplete bands of nematocyst batteries. The column is whitish at the base, darkening to brown near the top. The tentacles are brown. The species is found in Bermuda, Bahamas, and the West Indies, and a specimen has been collected at Port Isabel, Texas.

***Aiptasiomorpha luciae* (Verrill).**

Easily identifiable by its olive green column with orange vertical stripes (when not in a colorless phase), this little anemone (fig. 60) is almost cosmopolitan. It was first observed by Verrill at Woods Hole but may have spread originally from Japan. It is found on the Pacific coast of North America, at various places in Europe, and now from the Texas coast (Port Aransas).

***Aiptasimorpha texaensis* Carlgren and Hedgpeth.**

A small, salmon pink to whitish species locally common in bays of Texas and Louisiana. It has been recorded from salinities as low as 9 parts per thousand, and seems to be an estuarine species. It is usually found on oysters and piling.

***Ceriantheomorphe brasiliensis* Carlgren.**

This cerianthid has been collected near the coast of Texas and northeastern Mexico, and was originally described from San Sebastián, Brazil. Cary reported a colony of cerianthids from the Chandeleur Islands, which may be this species, or possibly *Cerianthiopsis americanus*, which occurs at Beaufort. These large burrowing anemones are difficult to collect, and no specimen from the Chandeleurs has come to notice.

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GULF OF MEXICO MADREPORARIA[1]

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By reason of the great difference in their normal habitat corals fall into two very distinct groups. The hermatypic or reef corals are usually, but not always, large and massive or branching in form. They are usually associated with other corals in building considerable masses of living coral reef. The deep-water or ahermatypic corals, on the other hand, are usually small and solitary though sometimes branching in form.

Hermatypic corals grow in water up to 50 fathoms in depth but are only active in reef building in depths to 25 fathoms. Most reef growth occurs in less than 15 fathoms. Ahermatypic corals are found mostly in deeper water from the edge of the continental slope to the neighborhood of 3,000 fathoms. The majority live between 90 and 300 fathoms. The temperature range for reef corals is approximately 19° C. to 36° C. (63° F. to 97° F.) with an average minimum, however, of 22° C. (72° F.). Ahermatypic corals live best within a range from about 8° C. to 21° C. in the West Indian region.

The distribution of reef corals in the Gulf of Mexico and the relation of the coral fauna of this area to those of neighboring areas is dependent upon the physiological requirements of corals. These have been studied in detail and are discussed by Vaughan in a series of papers describing experiments carried out at Dry Tortugas.

The average optimum salinity for reef corals is 36 parts per thousand, although a range of 27 to 40 parts per thousand may be tolerated. Exposure to air is also tolerated to a variable extent. Species with more porous skeletons are considerably more resistant to exposure. Strong light is essential to vigorous growth. This is apparently the result of the zooxanthellae which are normally present in the tissues of reef corals. Corals are carnivorous in habit.

Reef corals do not, as a rule, withstand any great amount of sediment and are accordingly found where vigorous water circulation exists The branching corals grow more readily in comparatively still water than do the massive types. A few species such as *Porites furcata* and *Manicina areolata* may be found on muddy bottoms.

Growth rates of corals at Dry Tortugas have been measured by Vaughan. Non-porous species grew at an average rate of 9.0 mm. in diameter and 5.00 mm. in height per year. Porous species increased at an annual rate of 40 mm. in diameter and 25.0 mm. in height. *Montastrea annularis*, a massive type, showed an annual increment in weight of 54.8 percent, whereas, a branching coral, *Acropora palmata*, increased 194.9 percent in weight per annum. Both specimens were approximately 100 grams at the beginning of the experiment. Growth of corals is greater at higher temperatures. Since temperatures in the Gulf of Mexico are generally close to the lower limit of the range, reef growth is accordingly slower than in the warmer seas. Larvae of species found in the Gulf of Mexico have a planktonic life of between 1 and 3 weeks.

Winter temperatures in the Gulf of Mexico are close to the lower limit for vigorous reef growth. There are therefore no strongly developed reefs except for those of the Dry Tortugas, the Florida Keys, and the Alacran and other reefs of the Campeche Bank. Less vigorous reef development is found at Veracruz and at a few other places within the warmer, more southerly waters of the Gulf (fig. 62).

Scattered coral heads which fail to form true reef structures are found elsewhere in the Gulf of Mexico, particularly off the west coast of Florida. Because of the amount of sediment present, they are rarely found close inshore but usually at some distance from the coast in more than 5 fathoms of water. Scattered heads are also found in deeper water in a line running from south of New Orleans toward the Texas coast and in another line running southward parallel to the Texas coast. Sur-

[1] Contribution No. 106 from the Marine Laboratory, University of Miami.

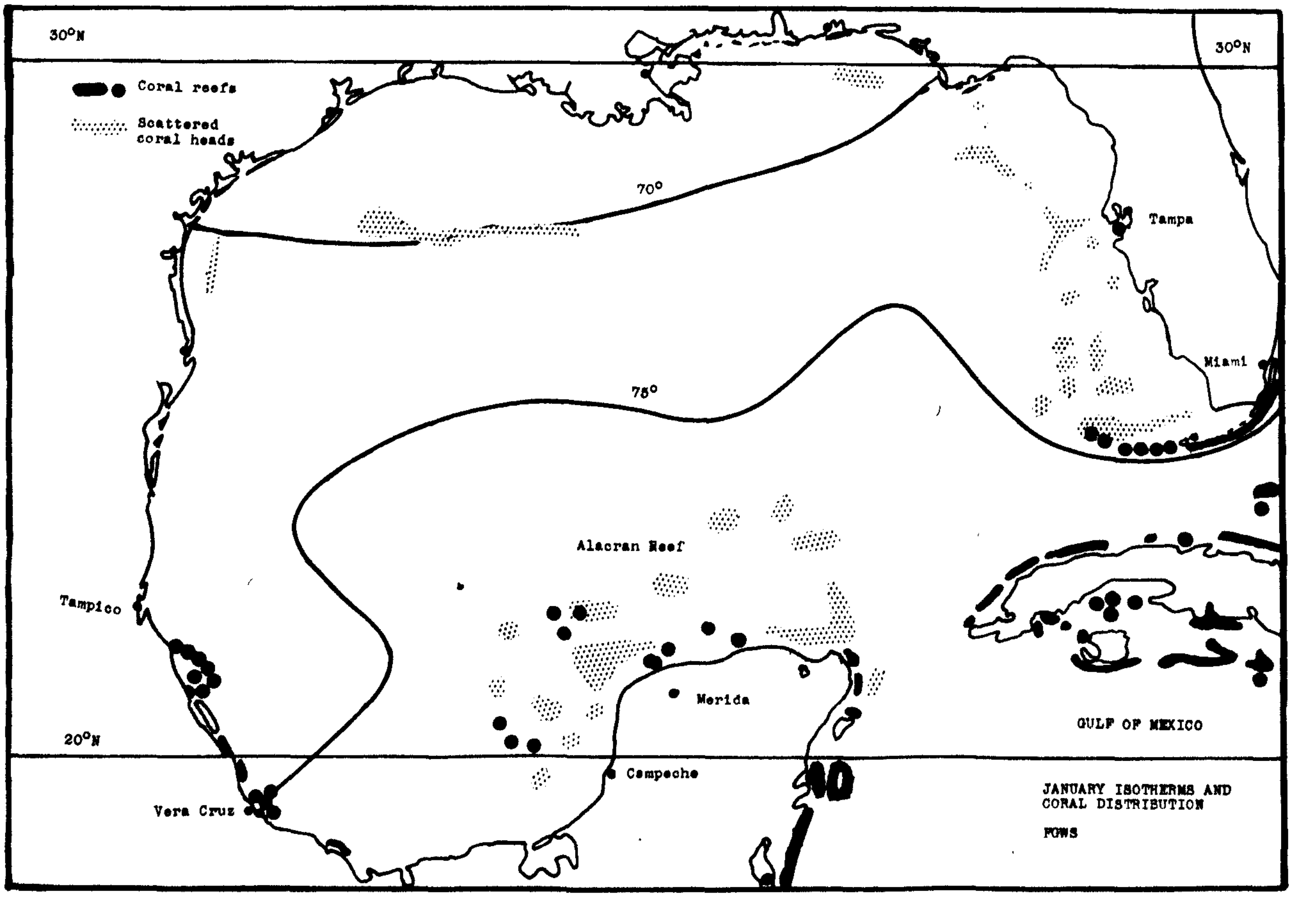

FIG. 62—January isotherms and distribution of corals in the Gulf of Mexico

prisingly few published records exist regarding the presence of reef corals in the Gulf of Mexico. The Alacran reef, described by Agassiz (1878, 1888), the Veracruz reef, described by Heilprin (1890), and the Dry Tortugas and Florida Keys reefs, described by Agassiz (1888), Vaughan, and others complete the list. From these, and various unpublished sources, Joubin (1912) prepared a map of coral reefs of this area. Data concerning patches of scattered coral heads are also shown on the U. S. Hydrographic Office Bottom Sediment Charts 1125 BS and 1126 BS published in 1943. All available records to date are indicated in the accompanying chart which shows approximate locations only.

Except for reefs of the Florida Keys and Veracruz, published accounts of Gulf reefs are insufficient to give an adequate list of species. The fauna is nevertheless typically West Indian. Forty-two of the 51 species known to the West Indies have been recorded from Florida. Only 11 of these are reported from Veracruz (Heilprin 1890).

The Caribbean reef fauna consists of about 26 genera and 51 species (table 1). The species listed here include a number which are undoubtedly varieties or growth forms, such as *Acropora prolifera* and certain species of *Porites*. They are included here, however, since they are recognizably different, and such a list is convenient to field workers who are more concerned with accurate and speedy identification rather than the sometimes debatable questions of taxonomy. For purposes of identification, the handbook of Atlantic reef corals by Smith (1948) is most useful since it contains complete keys and descriptions and is well illustrated. For an authoritative monograph on coral taxonomy, reference should be made to Vaughan and Wells (1943) who provide an extensive bibliography.

TABLE 1.—*Western Atlantic hermatypic species of corals*

[F indicates recorded from Florida; V indicates recorded from Veracruz]

SUBORDER ASTROCOENIIDA	
Family ASTROCOENIIDAE	
1. *Astrocoenia pectinata* Pourtalès	F
2. *Stephanocoenia michelini* Edwards and Haime	
SERIATOPORIDAE	
3. *Madracis decactis* (Lyman)	F
ACROPORIDAE	
4. *Acropora cervicornis* (Lamarck)	F
5. *A. palmata* (Lamarck)	FV
6. *A. prolifera* (Lamarck)	FV
SUBORDER FUNGIIDA	
AGARICIIDAE	
7. *Agaricia agaricites* (Linnaeus)	F
8. *A. fragilis* Dana	F
9. *A. nobilis* Verrill	F
SIDERASTREIDAE	
10. *Siderastrea radians* (Pallas)	F
11. *S. siderea* (Ellis and Solander)	FV
12. *S. stellata* Verrill	
PORITIDAE	
13. *Porites astreoides* Lamarck	FV
14. *P. branneri* Rathbun	
15. *P. divaricata* LeSueur	F
16. *P. furcata* Lamarck	FV
17. *P. porites* (Pallas)	F
18. *P. verrilli* Rehberg	
SUBORDER FAVIIDA	
FAVIIDAE	
19. *Favia conferta* Verrill	
20. *F. fragum* (Esper)	F
21. *F. gravida* Verrill	
22. *F. leptophylla* Verrill	
23. *Diploria clivosa* (Ellis and Solander)	F
24. *D. labyrinthiformis* (Linnaeus)	FV
25. *D. strigosa* (Dana)	FV
26. *Colpophyllia amaranthus* (Muller)	F
27. *C. Natans* (Muller)	F
28. *Manicina areolata* (Linnaeus)	F
29. *M. mayori* Wells	F
30. *Cladocora arbuscula* LeSueur	FV
31. *Solenastrea bournoni* Edwards and Haime	F
32. *S. hyades* (Dana)	F
33. *Montastrea annularis* (Ellis and Solander)	FV
34. *M. braziliana* (Verrill)	
35. *M. cavernosa* (Linnaeus)	FV
ASTRANGIIDAE	
36. *Astrangia solitaria* (LeSueur)	F
OCULINIDAE	
37. *Oculina diffusa* Lamarck	FV
38. *O. valenciennesi* Edwards and Haime	
39. *O. varicosa* LeSueur	F
TROCHOSMILIIDAE	
40. *Meandrina meandrites* (Linnaeus)	F
41. *M. brasiliensis* (Edwards and Haime)	F
42. *Dichocoenia stokesii* Edwards and Haime	F
43. *Dendrogyra cylindrus* Ehrenberg	F
MUSSIDAE	
44. *Mussismilia brasiliensis* (Verrill)	
45. *M. hartii* (Verrill)	
46. *Mussa angulosa* (Pallas)	F
47. *Isophyllastrea rigida* (Dana)	F
48. *Mycetophyllia lamarckana* (Edwards and Haime)	F
49. *Isophyllia sinuosa* (Ellis and Solander)	F
50. *I. multiflora* Verrill	F
SUBORDER CARYOPHYLLIIDA	
CARYOPHYLLIIDAE	
51. *Eusmilia fastigiata* (Pallas)	F

The West Indian fauna includes species belonging to the Astrocoeniidae, Acroporidae, Agariciidae Siderastreidae, Poritidae, Faviidae, Oculinidae, Trochosmiliidae, Mussidae, and Caryophylliidae. None of the Fungiidae are represented and only *Madracis* among the Seriatoporidae. *Montipora*, *Astreopora*, *Goniopora*, and *Trachyphyllia*, all of which exist as fossils of the Caribbean Neogene, are now absent. Genera known only to the West Indian fauna are *Colpophyllia*, *Dendrogyra*, *Meandrina*, *Mussa*, *Mycetophyllia*, *Manicina*, *Isophyllia*, *Isophyllastrea*, *Eusmilia*, *Dichocoenia*, and *Agaricia*. All of the West Indian genera occur on the Florida reefs. Their absence from other parts of the Gulf of Mexico must be ascribed to the existence of unfavorable temperature conditions which permit only the more hardy to live there since their presence on the Florida reefs, their known length of larval life, and the existence of favorable currents are sufficient for dispersal throughout the area.

The ahermatypic corals are much less restricted by geographical boundaries than the hermatypic forms since the required conditions for their existence are widespread throughout the deeper waters of the ocean. The extent of distribution of any species depends partly upon the depth range inasmuch as the deeper the normal habitat, the greater the continuity of suitable environments. On account of the generalized distribution of ahermatypic corals and the lack of adequate surveys of the greater part of the deeper waters of the Gulf of Mexico, it has seemed more useful to provide a list of ahermatypic corals known from the West Indies together with their temperature and depth ranges. It is reasonable to expect that where the proper temperature, depth, and bottom conditions exist in the Gulf, the appropriate West Indian species may be found eventually. Existing accounts of Gulf of Mexico corals are mainly confined to those of Pourtalès dealing with the deep-water fauna of the Florida Keys and between Dry Tortugas and the Campeche Bank.

Descriptions of West Indian ahermatypic species are to be found in Agassiz (1888), Pourtalès (1868, 1871, 1874, 1879, 1880), and Verrill (1883, 1908). A key to Western Atlantic genera is given in Smith (1948). A list of West Indian genera with temperature and depth ranges is given in table 2, compiled from data in Vaughan and Wells (1943).

TABLE 2.—*Ahermatypic genera of corals found in West Indies and Gulf of Mexico with approximate temperature and depth ranges*

SUBORDER ASTROCOENIIDA	
SERIATOPORIDAE	
Madracis Milne Edwards and Haime	0–800 meters; 10–27° C.
SUBORDER FUNGIIDA	
FUNGIIDAE	
Fungiacyathus Sars	60–6,000 meters; 1–21° C.
SUBORDER FAVIIDA	
ASTRANGIIDAE	
Astrangia Milne Edwards and Haime	0–110 meters; 8–28° C.
Phyllangia Milne Edwards and Haime	0–90 meters; 23–28° C.
Colangia Pourtalès	0–580 meters; 6–27° C.
OCULINIDAE	
Madrepora Linnaeus	60–1,400 meters; 4–16° C.
TROCHOSMILIIDAE	
Dasmosmilia Pourtalès	100–450 meters; 15–22° C.
ANTHEMIPHYLLIIDAE	
Anthemiphyllia Pourtalès	170–730 meters; 8–17° C.
SUBORDER CARYOPHYLLIIDA	
CARYOPHYLLIIDAE	
Caryophyllia Lamarck	0–2,800 meters; 2–27° C.
Coenocyathus Milne Edwards and Haime	0–6,800 meters; 9–26° C.
Cyathoceras Moseley	70–1,100 meters; 3–27° C.
Oxysmilia Duchassaing	75–300 meters; 10–20° C.
Bathycyathus Milne Edwards and Haime	55–145 meters; 10–13° C.
Trochocyathus Milne Edwards and Haime	15–1,500 meters; 4–27° C.
Peponocyathus Gravier	100–1,100 meters; 7–21° C.
Tethocyathus Kuhn	65–1,100 meters; 3–12° C.
Deltocyathus Milne Edwards and Haime	15–4,300 meters; 4–28° C.
Ceratotrochus Milne Edwards and Haime	55–700 meters; 5–17° C.
Stephanocyathus Sequenza	360–2,200 meters; 3–12° C.
Turbinolia Lamarck	
ss *Batotrochus* Wells	180–570 meters; 11–21° C.
Sphenotrochus Milne Edwards and Haime	22–275 meters; 9–26° C.
Desmophyllum Ehrenberg	35–2,000 meters; 3–23° C.
Parasmilia Milne Edwards and Haime	310–370 meters; 8–12° C.
Coenosmilia Pourtalès	145–450 meters; 13–23° C.
Anomocora Studer	90–820 meters; 4–17° C.
Asterosmilia Duncan	80–200 meters; 13–15° C.
GUYNIIDAE	
Guynia Duncan	170–650 meters; 7–12° C.
Stenocyathus Pourtalès	80–820 meters; 7–14° C.
Schizocyathus Pourtalès	100–1,500 meters; 10–18° C.
FLABELLIDAE	
Flabellum Lesson	0–3,200 meters; 2–27° C.
Monomyces Ehrenberg	0–1,000 meters; 6–28° C.
Gardineria Vaughan	70–600 meters; 6–18° C.
SUBORDER DENDROPHYLLIIDA	
DENDROPHYLLIIDAE	
Balanophyllia Wood	0–1,100 meters; 7–28° C.
Dendrophyllia	10–500 meters; 11–27° C.
Tubastrea Lesson	0–400 meters; 15–28° C.
Trochopsammia Pourtalès	500–1,500 meters; 5–7° C.
Enallopsammia Michelotti	270–2,000 meters; 3–15° C.
Thecopsammia Pourtalès	150–1,000 meters; 0–14° C.
Bathypsammia von Marenzeller	220–330 meters; insufficient data for temperature range.

In shallow water the only ahermatypic corals are 3 or 4 species of *Astrangia*, *Madracis*, and *Phyllangia*. Most species are found in deeper water from the edge of the continental slope downward. A total of 84 species is known. According to Vaughan and Wells (1943), 13 of these are identical with living species of the northern and eastern Atlantic; 59 are endemic. Cosmopolitan species are *Caryophyllia communis*, *Deltocyathus italicus*, *Desmophyllum cristagalli*, *Fungiacyathus symmetricus*, *Lophelia prolifera*, *Madrepora oculata*, and *Stephanocyathus nobilis*.

TABLE 3.—*West Indian fossil genera found living elsewhere.*

SUBORDER ASTROCOENIIDA	
ASTROCOENIIDAE	
Stylocoeniella Yobe and Sugiyama	Eocene–Oligocene; Recent–Japan, Mauritius
SERIATOPORIDAE	
Stylophora Schweigger	Eocene–Miocene; Recent–Red Sea, Indo-Pacific
SUBORDER FUNGIIDA	
AGARICIIDAE	
Pavona Lamarck	Oligocene–Miocene; Recent–Indo-Pacific
Leptoseris Milne Edwards and Haine	Oligocene–Miocene, Recent–Indo-Pacific
THAMNASTERIDAE	
Psammocora Dana	Miocene; Recent–Indo-Pacific
AGATHIPHYLLIIDAE	
Diploastrea Matthai	Cretaceous–Oligocene; Recent–Indo-Pacific
PORITIDAE	
Goniopora de Blainville	Cretaceous–Miocene; Recent–Indo-Pacific
SUBORDER FAVIIDA	
FAVIIDAE	
Favites Link	Eocene–Miocene, Recent–Indo-Pacific, Red Sea
Goniastrea Milne Edwards and Haine	Eocene–Oligocene, Recent–Indo-Pacific, Red Sea

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CTENOPHORES IN THE GULF OF MEXICO

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Ctenophores are so fragile that they are not readily preserved or, if they are, certain diagnostic characters may become obscured. Thus, many records of their occurrence are somewhat uncertain. Equally uncertain are their names because about 40 years ago four important papers appeared almost simultaneously (Bigelow 1912; Mayer 1912; Mortensen 1912; Moser 1912), and insofar as I can ascertain, nobody has reviewed the group critically since that time. It is probable, however, that the ctenophore fauna of the Gulf of Mexico is as well known as that of any neighboring area due to Mayer's (1900, 1912) and Fewkes' (1882) observations at the Tortugas. Nevertheless, only about a dozen species have been recorded with any certainty in the Gulf: *Beroë ovata* Bosc; *Bolinopsis vitrea* L. Agassiz; *Cestum veneris* LeSueur; *Eurhamphaea vexilligera* Gegenbaur; *Folio parellela* Fol; *Hormiphora hormiphora* Gegenbaur; *Leucothoe ochracea* [1] Mayer; *Mnemiopsis mccradyi* Mayer; *Ocyropsis crystallina* Rang; *Ocyropsis maculata* Rang; *Tinerfe beehleri* Mayer; *Tinerfe lactea* Mayer (using the names that appear to be acceptable today). This is a slight reduction in the number originally described because a number proved to be identical with species which had been described earlier. This list also includes most of the species that have been reported from neighboring parts of the Atlantic. Whether other species will be found in this area seems problematical. At any rate, although ctenophore species are more numerous in the Gulf, they apparently do not occur in dense swarms as is so characteristic of them in more northern waters.

[1] Fewkes' (1882) record of *Eucharis multicornis* Quoy and Gaimard is condered by Mayer (1912, p. 35) to have been his new species, *Leucothoe ochracea*.

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