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The Gulf of Mexico Menhaden Fishery in Relation to the Sports Fisheries

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Abstract

The coastal waters from Pascagoula, Mississippi, to Port Arthur, Texas, produced 21% of the fishery landings of the United States during the years 1961 and 1962. The commercial fisheries depend largely upon the menhaden, shrimp, industrial fish (so-called), oysters, and crabs. Menhaden live in large schools and the schooling behavior is the only way the fish has of protecting itself. Fishermen want only menhaden because of its oil and they lose money if other fish are caught. Menhaden schools consist purely of menhaden but there are hangers-on around the edges consisting of such fishes as sharks, mackerel, bluefish, jacks, and other predators. Large, powerful fishes generally avoid menhaden nets and are not taken except in small numbers. The assertion that menhaden nets destroy large numbers of other fishes is not true, as has been shown by several careful investigations. Throughout the years menhaden nets have been developed for the catching of menhaden alone. If menhaden nets were good gear in which to catch other commercial fishes, which are the same as the estuarine sports fishes, they would have been adopted by the commercial fishermen long ago or they would have put the other commercial fisheries out of business. During the past five years, if all the sports fishes caught had been marketable, the menhaden boats would have taken a total of 87,000 pounds of fishes a year from Mississippi waters. Marine nets do not destroy the spawn of fishes, as may be demonstrated in several ways. Menhaden nets are said to drag the bottom and stir up the mud. They are not made to do so and they do not drag the bottom nearly so much as an ordinary shrimp trawl. Furthermore, if they did drag the bottom they would benefit the region. It has been charged that the decline of sports fishes on the Mississippi coast for the past several years has been due to the menhaden fishery. There is no proof that the sports fishes have declined and it would be strange if the sports fishes declined in the waters which have been so fertile as to produce menhaden at the rate of a billion pounds a year. Menhaden form a small component of the food of other fishes. The menhaden fishery is not in competition with sportsmen or other commercial fisheries. Charges brought against the menhaden industry have no reasonable basis and some of them are preposterous. This is another example of misplaced conservation zeal which will do more harm than good, if the radical statements are given any credit. The real marine conservation problem in Mississippi is the maintenance of the bays in their unpolluted and pristine condition. Misplaced conservation activities misdirect the attention of the general public into fruitless

blind alleys. Today sportsmen catch 34 to 37 million pounds of fish from the bays of Texas without materially reducing the supply. Almost forty years ago sportsmen began to move against the small Texas commercial fin-fishery which produced only about 4 million pounds a year and finally forced this fishery down to where it is now about 1 million pounds a year. The commercial fishery could easily have taken 10 to 20 million pounds of fish with no damage to the stocks and produced cheap food. Instead they were forced out of business years ago. The fish they would have caught are all dead and wasted now and Texas has lost about a half billion pounds of cheap fine food during the last forty years. This is an example of misplaced conservation zeal.

INTRODUCTION

THE AREA from Pascagoula, Mississippi, to Port Arthur, Texas, currently produces 21% of the commercial fishery landings of the United States. It is one of the most productive fishery areas in the world. It is also an extremely fertile area for sports fishes, particularly those of the estuarine type such as speckled trout, redbfish, drum, croakers and their relatives, and flounders. Both the commercial and sports fishes of this area are largely estuarine, with the exception of the high seas forms such as sailfish, tuna, spearfishes, and to a lesser extent, mackerel. The average coastal sport fisherman deals with the inshore or estuarine fishes and so does the commercial fisherman. The commercial fishery depends largely upon menhaden, industrial fishes, shrimp, oysters, and crabs. There is practically no competition between sport and commercial fishing because different species are exploited.

The menhaden is a plankton feeder or water strainer and it is extremely abundant because it feeds upon the myriads of small microscopic organisms growing in the water without depending upon such intermediate animals as shrimp, crabs, small clams, or small fishes. Apparently there is never a dearth of food for the menhaden and thus it grows in enormous numbers. It is a very oily and bony fish and is not used for human food.

FISH CAUGHT IN MENHADEN NETS

Menhaden live in large schools in the bays and are caught by nets which surround the schools. These nets are brought together at the bottom and the whole school is surrounded. The fishermen only want menhaden because they lose money if other fish are caught and, in fact, menhaden schools consist purely of menhaden. Hangers-on around the edges of these schools consist of sharks and in saltier waters of mackerel, bluefish, and jacks. These large, powerful fishes generally avoid the nets and are not taken except in small numbers. The assertions that menhaden fishermen destroy large numbers of other fishes are simply not true, as has been shown by several expensive and careful investigations.

Filipich (1947) made five unannounced checks of menhaden boat unloadings at Mississippi factories. In 295 tons of menhaden unloaded he found one mackerel and six white trout. An investigation by six different people for the Texas Game and Fish Commission conducted in 1948 and 1949 (Miles and Simmons, 1950; Knapp, 1950) showed that one other animal, including shrimp and crabs, was taken for each 4,490 menhaden. These workers found that among 5,326,000 menhaden there were 36 gafftopsail catfish, 75 crabs, 91 jacks, 103 croakers, 191 shrimp, 205 Spanish mackerel, 242 white trout, 304

bluefish, and a few other fishes, the total being 7,589. They found that the percentage of other animals caught was 0.024. Workers at the Gulf Coast Research Laboratory (Christmas, Gunter, and Whatley, 1960) made a study in 1958-59 which showed that 97.2% of the menhaden catch in Mississippi and Louisiana was menhaden. A total of three-fourths of all the other fishes caught, 2.4%, were mullet and croakers. Thus, the remaining fishes caught amounted to 0.4%. Of this remainder, 617 were catfish, gizzard shad, sharks, and rays. The sports fishes taken among 56,000 menhaden amounted to 0.31%. They were: 83 white trout, 70 sand trout, 29 whiting, 7 speckled trout, 5 Spanish mackerel, and 3 bluefish, a total of 197.

Other investigations conducted on the Atlantic coast as long ago as 1894 (Smith, 1896) showed that menhaden fishermen destroyed very few other fishes. In fact, results were very similar to those found in Texas almost fifty years later and those found on the Mississippi and Louisiana coast nearly seventy years later. The menhaden has no means of defense against its predators except to flee and the individuals protect themselves somewhat by dense schooling. Menhaden fishermen want only menhaden because the other fishes do not yield the high oil content the menhaden industry is seeking. Throughout the long years they have learned to fish in a way which catches menhaden and few other fishes. Unbiased investigations by reputable scientists have shown that, except for mullet and croakers, the menhaden catch on the Gulf coast amounts to about 0.4% other fishes. The Mississippi menhaden industry has a standing offer to take anyone aboard the fishing vessels at any time and demonstrate the operations.

It should be pointed out that if fishing with menhaden nets were a good way to catch other fish, these methods would have been adopted by commercial fishermen long ago. As a matter of fact, it is not a good way to catch other fish as it has been perfected through many years for the catching of menhaden. The facts may be shown by the catch statistics. During the past five years Mississippi menhaden boats have landed an annual average of 216,183,000 pounds of fish, of which an average of 29,068,000 pounds (15%) came from the waters of Mississippi Sound. If all specimens of sports fish caught were of marketable size, the menhaden industry would have taken a total of 87,000 pounds per year from Mississippi Sound. Actually, the total commercial catch of marketable white trout, speckled trout, redfish, and flounders from the Mississippi coast amounted to about 332,000 pounds per year during the past four years. If the menhaden fishermen caught very many commercial fish other than menhaden, they would have long ago put the other commercial net fishermen out of business and these men would not have to go to the trouble of catching fish. Instead they would only have to select their catch from the menhaden boats, and that would be done because the commercial food fish are much higher priced than menhaden.

MENHADEN AS THE FOOD OF OTHER FISHES

Large menhaden are not taken by the ordinary bay fishes because they are too large to swallow, but they are the food of the slow moving sharks, a number of which are caught and destroyed at every setting of the menhaden nets. They are also prime food of the bluefish. The bluefish is highly predatory and it kills a great many more fish than it can eat, apparently for the pure fun

of killing. Large schools of bluefish probably decimate menhaden and other fishes in great numbers when they are present in the saltier waters of Mississippi Sound. Spanish mackerel eat menhaden but not in great numbers and the chief food of that fish is the so-called mackerel minnow, which is an anchovy. According to Reid (1955) small menhaden are eaten in considerable numbers by the white trout, *Cynoscion arenarius*, in Texas bays and this is the only report indicating that menhaden form a considerable part of the food of any fish.

I (Gunter, 1945) examined the stomach contents of 153 speckled trout ranging in size from 11 to 22 inches in length. Fifty-nine fish were empty and 8 contained indistinguishable material. The remaining 93 trout contained 28 fish of undetectable species, 28 mullet, 5 silversides, 5 cyprinidontid fishes, 3 menhaden, 1 pinfish, 1 pigfish, 26 commercial shrimp, 7 grass shrimp and 6 blue crabs. The following paragraph is quoted from that report:

"Pearson (*op. cit.*) found that the speckled trout fed largely on shrimp. My data show that they fed mostly on fish, but the discrepancy is due chiefly to the fact that most of the fish I opened were taken in winter months when shrimp were scarce. There seems to be no doubt that shrimp are preferred and during warmer months the food was found to be largely shrimp. On January 18, 1941, there was a freeze on the coast and shrimp immediately became scarce. Up to that time speckled trout had been feeding largely on penaeid shrimp, but after the freeze their food intake changed quickly and mullet became the chief food. The writer found no gobies, such as Pearson found in trout. Probably these little fishes are eaten by small trout which live largely in grass and which I did not open. Trout are voracious and the number found to be empty indicates that digestion is rapid. Five speckled trout contained mullet about half as long as themselves. One fish 44.5 cm long had eaten a mullet 26.0 cm long."

No menhaden were found in the stomachs of 124 black drum. The drum apparently lives mostly on crustaceans and mollusks. No menhaden were found in the stomachs of 25 croakers and 2 whiting. I also examined the stomach contents of 237 redfish ranging from 9 to 29 inches in length. Thirty-eight fish were empty and three contained soupy material. Algae and grass were found in 10 stomachs and probably were taken incidentally with other food. The remaining 194 fish had eaten fish 49 times and crustaceans 177 times. Fish only were found in 20 stomachs and crustaceans only were found in 146 stomachs. The fishes taken were mullet, eels, gobies, cyprinidontids, anchovies, one hardhead catfish, one spot, and one small flounder. One redfish 20 inches long had eaten a hardhead catfish 8 inches long. No menhaden were found. The main food consisted of blue crabs, commercial shrimp, grass shrimp, mud crabs, and mud shrimp. Strangely enough these redfish had eaten amphipods (beach and water fleas) several times. These little animals are too small to be taken one at a time and probably they were snuffed up when found in bunches.

Sixteen flounders 9 to 10 inches long were examined for stomach contents. Eight of them were empty, seven of them had eaten mullet, anchovies, pinfish, and moharras. Commercial shrimp were contained in three stomachs and one had eaten a stone crab. The flounder is a bottom feeder and it would not be expected to take menhaden very often.

Other extensive studies made in Texas waters were summarized by Miles

and Simmons (1950). They show that the menhaden do not form large amounts of food even of the mackerel which are taken around menhaden schools. Mackerel were found to take small menhaden and bluefish took larger ones. A total of 26,005 fishes of forty species contained 581 menhaden, about 1 menhaden to every 45 fish.

In summary, large menhaden form a considerable component of the food of the bluefish, which is a highly destructive predator, and a minor component of the Spanish mackerel food. Menhaden are minor components of the food of sports fishes in Mississippi Sound with the possible exception of the white trout which apparently eats considerable amounts of small menhaden before they obtain the size which the menhaden industry catches. The chances are that if the total menhaden population were to disappear that event would not initiate a decline in the populations of sports fishes of the Mississippi Gulf coast.

MENHADEN NETS CHARGED WITH DESTROYING SPAWN

People who are acquainted with the nests of fresh water sunfishes and the eggs of trout, salmon, and striped bass, which are all spawned in rivers, have charged that menhaden nets destroy the eggs and spawn of the marine sports fishes. It has been charged even in public hearings that the eggs of bluefish, mackerel, kingfish, pompano, and others were destroyed by the menhaden nets. This is really a weird idea and the marine biologist is surprised when it is brought up because it is so far fetched it never crossed his mind. There are several reasons why the charges are untrue.

In the first place, marine fishes in question do not build nests and there is nothing to be swept away by a menhaden net or a trammel net or an otter trawl. The eggs of marine fishes are quite minute and most of them are not recognizable as to species, because they are all so similar. They are shed free in the water and are then at the mercy of the waves, winds, and currents. The young of the mackerel, pompano, kingfish, lemon fish, and others do not enter the bays and low salinity waters. In fact, they are found outside in the open sea, and the pompano especially are found in the boiling surf of the Gulf beach along with hosts of other small, clear, jelly-like larval fishes upon which they feed. It was a matter of amazement to me when I first observed this situation and saw that such small delicate organisms could survive in the turbid, sandy, rolling surf.

Another reason why the menhaden nets do not destroy the spawn of the bay fishes is because nearly all of the important and abundant species spawn in high salinity waters. This holds true for the redfish, the menhaden, the blue crab, the three species of commercial shrimp on this coast, the croakers, and the mullet. The mullet has been taken while spawning at sea 100 miles south of Mississippi Sound. Because the eggs are at the mercy of the winds and currents probably a great many of them are lost and the young fishes do not make it back into the bays, which they must do, apparently, or perish. For that reason, apparently, nature has insured the future crop by always having a vast over-supply of eggs. One oyster alone spawns about forty million eggs a season and it has been calculated that the shrimp shed several trillion eggs into the waters of the northern Gulf every year. These numbers are so vast that if all the larval shrimp made it into the bays there would not be enough

room to support them, and in fact the shrimp that do grow to maturity are only a minute fraction of one % of the numbers of eggs which are spawned. The speckled trout, the white trout and the hardhead catfish, which carries its eggs in its mouth, are the only well-known abundant fishes that spawn in the bays. The trout spawn in the grass beds and the small fish stay there. These areas are not fished by netters. The young shrimp, the young mullet, the young menhaden are always found close to shore. They do not venture into offshore waters until they reach considerable size and are past the larval stage. Thus, they are not disturbed by the shrimp trawls or menhaden fishermen.

Another reason why the menhaden nets do not hurt the spawn of the common sports fishes is the fact that this spawn is not present during the menhaden season, which extends from April to November. The menhaden themselves and the mullet are fall and winter spawners. The same thing holds true for the redfish and the two species of croakers caught by sports fishermen. The flounder is a fall to spring spawner. The black drum is a winter to spring spawner. The white trout and the speckled trout are spring to fall spawners and they are the only two species of the common sports fishes with spawn in the bays during menhaden season. However, they spawn in grass beds in shallows near shore, as stated above, and do not leave these beds until they are a few inches long. For that reason the young are not taken by the menhaden fishermen nor by the shrimp trawlers.

In fact, all eggs and larvae in the sea and the bays are apparently undisturbed by nets or by boats because they are cushioned by the water. The same thing happens to the eggs of the striped bass which are spawned in the rapids of the Roanoke River. They are so delicate that if touched by one hair of a camel's-hair brush in the laboratory they will die. Nevertheless, they are buoyed by the water in the rapids and never touch the rocks or the bottom. It is barely possible that the high speed propellers of the boats destroy some spawn, but that is unlikely. We know, for instance, the delicate shrimp larvae, barnacle larvae, and oyster larvae will go through high speed pumps and end up inside the laboratories in pipes and aquaria where they will grow. Sometimes this fouling material causes trouble in pipes where there is considerable salt water intake. This being the case, it is highly improbable that the slow pull of a net mesh through the water will damage spawn. Thus, neither the commercial trammel netter, or shrimp trawler, the bait fisherman on shore, or the menhaden netter destroys the spawn or larvae when their nets are dragged through the water. Furthermore, it is highly doubtful that high speed propellers do any damage. This situation may become changed when jet propelled boats are used which will throw large amounts of heat into the water. Quite probably that process will kill larvae of all kinds.

MENHADEN NETS SAID TO DRAG THE BOTTOM AND STIR UP MUD

Menhaden are surface fish for most of the time when they are in the bays and the schools are detected by sight. The menhaden net is pursed from below by a process equivalent to pulling the draw string of a pouch. Probably the nets do drag the bottom for a little distance but it is not very much and not very hard and it does not visibly muddy the water. In fact, no menhaden net drags the bottom nearly so much as the boards of a shrimp trawl being pulled

over a distance of 25 to 50 yards. Even so, this process is not harmful and in fact it probably is beneficial to life in the bays.

It is a well-known fact that large fresh water reservoirs slowly decrease in their production of sports fishes over the years. One idea concerning this decrease is the fact that the phosphate and other fertilizer salts, necessary to the minute plant plankton in the water, are buried in the sediment. I have discussed with fresh water biologists the idea of getting some sort of plow with which to plow the bottoms of these waters and rejuvenate their fertility. It is also recognized that part of the phosphate coming into the bays of the Gulf coast is buried in the sediments and, therefore, the scratching of the bottom by the trawl boards has a beneficial aspect.

A period of high winds kicks up more sediments in the bays than all the hydraulic dredges, channel dredges, and all the shrimp trawlers on the coast could possibly do. The shore waters of the entire Gulf coast are nearly always muddy and turbid. The estuarine animals of the area are accustomed to it and it is their natural environment. Strong hurricanes cut new channels through islands, deeply erode the shore, and stir up the bottom terrifically. They do change the populations of shrimp and fish and move them about and sometimes they bury oyster beds or even roll them ashore. Nevertheless, no long term decline in sports or commercial fishing has ever been noted as the result of a hurricane. Their effects on marine life seem to be local and transient and not very great. These great storms muddy the water more than any human agency could possibly do, but they do not seem to cause any great damage to the fish populations. Ingle (1952) of the Florida State Board of Conservation has shown that shrimp gather around the outlets of hydraulic dredges in turbid waters, and the shrimp fishermen have learned that such areas are good places to trawl when the dredges are in operation.

In summary, it may be said that menhaden nets muddy the water much less than other types of fishing and human activities, and further, that stirring up the mud of the bay bottoms is probably beneficial instead of harmful.

THE DECLINE OF SPORTS FISHERIES OF THE PAST SEVERAL YEARS HAS BEEN DUE TO THE MENHADEN INDUSTRY

Accurate records of commercial fisheries production have been kept by the federal government and the State of Mississippi for many years. The trammel net fishermen and the trot-liners have produced a rather modest amount of trout and redfish for several years and this production has not changed. The oyster production has increased tremendously and shrimp production is in more or less of a steady state. The menhaden fishery has slowly increased until last year it was over a billion pounds for the whole Gulf. The same thing held true for the previous year. If the menhaden were a primary food for sports fishes, it is to be expected that the sports fish population would have been going up. As a matter of fact, there is no indication that this is not true for there are no statistics on the sports fishermen's catch. Since the recent arguments over menhaden, the New Orleans sports writers and even some of the people who have attacked the menhaden industry have written that fish are biting fine on the Mississippi coast and that people should come and go fishing. Furthermore, it is a well-known fact that sports fishing has increased a great deal and there are many more fishermen in the bays today than there were ten years

ago. With a steady production of fish there are probably less fish for each individual fisherman. Nevertheless, there is no indication that any of the common species are being over-fished or exterminated either by the netters or the sportsmen. In an open meeting one man charged that he had to go to Breton Sound to catch an adequate supply of redfish. As pointed out below, redfish very seldom take menhaden. Furthermore, menhaden were not running in Breton Sound and Chandeleur Sound this year and that is the reason the menhaden boats were operating in Mississippi Sound. If the menhaden were a prime food of the redfish, they would have followed the menhaden schools rather than being down in Breton Sound where menhaden were scarce at that time. Such charges as these are simply unreasonable and they have no factual base or background. The same thing holds true for most of the other things that have been said about the menhaden industry by sportsmen.

THE MENHADEN INDUSTRY SHOULD BE PUT OUT OF MISSISSIPPI SOUND AND FORCED TO FISH SOUTH OF THE BARRIER ISLANDS

Where the fresh waters meet the sea, as they do in Mississippi Sound and along the Louisiana coast, there is a mixture of fresh water and sea water and the salinities are of intermediate values. These are the areas that are called brackish or estuarine waters. Such areas are the home of the oyster, the menhaden, the croaker, the mullet, the speckled trout, and the white shrimp.

The menhaden fishery is an estuarine fishery and it could no more operate outside of Mississippi Sound than the oyster dredges could. During the 1958-59 season, workers at the Gulf Coast Research Laboratory analyzed the catches of boats which fished for 26 days in Louisiana and Mississippi. Ten sets were made west of the Mississippi River, 44 were made in Breton Sound, 8 were made in Chandeleur Sound and 24 were made in Mississippi Sound. Every one of these hauls was made in depths of less than three fathoms. Three million fish weighing two million pounds were caught and the total was equivalent to about 20% of the yearly catch of one boat.

The salinity of the water was tested at each set by the investigators. It ranged from 6.2 to 31.6 parts per thousand (ppt). Here it should be pointed out that salinity of pure sea water on the Gulf of Mexico coast is 36.5 ppt. In other words, if you had a thousand pounds of sea water and evaporated it all down there would be 36.5 pounds of salt left.

The fishery studied above was typical of the whole fishery and the boats observed were average menhaden boats. The average salinity at which all sets were made was 21.4 ppt (0.6 sea water) and 88% of all hauls were made between salinity ranges of 15-29 ppt. Such salinities are found in the bays and sounds and they do not exist in the Gulf of Mexico off Mississippi. Obviously the menhaden fishery, like the shrimp and oyster fisheries, depends upon the estuaries and it cannot be exiled into the Gulf of Mexico where it could not exist.

AN EXAMPLE OF MISPLACED CONSERVATION ZEAL

About forty years ago sports fishermen in the State of Texas began to move in on the net fishermen, who were then producing only about 4 million pounds of fish a year. They slowly closed the bays to all net fishermen and reduced the

annual commercial catch to around 1 million pounds. Even so, it was observed during this period that hard cold spells on the Texas coast would kill up to 90 million pounds of fish a year, which caused a reduction in the fish population (Gunter, 1952). Furthermore, it was shown by two very careful studies (Belden Associates, 1958, 1961) that the sports fishermen catch in Texas waters today amounts to 26 to 40 million pounds of fish a year, without any apparent reduction in the catch from year to year. The commercial fishermen themselves only produced a peak catch of 11 million pounds a year during the war years, when all regulations were relaxed. Obviously the commercial netters could have produced some 10 to 12 million pounds of fish a year without infringing at all upon the sportsmen, who nevertheless put them out of business. Thus the State of Texas lost in cheap wholesome food about 6 to 10 million pounds of fish every year for about forty years. Years ago there were practically no sports fishermen on the Texas coast compared to what there are today, and today the sports fishermen are taking 30 to 40 million pounds of fish without reducing the fish population. The commercial fishery could have done the same thing for many years to the benefit of all the people, but they were not allowed to do so because of misplaced conservation zeal carried on and promoted by people who did not understand marine biology or fisheries. Fish are short lived animals and the Texas fishes of past years are now all dead and wasted and the resource went unutilized. Similar situations should not develop on the Mississippi coast or elsewhere.

CONCLUDING STATEMENT

Throughout the years, I have pondered the demands of certain groups of people concerning the fishery industries, all set forth in the name of conservation, although baseless and unreasonable with no facts to support them. I have come to the conclusion that a certain percentage of the population dislikes seeing another man catch a fish or fishes, especially in large quantities, and they assume that somehow or another they are injured thereby. So far as I can see this is the only explanation for some of the baseless contentions that have been advanced about the menhaden fishery on the Gulf coast.

The menhaden fishery is a legitimate fishery which is not in competition with the sportsmen or with the other commercial fisheries. It does not destroy sports fishes or other types of fishes. It does not destroy the food of other fishes and it certainly does not destroy the spawn. Most of the charges brought against the menhaden industry have no reasonable basis and some of them are obviously preposterous. The whole situation is another example of misplaced conservation zeal which will do more harm than good if these radical statements are given any credit or countenance by the officials of the State of Mississippi.

The real marine conservation problem in Mississippi is the maintenance of the bays in their unpolluted pristine condition. If this is done, there will always be sports fish, menhaden, oysters, commercial fish, and shrimp resources. If it is not done, the resources will disappear. One thing that misplaced conservation activities do, such as the unjustified attacks upon the menhaden fishery, is to misdirect the attention of the general public away from the primary conservation problem, which is the preservation of the bays, and into fruitless blind alleys.

LITERATURE CITED

- BELDEN ASSOCIATES
1958. The salt water fish harvest of Texas sportsmen, September 1957-August 1958. First Survey for The Texas Game and Fish Commission.
1961. Salt water fish harvest of Texas sportsmen September 1959-August 1960. Second Survey for The Texas Game and Fish Commission, 88 p.
- CHRISTMAS, J. Y., GORDON GUNTER AND EDWARD C. WHATLEY
1960. Fishes taken in the menhaden fishery of Alabama, Mississippi, and eastern Louisiana. U.S. Fish Wildl. Ser., Spec. Sci. Rep.—Fish. No. 339, 10 p.
- FILIPICH, MECO
1947. Report to the Mississippi Seafood Commission, Biloxi, Mississippi. Menhaden Plants Report, 4 p. Advertiser Printing Co., Pascagoula.
- GUNTER, GORDON
1945. Studies on marine fishes of Texas. Publ. Inst. Mar. Sci., Univ. Tex., 1 (1): 1-190.
1952. The import of catastrophic mortalities for marine fisheries along the Texas coast. Jou. Wildl. Mgt., 16 (1): 63-69.
- INGLE, ROBERT M.
1952. Studies on the effect of dredging operations upon fish and shellfish. Fla. St. Bd. Conserv., Tech. Ser. No. 5, 26 p.
- KNAPP, F. T.
1950. Menhaden utilization in relation to the conservation of food and game fishes of the Texas Gulf coast. Trans. Amer. Fish. Soc., 79: 137-144.
- MILES, DEWEY W. AND ERNEST G. SIMMONS
1950. The menhaden fishery. Bull. Tex. Game, Fish Oyster Comm., 2: 1-28.
- REID, G. K., JR.
1955. A summer study of the biology and ecology of East Bay, Texas. Tex. Jour. Sci., 7 (3): 316-343.
- SMITH, H. M.
1896. Notes on an investigation of the menhaden fishery in 1894, with special reference to the food-fishes taken. Bull. U.S. Fish Comm. 1895, 15: 285-302.
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The Importance of the Occurrence of Menhaden in the Coastal Waters and Estuaries of Peninsular Florida

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Abstract

Current information on the distribution and seasonal occurrence of juveniles and adults of three species of menhaden in Florida waters is summarized. Results suggest a resource potential of sufficient magnitude to support a commercial fishery, particularly off the southwest coast during the fall and winter.