CHAPTER XVII
FISHES AND SEA TURTLES

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THE ORIGIN, RELATIONSHIPS, AND GEOGRAPHICAL DISTRIBUTION OF THE MARINE FISHES OF THE GULF OF MEXICO[1]

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The Gulf of Mexico is the northwesternmost of the three Middle American basins. It is a typical, basin-shaped mediterranean sea with an area of 615,000 square miles and a maximum depth of about 2,000 fathoms (Sigsbee Deep) at its center. Its longest axis, oriented SW–NE between Veracruz, Mexico, and Apalachee Bay, Florida, measures about 960 nautical miles, and its short axis, oriented N–S between the Mississippi Delta and the Peninsula of Yucatán, measures about 460 nautical miles. The Gulf of Mexico is separated from the Atlantic Ocean by the Straits of Florida, about 110 nautical miles wide between Cape Sable, Florida, and Cabo Hicacos, Cuba, with a maximum depth of about 900 fathoms (average depth about 500 fathoms). It is separated from the northwestern Caribbean Basin by the Yucatán Channel, about 110 nautical miles wide between Cabo Catoche, Yucatán, and Cabo San Antonio, Cuba, with a maximum depth of about 1,000 fathoms (average depth about 700 fathoms). The total perimeter of the Gulf of Mexico comprises about 3,000 nautical miles of which only about 220 (7 percent) are taken up by the openings (Straits of Florida and Yucatán Channel).

The above conditions would seem to indicate that the Gulf of Mexico contains a characteristic fish fauna of its own appreciably distinct from that of neighboring areas. In this respect, however, it is to a great extent a continuation of the Caribbean region. (See Rivas, 1949, for list of game and commercial fishes.)

There is a very slight amount of subspecific distinction between the fish faunas of the Gulf of Mexico and the Caribbean Sea, and a temperate Atlantic element is present in the Gulf but absent in the Caribbean region. On the other hand, there are several species which occur in the Caribbean region but not in the Gulf of Mexico, and there is no marked transition between the fish faunas of the Gulf of Mexico and the Caribbean Sea or the Atlantic Ocean through the Yucatán Channel and the Straits of Florida, respectively. There is relatively little known of the deep-sea fish fauna of the Gulf, but the present depth of the Yucatán Channel and the Straits of Florida cannot be construed as barriers preventing the dispersal of deep-sea fishes to and from the Gulf. According to the paleogeographic evidence (Schuchert 1935) there was a land barrier across the Yucatán Channel during the Mio-Pliocene, and the Straits of Florida were then shallower than at present. These conditions, however, were relatively short-lived, and their former existence is now reflected in the slight subspecific transition (affecting only very few species) observed through the Yucatán Channel and the presence or absence of certain forms north and south of this strait. The Gulf Stream, entering from the Caribbean Sea through the Yucatán Channel and leaving through the Straits of Florida, is one of the most important factors in making the fish fauna of the Gulf of Mexico homogeneous with that of the rest of the Caribbean area.

Among many others, the genera *Harengula* (Clupeidae), *Mugil* (Mugilidae), and *Centropomus* (Centropomidae) will serve to illustrate the above distributional pattern. Of the three species of *Harengula* (sardines) known from the Caribbean area only *H. pensacolae* occurs throughout the entire perimeter of the Gulf, being rather scarce in the Caribbean Sea. On the other hand, *H. humeralis* and *H. clupeola* are very abundant in the Caribbean Sea but penetrate into the Gulf only as far as the north coast of Yucatán, western Cuba, and southern Florida. *Mugil cephalus* and *M. curema* are the only mullets occurring throughout the entire perimeter of the Gulf of Mexico, whereas, *M. trichodon* penetrates only to the north coast of Yucatán, northwestern Cuba, and

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south Florida. *Mugil liza* (*M. brasiliensis* of authors) penetrates to the north coast of Yucatán and northwestern Cuba, but so far it has not been recorded from Florida. *Centropomus undecimalis* (snook) occurs throughout the entire perimeter of the Gulf, but *C. parallelus* and *C. pectinatus* penetrate only to the north coast of Yucatán, northwestern Cuba, and southern Florida. *C. ensiferus* seems to be absent from Florida.

SHORE FISHES

There are certain species of coastal fishes which occur along the entire perimeter of the Gulf (except Cuba) but not in the West Indies proper. Some of these species are entirely confined to the Gulf, and others penetrate the Yucatán Channel and the Straits of Florida, extending along the mainland of Central America and the Atlantic coast of the United States, respectively. These species represent a small percentage of the total fish fauna of the Gulf and include tropical representatives as well as forms of northern origin. The well-known sheepshead (*Archosargus probatocephalus*), channel bass (*Sciaenops ocellatus*), and the common weakfish (*Cynoscion regalis*) among several others, are good examples illustrating this condition. These fishes are fairly common in the Gulf of Mexico including extreme south Florida, but they have never been reported from Cuba or any other of the West Indies. The ecological conditions prevailing in extreme south Florida are common to northwestern Cuba, and since many coastal species occur in both these areas, it is difficult to explain the absence of certain forms in Cuba. The species under discussion are not tropical, and it seems reasonable to assume that the Gulf Stream forms a temperature barrier preventing their dispersal into the West Indies. On the other hand, the Gulf Stream has been a very important temperature factor favoring the dispersal of most tropical West Indian fishes into the Gulf of Mexico, especially its southern portion. The percentage of species present in the Gulf of Mexico but absent in the West Indies is considerably higher than that of West Indian species absent in the Gulf.

As already pointed out, most of the shore fishes of the Gulf of Mexico also occur in the Caribbean Sea, and many of them are strictly stenobathic forms confined to shallow water and apparently unable to disperse across deep and wide water gaps. Despite this condition most of the species occur on both sides of the Yucatán Channel and the Straits of Florida. These deep and relatively wide water gaps would represent a bathic barrier to the adult fish but not to its pelagic or semipelagic larva as demonstrated for some of those species.

A third, very characteristic distributional pattern affecting several species is well illustrated by *Acipenser sturio* (common sturgeon) and *Dorosoma cepedianum* (gizzard shad). These species occur along the north and east shore of the Gulf of Mexico as far south as central Florida and reappear along the Atlantic coast of the United States, being absent around south Florida. This discontinuous distribution seems to be caused by the influence of the main branch of the Gulf Stream acting as a thermal barrier and preventing dispersal around the southern extremity of peninsular Florida. *Acipenser sturio* and *Dorosoma cepedianum* are temperate forms, and their presence on either side of peninsular Florida may be explained by the former continuity which existed between the Gulf of Mexico and the Atlantic Ocean across northern Florida during the interglacial periods of the Pleistocene. According to the paleogeographic evidence, this passage existed until relatively recent times.

Peninsular Florida and the main branch of the Gulf Stream may therefore be considered as land and thermal barriers, respectively, preventing at present the exchange of temperate fishes between the Atlantic Ocean and the Gulf of Mexico. The isolating effect of these barriers as a factor in speciation is well-illustrated by the shads, *Alosa sapidissima* and *A. alabamae*, of the Atlantic and Gulf coasts, respectively. These two very closely related, Vicarious species seem to have evolved when the original ancestral population, continuous along the south coast of the United States, was split by the emergence of peninsular Florida. Neither *Alosa sapidissima* nor *A. alabamae* occur around south Florida. (See also Ginsburg, 1952, pp. 99–101.)

The paleogeographic evidence indicates that the Gulf of Mexico originated as a shallow basin and according to Schuchert (1935, p. 59):

"Previous to Middle Cretaceous time, it is believed, no such deep Gulf of Mexico as the present one was in existence, and the area now occupied by this suboceanic interior sea was a

gentle sag or flat platelike basin . . . With the Middle Cretaceous, the area commenced to subside . . . and this downward tendency persisted until the Gulf reached its present great depth and extent." [See also Lynch's article, pp. 67–86.]

It is therefore safe to assume that shallow-water or shore fishes were the first to become established in the Gulf of Mexico and that they constitute the oldest element of its ichthyological fauna.

As already indicated, the shore fish fauna of the Atlantic coast continued into the Gulf of Mexico before peninsular Florida was established as a barrier to many of the species during the Pleistocene. A connection with the Caribbean Sea through the Yucatán Channel was established during the Pliocene. It would seem, therefore, that the North Atlantic element became established in the Gulf before Caribbean fishes were able to disperse through the Yucatán Channel.

PELAGIC FISHES

As might be expected from the foregoing discussions, the pelagic fishes of the Gulf of Mexico are the same as those of the Caribbean Sea and adjacent parts of the Atlantic Ocean. They are mostly associated with the Gulf Stream, and the paleogeographic evidence would seem to indicate that their presence in the Gulf dates from relatively recent times.

DEEP-SEA FISHES

As already pointed out above, the Gulf of Mexico originated as a shallow basin. Bathic and other associated ecological conditions suitable to deep-sea fishes were not established until comparatively recent times. This would seem to indicate that the deep-sea fish fauna of the Gulf did not evolve in situ but was recently derived from the older, adjacent oceanic areas, such as the Caribbean Sea and the Atlantic Ocean. In fact, most of the deep-sea fishes of the Gulf of Mexico also occur in the Caribbean Sea and the Atlantic Ocean, and many of the species are cosmopolitan in distribution.

Owing to obvious collecting difficulties, deep-sea fish faunas are poorly known taxonomically as well as geographically, and further exploration may extend the range of a few species so far reported only from the Gulf of Mexico.

As already indicated in the introduction, the present depth of the Yucatán Channel and the Straits of Florida cannot be construed as barriers preventing the dispersal of deep-sea fishes to and from the Gulf.

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BIOLOGY OF THE COMMERCIAL FISHES OF THE GULF OF MEXICO

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The ecology of the fishes of the Gulf of Mexico differs in many respects from that of the Atlantic coast. The offshore waters of the Gulf (as indicated by current investigations by the Fish and Wildlife Service) are low in nutrients; the largest fish populations are thus found in the littoral zones where the nutrients necessary to grow the organisms forming the base of the food chain are washed from the land by rains and floods and carried in by rivers (Riley 1937).

At 1,200 fathoms the water masses in the Caribbean Sea are warmer and less dense than those outside the perimeter of the Caribbean. Those latter cold-water masses are derived from water that has sunk in high latitudes (Parr 1937, 1938). It therefore intermittently runs over the sills between the islands of the Antilles and flows down into the Caribbean and Cayman Basins. An intermediate water mass above 1,000 fathoms moves westward through the Caribbean between depths of 245 and 500 fathoms. This water, of Antarctic origin, is rich in nutrients. Between 100 and 250 fathoms the entering water is chiefly of South and North Atlantic central water origin.

There is little surface upwelling in the Caribbean, but on the Venezuelan coast the tilt of the water layers brings nutrient-rich waters up to the euphotic zone. The Gulf of Mexico derives its deep waters from water flowing from the Caribbean Sea over the sill in the Yucatán Channel which is not so deep as the main entrances to the Caribbean Sea. Proximity to this inflowing current may account for the productivity of the fisheries of the Campeche Banks.

Most of the new water entering the Gulf apparently flows out again through the Straits of Florida so that the main part of the Gulf is more or less of a cul-de-sac. This may influence the low nutrient content of the offshore waters of the Gulf.

As in most subtropical waters the high temperatures cause rapid growth. The same or related species in the Gulf tend to grow faster than on the northern Atlantic coast; they attain maturity at younger ages and are usually smaller in size. The life histories of many of the fishes of the Gulf are practically unknown. Some of those that occur both in the Gulf and along the Atlantic coast have been studied on the Atlantic coast, and presumably their life histories in Gulf waters are similar. Within the Gulf proper, mention should be made of the studies by Pearson, Gunter, and Gowanloch. However, the area is so vast, the species so numerous, and the conditions so diverse that the total knowledge is meager when compared to that of the Pacific or Atlantic coasts.

It is known that certain species can be caught in certain localities, but no detailed study is available on many of the most abundant species such as the menhaden, the anchovy, the Spanish mackerel, the groupers, and the snappers. Ginsburg (1930), in describing the biology of the common red snapper, *Lutianus aya*, says, "the red snapper is one of the important food fishes of this country. . . . Among the commercial food fish of the Gulf coast . . . the red snapper is second in point of quantity obtained, being exceeded only by the mullet . . . it is significant that practically nothing is known regarding the life history of the red snapper."

The relative abundance of the different species of fish is not accurately known, especially for those not landed by fishermen or only taken incidentally while in pursuit of other species. In estimating relative abundance, Gunter (1945a) uses the term "total species mass." He states that, "The estimates of relative species mass of the fishes given here are based on general impressions and observations, bolstered to some extent by data, and are admittedly more subjective than is desirable. It is quite certain, however, that irrespective of their rank in species mass, the species discussed are the most numerous fishes in Texas coastal waters." For the inshore fishes

of the northern and western Gulf, Gunter ranks the species as follows:

1. Anchovy, *Anchoa mitchilli diaphana.*
2. Mullet, *Mugil cephalus.*
   Menhaden, *Brevoortia* sp.
   Croaker, *Micropogon undulatus.*
3. Silverside, *Menidia beryllina peninsulae.*
   Sheepshead minnow, *Cyprinodon variegatus variegatus.*
4. Catfish, *Galeichthys felis.*
   Sandtrout, *Cynoscion arenarius.*
5. Red drum, *Sciaenops ocellata.*
   Speckled trout, *Cynoscion nebulosus.*
   Black drum, *Pogonias cromis.*

It will be noted that the species at the top of the list are preponderantly plankton feeders. They must form one of the chief layers in the food chain, linking the macroplankton to the predaceous fishes.

The food fishes in the Gulf I have grouped according to their habitat into at least five categories that seem to fit reasonably well with the known facts:

1. The bank fishes that are taken chiefly on the offshore banks. The best known is the red snapper, *Lutianus aya*, taken throughout the Gulf on numerous banks including the Campeche Bank.

2. Stenothermal species that are not found in abundance around the northern perimeter of the Gulf. This applies to many species in the Florida Keys such as the grunts (*Haemulon* spp.).

3. Inshore species whose abundance, because of their life history, is largely dependent on the ecological conditions in the inner bays and shallows. Examples are the red drum, *Sciaenops ocellata*, the croaker, *Micropogon undulatus*, and the mullet, *Mugil cephalus.*

4. Offshore species whose life histories make them more or less independent of the waters between the mainland and the barrier islands. These include the menhaden, *Brevoortia*, the pompano, *Trachinotus carolinus*, the butterfish, *Poronotus triacanthus*, and the Spanish mackerel, *Scomberomorus maculatus.*

5. Anadromous and estuarine species that either go into fresh water at certain times or live in fresh or brackish waters. Examples are the gizzard shad, *Dorosoma cepedianum*, the striped bass, *Roccus saxatilis*, the sea catfish, *Galeichthys elis*, and the snooks, (*Centropomus* spp.).

The offshore bank fishery has been described by Jarvis (1935). There are in reality two fisheries: one by small boats that fish along the shores of the Gulf, especially along the west coast of Florida and among the Florida Keys, the other by large vessels sailing from Pensacola and a few minor ports. These larger vessels also fish the shores of the Gulf out to the 100-fathom curve (but not close inshore). However, they take the bulk of their catch from the numerous offshore shoals lying north and west of Yucatán and known collectively as Campeche Bank.

In the waters fished by the offshore vessels (about 15 to 100 fathoms) the catch consists largely of groupers and snappers, the latter preferring the deeper water. Of the snappers the most abundant is the common red snapper, *Lutianus aya.* The silk or yellow-eye snapper, *Lutianus vivanus*, is caught in deeper water than the red snapper. The Caribbean red snapper, *Lutianus aya* (regarded by Ginsburg 1930, as a separate species), is fairly abundant on the eastern part of the Campeche Bank. The black-fin snapper, *Lutianus buccanella*, abundant in the Caribbean, is taken in small quantities from the deeper waters of Campeche Bank. The smaller vessels, when fishing in the shallower waters along the Florida coast and amongst the Florida Keys, take several other snappers, especially the gray or mangrove snapper, *Lutianus griseus*, the schoolmaster, *L. apodus*, the muttonfish, *L. analis*, the Lane snapper, *L. synagris*, and the yellowtail, *Ocyurus chrysurus.*

The offshore vessels also make large catches of groupers consisting principally of the red grouper, *Epinephelus morio.* Among the Florida Keys there are several groupers usually taken: the yellowfin grouper, *Mycteroperca venenosus*, the black grouper, *M. bonaci*, the gag, *M. microlepis*, the scamp, *M. falcata*, and the jewfish, *Promicrops itaiara.*

The fisheries in the vicinity of Key West are described by Schroeder (1924). The most striking feature is the large number of species taken among the Florida Keys and along the southern tip of Florida that are either absent or scarce in the northern Gulf.

The western and northern shores of the Gulf are fringed by narrow barrier islands and reefs that cut off long, shallow bays parallel to the

coast. Only a few narrow passes connect these inner bays with the open Gulf. Because of the low range of tide levels this results in weak circulation of water between the bays and the Gulf. As a result, these bays exhibit wide ranges in temperature and salinity. The rise in the rivers following the winter rains causes a great drop in salinity; many of the bays are almost fresh for periods of a few months. Many of them normally have a salinity around 15 to 20 parts per thousand contrasted with nearly 35 parts in open ocean water. During the winter a strong, cold, north wind occasionally drops the temperature very suddenly and many of the cold-sensitive fish are killed before they can reach deep water.

The importance of the passes connecting the bays to the open Gulf is shown by the life histories of many of the species. Thus, the redfish or red drum, *Sciaenops ocellata*, the croaker, *Micropogon undulatus*, the black drum, *Pogonias cromis*, the spot, *Leiostomus xanthurus*, and the striped mullet, *Mugil cephalus*, all important sport and commercial species, crowd through these narrow passes during the fall and early winter to reach the open Gulf. Here they spawn, chiefly in the vicinity of the passes. The post-larval and young of these species are later observed in vast schools entering the passes from which they spread throughout the shallow, inner bays. A few species, such as the spotted sea trout, speckled trout, or squeteague, *Cynoscion nebulosus*, spawn within the inner bays.

One of the most interesting areas biologically is the Laguna Madre, a narrow bay 115 miles long, paralleling the Texas coast. No rivers enter the Laguna, and its only present connection with the Gulf is through Corpus Christi Bay at the northern end. In depth it ranges from a few inches to 4 feet, with occasional deep holes. As a result of the shallow depths, the lack of permanent stream drainage, the high evaporation rate, and the poor connection with the Gulf, the monthly average salinity of the upper Laguna is above 50°/₀₀, and in some years salinities well over 100°/₀₀ are found.

Despite these conditions it produces a large quantity of fish. When the salinity rises above a critical point (about 72°/₀₀, Gunter 1945b) fish start dying by the thousands. This happens every few years. Because of the life histories of the species involved and the absolute necessity that the young find suitable conditions in the inside bays, perhaps the chief fishery problem of the region is the maintenance of proper conditions in these bays.

Because of the lack of any major streams the important feature in the Laguna Madre is the high salinity. The shallowness of the water makes it impossible to obtain any significant circulation through a narrow pass, no matter what its depth, so that the only major changes in salinity occur when there is a rise in the water level across the wide, northern entrance to Corpus Christi Bay. As the tide ranges are slight the extra high levels occasionally attained through the piling up of water by strong, inshore winds are of major importance to the circulation in the Laguna.

Excluding the Laguna Madre, most of the bays behind the barrier islands and reefs are entered by large rivers. The problem in these bays is, in part, similar to that of the Laguna. They differ, however, in that while high salinity is the problem in the Laguna, these other bays are troubled chiefly by low salinity. The difficulty has heightened with the passing years as soil erosion and sparse vegetative ground cover caused by overgrazing has intensified the magnitude of the floods. The problem in these other bays may be solved eventually through better agricultural practices and through flood control and power dams that will assure a steadier flow of fresh water. A certain amount of fresh water is needed to prevent conditions similar to those in the Laguna, but too much fresh water in a short period drops the salinity to almost zero. Because of the poor circulation these flood waters take many weeks to become mixed with water from the Gulf.

In addition to those species that depend on the ecological conditions in the inner bays, there are many species on the perimeter of the Gulf whose life histories, so far as known at present, render them more or less independent of conditions in the inner bays. These probably include the menhaden, *Brevoortia*, the pompano, *Trachinotus carolinus*, the butterfish, *Poronotus triacanthus*, and the Spanish mackerel, *Scomberomorus maculatus*. The actual degree to which any one species is dependent on the inside waters is at present largely a matter of speculation. The answer lies in continued research.

There are also many species of estuarine and anadromous fishes in the Gulf. Gunter (1945a)

TABLE 1.—*United States fish production in the Gulf of Mexico and eastern Florida in 1945*

[In thousands of pounds; based on Anderson and Power, 1950]

Species	Texas	Louisiana	Mississippi	Alabama	Florida	Total
Bank species (chiefly offshore):						
Red snappers, *Lutjanus* sp	288	26	12	1,361	3,092	4,779
Groupers	17	3	7	169	8,593	8,789
Bank and reef species (except offshore):						
Mangrove (gray) snapper, *Lutianus griseus*					214	214
Jewfish, *Promicrops itaiara*	12	2		3	423	440
Muttonfish, *Lutianus analis*					213	213
Yellowtail, *Ocyurus chrysurus*					330	330
Sea bass, *Centropristes* sp					101	101
Grunts, *Haemulon* sp					188	188
Pigfish, *Orthopristes chrysopterus*					157	157
Sharks	64	13			2,028	2,105
Inshore and pelagic species:						
Redfish, red drum, *Sciaenops ocellata*	1,297	596	66	260	2,053	4,272
Black drum, *Pogonias cromis*	1,213	301	19	141	986	2,660
Croaker, *Micropogon undulatus*	35	146	2	133	298	614
Spotted sea trout, *Cynoscion nebulosus*	1,680	639	102	370	4,376	7,167
White sea trout, *Cynoscion arenarius*	40	278	198	212	395	1,123
Spot, *Leiostomus xanthurus*		112	1		450	563
Sheepshead, *Archosargus probatocephalus*	34	138		104	732	1,008
Pinfish, *Lagodon rhomboides*					157	157
Mullet, *Mugil* sp	95	76	156	3,356	34,528	38,211
King whiting, *Menticirrhus* sp	120	500	191	193	1,761	2,765
Spanish mackerel, *Scomberomorus maculatus*	14	2	7	70	10,638	10,731
Menhaden, *Brevoortia* sp			57,340		121,912	179,252
Gafftopsail, sea catfish, *Bagre marinus*	59	343		8	469	879
Snook, *Centropomus* spp	1				512	513
Tripletail, *Lobotes surinamensis*		2			63	65
Sawfish, *Pristis pectinatus*		15				15
Pompano, *Trachinotus carolinus*	4	1		4	766	775
King mackerel, *Scomberomorus* sp	22				3,897	3,919
Flounders	135	221	168	217	751	1,492
Amberjack, *Seriola* sp					376	376
Mojarra, *Gerridae*					183	183
Permit, *Trachinotus goodei*					1	1
Tenpounder, Bonefish, *Elops saurus*					613	613
Hogfish, *Lachnolaimus maximus*					15	15
Harvestfish, *Peprilus* sp					17	17
Dolphin, *Coryphaena hippurus*					83	83
Crevalle, Jack, *Caranx hippos*				62	536	598
Cigarfish, Scad, *Decapterus punctatus*					55	55
Butterfish, *Poronotus triacanthus*					27	27
Cabio, *Rachycentron canadus*				1	119	120
Blue runner, *Caranx* sp				2	1,982	1,984
Bluefish, *Pomatomus saltatrix*			1	31	1,831	1,863
Barracuda, *Sphyraena* sp					46	46
Tarpon, *Tarpon atlanticus*						
Anadromous species:						
Alewives, *Pomolobus* sp					428	428
Gizzard shad, *Dorosoma cepedianum*					550	550
Hickory shad, *Pomolobus mediocris*					86	86
Shad, *Alosa sapidissima*					842	842
Striped bass, *Roccus saxatilis*						
Brackish and fresh-water species:						
Garfish, *Lepisosteus* sp		22				22
Catadromous species:						
Eels, common, *Anguilla bostoniensis*					60	60
Grand totals	5,130	3,436	58,270	6,697	207,393	281,466
Recapitulation:						
Bank species (chiefly offshore)	305	29	19	1,530	11,685	13,568
Bank and reef species (except offshore):						
Sharks	64	13			2,028	2,105
Others	12	2		3	1,626	1,643
Total	76	15		3	3,654	3,748
Inshore and pelagic species:						
Menhaden			57,340		121,912	179,252
Mullet	95	76	156	3,356	34,528	38,211
Sciaenids (drums, croakers, spot)	2,665	1,655	279	727	5,548	10,874
Spanish mackerel	14	2	7	70	10,638	10,731
Weakfishes	1,720	917	300	582	4,771	8,290
Carangids (jacks and pompanos)	4	1		68	3,340	3,413
Porgies (sheepshead and pinfish)	34	138		104	889	1,165
King mackerel	22				3,897	3,919
Bluefish			1	31	1,831	1,863
All others	195	581	168	226	3,274	4,444
Total	4,749	3,370	58,251	5,164	190,628	262,162
All other categories		22			1,966	1,988

shows that several species are taken only at very low salinities, while many species are taken both at low and at high salinities. Information is lacking as to whether the abundance of the latter group is dependent on low salinities. It may be that the nutrients carried by the rivers are of much greater importance than the salinities in determining both distribution and abundance.

The statistics on the catch are contained in the following table. Unfortunately, the Atlantic and Gulf coasts of Florida are not separable. Most of the Florida catch is from the Gulf coast and the Florida Keys. Out of a total catch of 281 million pounds, 179 million were menhaden, leaving only 102 million pounds of food fish for the five States.

Of the food fishes Florida produced 86 million pounds against only 16 million for the other four States. Considering the long coast line involved, this is a very small fishery.

Probably the chief problem now confronting fishery biologists in the Gulf is to ascertain the cause of the low productivity of the fin-fish fisheries. It may be more than mere chance that the greatest producing areas are where the two prongs of the land, the Florida and Yucatán Peninsulas, project close to the currents that flow from the Caribbean Sea into the Gulf and then turn eastward to flow out of the Straits of Florida.

The important shrimp fisheries appear to depend on nutrients from the land. The young shrimp are reared in the shallow marshes, and the older shrimp live on the mud bottoms, especially on both sides of the present Mississippi Delta and on bottom that was part of former deltas.

From the accounts of the fishery explorations and of the red snapper fisheries one gains the impression that the bottom fisheries of the Gulf are incapable of any large expansion. There remain then, unless further research proves otherwise, two sources of possible expansion. One is the tremendous potential productivity of the inner bays if the problems of fluctuating salinities can be solved. The other lies in the expanded exploitation of the pelagic fishes, especially those subsisting on the plankton, such as the menhaden, the anchovies, and other clupeids. Only exploitation will tell us whether these fishes can support a large catch.

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TAXONOMY AND DISTRIBUTION OF SEA TURTLES[1]

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Out of the total of nine species of living turtles found throughout the world, five occur in the Gulf area. Only three of these are normally found in the Gulf of Mexico in sufficient quantity to be of any commercial value. These are the green turtle, *Chelonia mydas* (Linné), the loggerhead turtle, *Caretta caretta* (Linné), and the hawksbill turtle, *Eretmochelys imbricata* (Linné). The bastard turtle or Kemp's turtle, *Lepidochelys kempii* (Garman) and the leatherback or trunk turtle, *Dermochelys coriacea* (Linné) are comparatively few so that they have at no time been of economic importance.

Considerable confusion existed at one time regarding the nomenclature. This arose from the wide distribution of some of the species and the comparative isolation of workers in various parts of the world. The work of Stejneger and Barbour (1943–44) based upon a number of collections is used here as a basis for the systematic arrangement. A more comprehensive list of synonyms and authors is given in the earlier work of Garman (1884).

Family CHELONIIDAE

***Chelonia* Latreille,** Hist. Nat. Rept., vol. 1, 1801, p. 22.
(Type: *mydas*)

***Chelonia mydas* (Linné).** Green turtle

***Testudo mydas* Linné**
Syst. Nat., Ed. 10, vol. 1, 1758, p. 197.

***Chelonia mydas* Schweigger**
Königsberg. Arch. Natur. Math., vol. 1, 1812, Pt. 3, p. 412.

Type locality: Ascension Island.

Range: Atlantic Ocean; Gulf of Mexico; occasionally as far north as Massachusetts.

***Eretmochelys* Fitzinger,** Syst. Rept., 1843, p. 30.
(Type: *imbricata*)

***Eretmochelys imbricata* (Linné).** Hawksbill turtle

***Testudo imbricata* Linné**
Syst. Nat., Ed. 12, vol. 1, 1766, p. 350.

***Eretmochelys imbricata* Agassiz**
Contr. Nat. Hist. U. S., vol. 1, 1857, p. 381.

Type locality: American seas.

Range: Florida and Gulf coasts; occasionally as far north as Massachusetts.

***Caretta* Rafinesque,** Specchio Sci., Palmero Vol. 2 No. 9, Sett. 1, 1814, p. 66.
(Type: *caretta*)

***Caretta caretta* (Linné). Atlantic loggerhead turtle**

***Testudo caretta* Linné**
Syst. Nat., Ed. 10, vol. 1, 1758, p. 197.

***Caretta caretta* Stejneger**
Ann. Rep. U. S. Nat. Mus., 1902 (1904), p. 715.

Type locality: "About the American Islands."

Range: Atlantic Ocean, breeding as far north as Beaufort, North Carolina; north occasionally to coast of Massachusetts.

***Lepidochelys* Fitzinger,** Syst. Rept., 1843, p. 30.
(Type: *olivacea*)

***Lepidochelys kempii* (Garman). Kemp's, Mexican or loggerhead**

***Thalassochelys* (*Colpochelys*) *kempii* Garman**
Bull. Mus. Comp. Zool., vol. 6, 1880, p. 123.

***Lepidochelys kempii* Baur**
Am. Naturalist, vol. 24, 1890, p. 487.

***Caretta kempii* Stejneger and Barbour**
Check List N. Am. Amph. Rept., Ed. 4, 1939, p. 170.

Type locality: Gulf of Mexico.

Range: Northern part of Gulf of Mexico north to Cape Hatteras, and occasionally, to the coast of Massachusetts, the Azores, and the coast of Ireland.

Family DERMOCHELIDAE

***Dermochelys* Blainville,** Bull. Soc. Philom. Paris, 1816, pp. 111–119.
(Type: *coriacea*)

***Dermochelys coriacea* (Linné). Leatherback or trunk turtle**

***Testudo coriacea* Linné**
Syst. Nat., Ed. 12, vol. 1, 1766, p. 350.

***Dermochelys coriacea* Boulenger**
Cat. Chel. Brit. Mus., 1889, p. 10.

Type locality: Mediterranean Sea.

Range: Atlantic Ocean, occasionally on entire coast as far north as Nova Scotia.

Turtles usually possess bony plates covering the outer surface of the body. The plates are fused so as to form a rigid shell which may or may not be covered with horny shields. The dorsal portion is referred to as the carapace and the ventral as the plastron.

Dorsally along the median line there is a row of plates, known as the neurals, which are fused

[1] Contribution No. 108 from the Marine Laboratory, University of Miami.

with the vertebrae. The anteriormost of this is the nuchal. Lateral to the neurals are a paired series of plates which fuse with the ribs. These are the costals. The outermost edge of the carapace, enclosing the costals, consists of a series of plates called the marginals.

Green turtles.—These are characterized by a single pair of large shields, the prefrontals, on top of the head and between the eyes. Four costal only are present on each side. The shields of the carapace do not overlap as they do in the hawksbill except slightly when very young, and the margin of the carapace is smooth. The limbs are paddle-shaped and possess only one claw except in occasional aberrant individuals which have two.

The tail of the female barely reaches beyond the margin of the carapace. The tail of the male reaches some distance beyond. The eggs are soft-shelled and white in color and not quite spherical, between 40 and 46 mm. in diameter.

The size does not usually exceed a carapace length of 36 inches and a weight of 200 pounds, although 850 pounds has been recorded.

The green turtle is valued principally for use as food.

Hawksbill turtles.—Like the green turtles, these have only four pairs of costal shields. They differ in that they overlap, and the overlapping edges are rough and serrated. The margins of the carapace are markedly serrate, each marginal shield projecting from the posterior end as a pointed extremity. The marginal serration is less noticeable on the anterior end of the animal. Two pairs of large shields, the prefrontals, are located between the eyes on top of the head. The paddle-shaped limbs are each equipped with two claws, rarely one. The jaws form a hooked beak from whence the name "hawksbill" is derived.

Sexual dimorphism of the tail is the same as in the green turtle. In males the two shields in the center of the top of the head, the frontal and frontoparietal, are separate. In the female they are fused. Eggs are 38 to 41 mm. in diameter, white, with a mucilaginous coating.

Loggerhead turtles.—The distinguishing feature in these turtles is the presence of five or more pairs of costal shields instead of the four pairs in the hawksbill and green turtles. Two pairs of large shields, the prefrontals, are found on the top of the head between the eyes. Five or more costal shields are present on each side, the first one of each row making contact with the nuchal. Limbs are paddle-shaped, each with two claws. Sexual dimorphism of the tail is a feature of this species, similar to the leatherback. Eggs are approximately 42 mm. in diameter and are white and soft. Deraniyagala (1943, 1945) has good evidence that the loggerhead has broken up into several subspecies or races.

Kemp's loggerhead is distinguished by being olive green in color dorsally, whereas the Atlantic loggerhead is brown or red. The former possesses four enlarged inframarginal shields along the outer edge of the marginals. Each of these has a pore. The neurals are equilateral in a continuous series. The Atlantic loggerhead, on the other hand, has only three enlarged inframarginals which do not possess pores. The neurals in this species have elongated posterolateral sides and are sometimes interrupted by costae. The Atlantic loggerhead has two-clawed limbs. Those of Kemp's turtle are three-clawed. Three and a half feet is a good length for the carapace of the loggerhead. The weight rarely exceeds 350 pounds. Kemp's loggerhead rarely exceeds 2 feet in length. It is not of commercial importance. It is nevertheless edible although inferior to the green turtle.

Leatherback turtles.—The carapace of this species is soft and free from the vertebrae and ribs. It is covered with smooth skin instead of horny shields. Seven prominent ridges extend down the back. In the male the tail extends beyond the hind limbs when extended. The eggs are soft and white and from 50 to 56 mm. in diameter.

KEY TO THE GULF OF MEXICO SEA TURTLES

1. Back is covered with leathery skin. — Leatherback, Luth, or Trunk Turtle *Dermochelys coriacea* — 2
   Back covered with shields or plates — 3
2. Five pairs of shields or plates along the back. Color uniformly brown, black, or olive green — 4
   Four pairs of shields or plates along the back. Color brown or black mottled with yellow —

3. Inframarginals three, without pores, two-clawed, brownish.	ATLANTIC LOGGERHEAD TURTLE *Caretta caretta*
Inframarginals four, with pores, three-clawed, olive green.	KEMP'S LOGGERHEAD TURTLE *Lepidochelys kempii*
4. Shields do not overlap. Usually only one claw on front flipper. Jaw not beak-like.	GREEN TURTLE *Chelonia mydas*
Shields do overlap. Two claws on front flippers. Upper jaw forms overhanging beak.	HAWKSBILL TURTLE *Eretmochelys imbricata*

DISTRIBUTION IN THE GULF OF MEXICO

The building of harbor works, the increasing human populations in the immediate proximity of the sandy beaches used for turtle nesting, and heavy fishing in the past have all contributed to the decline in numbers of all species of marine turtles in the Gulf of Mexico. The populations have now been reduced to the point where the commercial utilization of the more common green turtle is purely local in extent and limited principally to the Florida Keys. Most of the turtles landed in Florida today are shipped from Nicaragua or from the Cayman Islands.

The green turtle is still seen frequently in the Florida Keys, but is no longer common in the western or northern part of the Gulf of Mexico although seen occasionally. This marks a definite decline in numbers, since 3,500 pounds of green turtle were landed in Louisiana in 1936. Since then the catch has declined and is no longer reported. In Texas the most recently reported catch is for 1925 when 2,550 pounds were landed. This may be contrasted with landings of 90,793 pounds in Louisiana and 83,000 pounds in Texas during 1890. In the same year 468,256 pounds were landed in Florida. This is now reduced to less than 50,000 pounds, a large proportion of which is imported.

The hawksbill turtle has similarly declined. These are present throughout the Caribbean and are still to be seen frequently in the Florida Keys. They are not common anywhere else in the Gulf of Mexico.

The Atlantic loggerhead turtle is most often found, although not abundantly, in the Gulf of Mexico, more so off the eastern shores and the Florida Keys. Kemp's loggerhead is rarely recorded, possibly because it may be confused with the Atlantic loggerhead. It is found occasionally on most parts of the Gulf coast and rarely on the Atlantic coast.

The leatherback turtle is widely distributed throughout the tropical and subtropical seas. It is nowhere common, however, and is rarely seen today in the Gulf of Mexico. Since it prefers deep water to the shallow bays and lagoons, there is less opportunity for observing it, and this may partially account for its apparent rarity.

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