

is that someone must show the way. In the South the only people with the skill and patience required are the men of the U. S. Bureau of Commercial Fisheries. It is up to the fishing industry to make plain to the Fish and Wildlife Service in Washington that they must not overlook the fact (as they sometimes do) that shrimp and menhaden are this country's two greatest fisheries resources, and then it is up to the fishing industry to help Fish and Wildlife get the money needed to implement the experimental fishing.

To the skeptics I merely point out the Pacific Coast tuna industry: three years ago it was almost bankrupt; and spent its time and money with hat in hand begging Congress to protect it from hard-working foreigners just as our shrimp and menhaden industries are doing today. Converting from live-bait boats to purse-seiners, the Pacific Coast tuna fishermen are now prosperous, new boats are again building, and thousands of shrimp trawlers now working will accomplish the same result for the shrimp and menhaden industries.

A Challenge to the Fish Meal and Oil Industry in the Gulf of Mexico

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THE CLUPEOID OR HERRING-LIKE FISHES constitute the most abundant fishery resource used by man and account for nearly one fourth of the world's total fish production. Historically the herrings have been utilized directly as food, but in recent years these fishes have achieved greater importance as the principal raw material of the fish meal and oil industry. The distribution of these fishes is worldwide. Most of the numerous species in the group occur in the ocean where they are principally confined to the coast or at least are not concentrated far from shore.

There are other important characteristics which make the herring-like fishes particularly desirable to the fish meal and oil industry (1) Most of these fishes normally occur in dense schools. Furthermore, they generally school by species, and the individual schools usually consist of fish which are fairly uniform in size. These schooling characteristics facilitate mass production methods of catching, handling, and processing. (2) The herrings are plankton feeders and thus form one of the early links in the food chain; consequently they are among the most numerous fishes. The menhaden, for example, is one of the few fishes that feeds directly on the basic food producer in the ocean and thus represents a two-link food chain—the shortest possible and uncommon among the fishes in the sea. (3) They grow rapidly and reach maturity early; consequently many species can be utilized at the end of their first year of life and probably afford the maximum yield by the end of their second or third. (4) Many of the clupeoids undertake seasonal and annual migrations which lead them into areas where they can be conveniently caught. (5) Fishes in this group are relatively high in protein and body fat.

Because of these and other characteristics, there is little doubt that the

clupeoid fishes in the Gulf of Mexico constitute the most promising resource, yet of the 25 generally recognized species in this group which occur in the Gulf and contiguous waters, only two—the Gulf menhaden, *Brevoortia patronus*, and the anchoveta, *Cetengraulis edentulus*—are being utilized by the fish meal and oil industry.

In the search for basic knowledge of the species which constitute the menhaden resource and their distribution in time and space, several survey trips were made along the southeast coast of the United States during late 1958 and 1959. Results revealed that the stocks along the Atlantic and Gulf coasts were not isolated and separated from each other as believed, but were distributed continuously around the Florida peninsula (Reintjes, 1960). This finding showed that the distribution of these fishes in the Gulf of Mexico was much greater than was reported. During the past year, therefore, efforts were directed toward the collection of the various species of menhaden in coastal waters from Fernandina Beach, Florida, on the Atlantic coast to the Gulf of Campeche. A second objective of the field work was to obtain information on the distribution and relative abundance of other herring-like fishes of potential value to the fish meal and oil industry.

Based upon field observations, discussions with fishermen and processing plant operators, and extensive collections, it was obvious that the clupeoid fishes in the Gulf of Mexico are much more widely distributed and occur in greater abundance than previously known.

The primary purpose of this paper is to summarize present information on the range, relative abundance, and seasonal occurrence of several species in the hope that it may stimulate exploration and subsequent utilization by the fish meal and oil industry.

The Gulf menhaden at present is the more important of the two species being utilized. Juveniles occur in schools in the open waters along the Gulf coast from Mexico to southern Florida. Larvae appear in salt-water lagoons and estuaries along the Gulf coast during the winter months, and young-of-the-year juveniles are encountered in these same areas throughout the summer. This species supports the commercial purse-seine fishery which is conducted generally from mid-April to mid-October in the vicinity of Apalachicola, Fla., and along a relatively short stretch of coast lying between Alabama and Texas. Samples from the catches indicate that the fishery is based on 1- and 2-year-old fish. Older, sexually mature fish are generally absent from the catches. Collections from southern Florida and Mexico (southward to Yucatan) have shown that during the summer adults increased in size toward the southern limits of the range; however, the abundance of both juveniles and adults appeared to diminish. The occurrence of large, adult Gulf menhaden in southern Texas and in the vicinity of Veracruz in mid-summer suggests a greater abundance of this species in the southern Gulf of Mexico during the winter when it disappears from more northerly waters. It also is of interest to note that spawning adults of this species were taken during the past two winters off the east coast of Florida, and some of the catch in the Indian River area this fall has consisted of large, spawning adult fish provisionally identified as Gulf menhaden. These averaged about 10 inches in length. In summary, present information indicates that either this species has an unusually short life-span, which based on present information appears unlikely, or the adult segment of the population is not being utilized by the fish meal industry. If the older,

larger fish exist in concentrations—and we believe that they do—and if these could be located and caught, they could appreciably increase the yield and afford a greater economic return than is now being realized from the species population.

The finescale Gulf menhaden is known to occur from eastern Louisiana to the Gulf of Campeche (Christmas and Gunter, 1960) and there is evidence to suggest that it extends around the Yucatan Peninsula and into the Caribbean Sea. This species does not occur in abundance in purse-seine catches; however, individual landings consisting entirely of finescale Gulf menhaden have been reported in western Louisiana waters and off Campeche. This past summer, large adults were present in beach-seine, gill-net, and shrimp-trawl landings along the entire Texas coast. Since none of these gears is adapted to catching menhaden, even in areas of known abundance, their occurrence in the catches is of significance. Juveniles of this species also were obtained as far westward as the Laguna Madre of Texas. It is concluded that this species constitutes an unknown resource which apparently occurs in greatest abundance from Corpus Christi, Texas, to the lower Gulf of Campeche.

Yellowfin menhaden are distributed continuously from the central east coast of Florida to the delta of the Mississippi River. A gill-net fishery for this species for bait purposes is conducted throughout the year in Indian River, Florida. Landings in recent years have averaged about 325,000 pounds, and the fish have been available throughout the year. Fish in the catches are consistently large, ranging from about 8 to 12 inches in length. Adults of this species also have been caught by gill nets in Florida Bay near Marathon during the winter and off Naples in early spring. Eggs, larvae, and juveniles of this species have been collected in Indian River, and juveniles have been encountered in abundance in estuaries near Everglades City, Naples, Punta Gorda, and in Tampa Bay, Fla. It appears that the areas of greatest abundance of yellowfin menhaden are from Cape Canaveral to St. Lucie Inlet on the Atlantic side and from Cape Sable to Sarasota, Fla., in the Gulf of Mexico. The whereabouts of the younger adults are unknown, yet it probably is this segment of the species population which offers the greatest potential to the fish meal and oil industry.

The thread herring, *Opisthonema oglinum*, occurs generally throughout the Caribbean and along the Gulf coastal states southward to the Gulf of Campeche. This species was found to be available in large quantities throughout the year along the west coast of Florida and appeared to be present in large numbers in the shallow coastal waters of the remaining Gulf states during the summer. Based on surface school observations and the results of experimental fishing by Bureau's exploratory vessel M/V *Oregon*, it has been estimated that this species is more abundant than the Gulf menhaden. It can be caught with standard menhaden purse-seine gear since substantial landings are made each fall at Beaufort and Southport, N.C., when schools are encountered in the shallow waters along the shore. The oil yield at that time of year generally exceeds that of menhaden of comparable size. The fish reach a maximum length of about 12 inches.

Several species of anchovies occur along the Gulf coast and through the West Indies. The most abundant species appeared to be the bay anchovy, *Anchoa mitchilli*, which is distributed in the northern and western Gulf to Texas where surface schools are available from early spring through late

autumn. Indeed Gunter (1945) has estimated this to be the most numerous species in Texas coastal waters. The anchoveta, *Cetengraulis edentulus*, occurs in quantity in southern Gulf of Mexico and is the principal species presently being exploited by the purse-seine fishery in the Gulf of Campeche.

Other clupeoids such as the scaled sardine, *Harengula pensacolatae*; Atlantic round herring, *Etrumeus sadina*; and the Spanish sardine, *Sardinella anchovia*, may also exist in mid-water depths in commercial quantities, but there is little precise knowledge of their seasonal distribution and relative abundance.

The Bureau's Pascagoula, Miss., Exploratory Fishing Base has gathered a wealth of information on the geographical distribution, seasonal occurrence and relative abundance of the Gulf clupeoids. These catches are being examined in detail for species identification and length, weight, and maturity condition of the fish. The Bureau's Biological Laboratory at Galveston also is gathering information on those clupeoid species which appear in the industrial trawl fishery conducted in the northern Gulf. Summaries of these data will be of great value to those individuals within the fish meal and oil industry who are interested in locating and exploiting new stocks of fish.

It is recognized that many of the shallow waters close to shore are known and, to a large extent, are being exploited by the present purse-seine fishing fleets, but it also appears that, either because of gear limitations or lack of exploration, there occur in these same areas commercial concentrations of fishes suitable for reduction into meal and oil which are not being utilized. It also is recognized that there are many practical problems which tend to limit or discourage a systematic program of new resource development, but it also must be pointed out that once the biological potential is recognized that, because of its trained personnel, equipment, and facilities, the industry is in the best position for making a complete appraisal of the economic potential of the resource, from the development of efficient methods of capture to the processing of the raw material. Most of the crews, vessels, and plants are idle during the winter months when they could be utilized for these purposes.

If further development of the clupeoid resource in the Gulf of Mexico is contemplated, the following may serve as useful guidelines:

- (1) Exploratory fishing should be conducted to ascertain the whereabouts of Gulf menhaden during the winter months and determine whether fish larger and older than those presently being caught exist in concentrations within the region. The most likely places of occurrence appear to be along the southern coast of Florida and along the eastern coast of Mexico.
- (2) Initial utilization of the yellowfin menhaden population probably should be attempted during the winter months in the vicinity of the Indian River and along the southwest coast of Florida.
- (3) Initial efforts to locate the finescale Gulf menhaden population probably should be attempted along the south Texas coast and the Gulf of Campeche.
- (4) Until considerably more information is available, the potential of the yellowfin and finescale Gulf menhaden resources should be considered much smaller than that of the Atlantic and Gulf menhadens.
- (5) Winter capture of menhadens, anchovies, scaled sardine, and other

clupeoids probably will require the development of fishing methods and equipment somewhat different from those presently employed by the menhaden purse-seine fishery. Possibly auxiliary boats employing lampara or small-mesh purse seines or mid-water trawls would be most satisfactory in the company of large refrigerated menhaden vessels serving as carriers. The exploratory fishing staff at Pascagoula, Mississippi, is working on the problem of gear design.

- (6) The thread herring resource appears to offer the greatest potential as an additional source of raw material during the winter. The most likely area for initial exploration is along the west coast of Florida.

In summary, the work conducted during the past several years has demonstrated that number of the clupeoid fishes are more widely distributed in the Gulf of Mexico than was believed, and it probably is the winter concentrations of the several species mentioned which offer the greatest challenge to the fish meal and oil industry.

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