ANTHOZOA: ALCYONARIA [1]

By FREDERICK M. BAYER, *U. S. National Museum*

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		b	b			a		
Muricea pendula, 2, 6, 24			a				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 tourneforti, 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		"Mexico"			a		
Plexaurella minuta, 11														
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 elisabethae, 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.

BIBLIOGRAPHY

Bayer, Frederick M.

1949. Chalcogorgiinae, a new subfamily of Chrysogorgiidae (Coelenterata: Alcyonaria), and a description of *Chalcogorgia pellucida*, new genus and new species, from the Straits of Florida. Jour. Washington Acad. Sci. 39 (7): 237–240, 1 fig.

1952. New western Atlantic records of octocorals (Coelenterata: Anthozoa), with descriptions of three new species. Jour. Washington Acad. Sci. 42 (6):

Bielschowsky, Eva.

1929. Die Gorgonarien Westindiens. Kap. 6: Die Familie Gorgoniidae. Zool. Jahrb. Supp. 16 (1): 63–234, figs. 1–40, pls. 2–5.

Cary, Lewis R.

1906. A contribution to the fauna of the coast of Louisiana. Gulf Biol. Sta., Cameron, La. (Louisiana State Bd. of Agric. and Immig.), Bull. 6: 50–59.

1918. The Gorgonaceae as a factor in the formation of coral reefs. Carnegie Inst. Washington Pub. 213: 341–362, pls. 100–105.

Deichmann, Elisabeth.

1936. The Alcyonaria of the western part of the Atlantic Ocean. Mem. Mus. Comp. Zool. Harvard 53: 1–317, pls. 1–37.

Gordon, Isabella.

1925. Gorgonids from Curaçao Island. Het Koninklijk Zool. Genootschab Leyden. Bijdragen tot de Dierkunde 24: 15–24, pls. 3–4.

Heilprin, Angelo.

1890. The corals and coral reefs of the western waters of the Gulf of Mexico. Proc. Acad. Nat. Sci. Philadelphia 1890, 42: 303–316.

Kükenthal, Willy.

1916. Die Gorgonarien Westindiens. Kap. 1, Die Scleraxonier; Kap. 2, Über den Venusfächer; Kap. 3, Die Gattung *Xiphigorgia* H. M. Edw. Zool. Jahrb. Supp. 11 (4): 444–503, 26 figs., pl. 23.

1919. Gorgonaria. Wissenscahftliche Ergebnisse der deutschen Tiefsee-Exped. auf dem Dampfer *Valdivia* 1898–99, 13 (2): 1–946, 318 figs., pls. 30–89.

1924. Gorgonaria. Das Tierreich 47: xxviii+478, 209 figs. Berlin u. Leipzig.

Kunze, G.

1916. Die Gorgonarien Westindiens. Kap. 4.—Die Gattung *Eunicea* Lamouroux; Kap. 5.—Die Gattung *Plexaurella*. Zool. Jahrb. Supp. 11 (4): 505–586, 55 figs., pls. 24–28.

Moser, Johannes.

1921. Ergebnisse einer Revision der Gattung *Plexaura* Lamouroux. Zool. Anzeiger 53 (5/6): 110–118.

Pourtalès, L. F., de

1863–1869. Contributions to the fauna of the Gulf Stream at great depths (2d series). Bull. Mus. Comp. Zool. Harvard College 1 (6): 103–120, 1867; 1 (7): 121–142, 1868.

Riess, Margot.

1929. Die Gorgonarien Westindiens. Kap. 8.—Die Familie Muriceidae. Zool. Jahrb. Supp. 16 (2): 377–420, 4 figs., pl. 8.

STIASNY, GUSTAV.

1935. Die Gorgonacea der *Siboga*-Expedition. Supplement 1, Revision der Plexauridae. *Siboga*-Exped. Monog. 13b[7]: vi+106, 27 figs., pls. 1–7.

1937. Die Gorgonacea der *Siboga*-Expedition. Supplement 2, Revision der Scleraxonia mit Ausschluss der Melitodidae und Coralliidae. *Siboga*-Exped. Monog. 13b[8]: vi+138, 38 figs., pls. 1–8.

1941a. Studien über Alcyonaria und Gorgonaria, II. Zool. Anzeiger 134(3/4): 53–71, 8 figs.

1941b. Studien über Alcyonaria und Gorgonaria, III. Zool. Anzeiger 134(11/12): 254–268, 11 figs.

1941c. Studien über Alcyonaria und Gorgonaria, IV. Zool. Anzeiger 135(1/2): 13–25, 10 figs.

1941d. Gorgonaria von Venezuela (Inseln Blanquilla und Los Frailes). Arch. Néerl. de Zool. 6 (1): 101–116, figs. 1–4, pls. 1–2.

THOMSON, J. ARTHUR.

1927. Alcyonaires provenant des campagnes scientifiques du Prince Albert I[er] de Monaco. Rés. Camp. Scient. Albert de Monaco 73: 1–77, pls. 1–6.

TOEPLITZ, CHARLOTTE M.

1929. Die Gorgonarien Westindiens. Kap. 7.—Die Familie Gorgonellidae, zugleich eine Revision. Zool. Jahrb. Supp. 16 (2): 235–376, 26 figs., pls. 6–7.

VERRILL, ADDISON EMERY.

1864. List of the polyps and corals sent by the Museum of Comparative Zoology to other institutions in exchange, with annotations. Bull. Mus. Comp. Zool., Harvard College 1 (3): 29–60.

1869. Critical remarks on the halcyonoid polyps with descriptions of new species in the museum of Yale College, No. 4. Am. Jour. Sci. (2) 48: 419–429.

1883. Report on the Anthozoa, and on some additional species dredged by the *Blake* in 1877–79, and by the U. S. Fish Commission steamer *Fish Hawk* in 1880–82. Bull. Mus. Comp. Zool., Harvard College 11 (1): 1–72, pls. 1–8.

1904–1907. The Bermuda Islands. Part 5.—Characteristic life of the Bermuda coral reefs. Trans. Connecticut Acad. Sci. 12: 160–304, 28 pls.; index and errata, pp. 311–316.