During the spawning season, especially after the first month of spawning, there are many spent mullet, or "spikes," in company with mullet still heavy with roe, and the pre-spawning season mullet vary considerably in their condition, so that it is difficult to determine when any one mesh size will take a larger or smaller class of fish. The change is gradual, and for this reason there has been no attempt to subdivide the samples into seasons. Any such division would be arbitrary at best.

The entire catch of 103 fish was measured from an illegal 2 5/8 inch stretched mesh. It was found that only 44, or less than 43 per cent, of the fish were under twelve inches in length. Of nine samples, each consisting of the entire catch of a 2 6/8 inch stretched mesh net and totaling 1460 mullet, 912, or over 62 per cent, were under twelve inches in length. Two samples of fish captured by 2 7/8 inch stretched mesh nets, a type seldom used, contained 174 fish, of which 92, or almost 53 per cent, were under twelve inches. Fifteen samples taken from 3 inch stretched mesh, and totaling 1728 fish, contained 862, or approximately 50 per cent, mullet under twelve inches. Of seven samples measured from landings of 3¼ inch stretched mesh nets, and numbering 795 fish, 237, or less than 30 per cent, were under twelve inches. One sample was obtained from a net rarely used at Cedar Key (where all samples were taken) of 3 7/8 inch stretched mesh. This sample consisted of 86 fish, all of which were twelve or more inches in length.

The legal minimum size limit on mullet for the state of Florida is now 10½ inches. This permits the taking of fish, especially females, which are too small ever to have spawned. In some counties the minimum limit is further reduced. Levy County permits the taking of ten-inch mullet, and in the area west of the Aucilla River the limit is eight inches.

Fifty-one market samples (samples measured without regard to type of gear used in their capture, and selected at random) included a total of 7,049 mullet; 3,496, or almost 50 per cent, of these were under twelve inches in length.

It would appear, therefore, that the fishery is at present taking many mullet before they are allowed to mature. Further study is necessary before recommendations can be made as to regulations of size limits of fish or mesh sizes.

The Florida Sponge Industry

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ALL OF THE NATURAL SPONGES produced in the United States come from the coastal waters of Florida.

In past years sponges occurred in commercial quantities all along the coast of Florida from Biscayne Bay south to Key West and along most of the west coast north almost to Carabelle.

An average of over one million dollars worth of sponges has been marketed annually for the past fourteen years. In 1943, 1944, 1945 and 1946 the sales of wool sponges alone were well over two million dollars per year.

Production declined sharply after the sponge disease of 1939-1940, and by 1947 the landings were markedly smaller. The University of Miami Marine Laboratory, at the request of the Florida State Board of Conservation, undertook in December 1947 a brief survey of the sponge grounds north of Anclote

Light in order to determine the condition of the sponge beds. Particular attention was given to the deeper bars in from 16 to 22 fathoms. The results of that investigation presented such a somber picture that the Marine Laboratory was requested to survey to area north of the Dry Tortugas and west of Carabelle in an attempt to find new sponge beds suitable for commercial exploitation, and to seek new sponges which might be of possible commercial value but which are not now being utilized.

This survey was carried out in September and October of 1948. The first part of the cruise covered the coastal area from Tarpon Springs south to Florida Bay, past Key West, the Marquesas and Tortugas and north to Tarpon Springs again. The second part of the cruise likewise began at Tarpon Springs and continued north along the Florida coast to a spot offshore from Panama City.

The vessel used was the *P. Kremasto,* a Greek-type diving boat 42 feet in length, equipped with a Bendix DR-3 supersonic depth recorder. A laboratory bench was constructed in her waist.

Using charts of the region, stations were selected which showed as rocky ledges or as coral reefs.

When the station was reached, the bottom was carefully charted with the depth recorder, a buoy was placed at the center of the station location and the bottom was tested with a soaped sounding lead.

The vessel then circled the buoy while surface and bottom samples of seawater were taken, and surface and bottom plankton tows were made. The determinations for pH, temperature, salinity and dissolved oxygen were then carried out while the diver was being dressed.

The diver descended to the bottom and made a general exploratory dive, taking a sample of the bottom deposits and collecting specimens of all the bottom dwelling plants and animals. The biological specimens, when brought on deck, were carefully sorted and examined for any signs of disease. They were then tagged and preserved in alcohol for later, more detailed study in the laboratory. If no commercial sponges were found on the first dive, the vessel moved to a new location on the same bar and the diver again went down. Each station was therefore covered by several dives at different locations grouped around the marker buoy.

When commercial sponges were encountered, the diver worked the beds under normal sponge diving conditions for a given unit of time in order to determine the catch per unit effort at each sponge bar.

Twenty-two stations were worked during forty-three days at sea. Sponges were found in commercial quantities only at two reefs which were already known to the industry. Single specimens of bastard wire sponge were found at two stations, and a damaged yellow sponge was taken at another station. This was the only commercial sponge taken that showed signs of recent damage, but many of the sheepswool sponges taken from the shallow water producing bar had scars and evidences of old damage. The only other sponge ground that showed damage was a non-commercial cup sponge, which is closely related to the commercial sponges.

A joint survey was made in September of this year by the Marine Laboratory and the U.S. Fish and Wildlife Service in order to investigate recent reports of sponge mortality in the region between Anclote Key and Saint Marks. According to reports of the boat captains the mortality was first noted in December 1948 in 9 to 10 fathoms off Pepperfish Keys. Damaged sponges were observed in the Rock Island region in shallow water about the first of

June, 1949. Both hook boats and diving boats reported that within 20 days virtually all of the sponges inside of 7 fathoms were dead or damaged. The divers stated that all of the sponges in the 4 to 10 fathom range between Cedar Keys and Anclote Light had been destroyed, and that between Cedar Keys and Saint Marks 95 per cent of the sponges in this depth range had been destroyed. Southwest of Anclote Key in 5 to 5½ fathoms some damaged and some live sponges were reported in May; in July one boat worked this area and found no sponges, either alive or dead. According to the reports of the sponge fishermen, this is the southernmost limit of the sponge damage.

The sponge fishermen agreed that the present mortality affects the sponges in the same manner as the 1939-1940 disease. Wool sponges are more resistant than are the grass and yellow sponges; non-commercial sponges and some species of coral are also evidently damaged by the blight.

The survey on the Fish and Wildlife vessel *Pompano* indicated that a few healthy sponges remain, but that numbers of damaged sponges (and coral also) are present on the reefs. Several typical sponge bars were found to be entirely devoid of commercial sponges.

There is no way to estimate the exact loss that has occurred since the blight was first reported late in 1948. Results of this survey, when considered with the results of the 1948 survey, indicate that the sponge population is at present very low in the area investigated, and that most of the remaining sponges occur in less than 4 fathoms.

Definite evidence exists that the recent sponge damage is the result of a blight of some sort; whether or not it is the same as the disease of 1939-1940 will no doubt be determined by study of the diseased tissue by Dr. Galtsoff.

The entire Tarpon Springs sponge fleet is at this time at rest in its harbor, and none of the captains plans to put out to sea in search of sponges. In the past few months the vessels that have ventured out have not found enough sponges to pay for the expenses of the trip.

So far in 1949 (8 months) $392,000 worth of wool sponges have been sold on the Tarpon Springs sponge exchange. This figure, when charted with the sales of previous years, continues the severe downward trend and is an indication of the critical condition of the industry.

As a part of the 1948 survey many types of non-commercial sponges were cleaned and tested in order to determine whether or not any were suited for commercial uses. None was found to be satisfactory. Lack of water retention, harshness or weakness of the fibers prevented the acceptance of any of the test group.

Quantities of several types of non-commercial sponges were dried and were submitted to biochemists in an attempt to utilize such sponges as raw material in the preparation of manufactured goods.

It is apparent that a normal recovery of the Florida sponge beds is unlikely to occur for a considerable time. The surveys conducted during the past few years clearly indicate that there is no likelihood that the industry can be saved by extending fishing in the waters of neighboring states, or by seeking sponges in deeper water.

It is suggested that the only practical means of hastening the re-establishment of the Florida sponge industry is by sponge cultivation. The type of bottom required for sponge cultivation must be carefully selected in order to provide a fairly smooth firm bottom, free from silting. Currents must not be excessive, but the water must be unpolluted and should have a normal salt concentration. There must be no danger of fresh water from rivers or streams en-

tering the sponge plantation. The water must be deep enough to prevent disturbance of the bottom by wave action, yet shallow enough to allow planting and harvesting of the sponges to be carried out without difficulty. Fortunately, rather extensive regions suitable for sponge cultivation exist in the Florida Keys and at a few places on the Florida Gulf Coast.

The technique of sponge cultivation consists of cutting the mature sponge into pieces which are attached to cement discs, or to wires, stakes, etc., which will support the cutting above the sea bottom. Care must be taken that the sponge is not crushed when it is being cut, and both the parent sponges and the cuttings must be protected from rainfall and other fresh water.

In the past century several experimental sponge plantations have been set up. Early work in the Adriatic was halted because of the hostility of the spongers and also because of excessive operational costs. Plantings made by a Mr. Monroe in 1880 were instrumental in the presentation of a sponge cultivation law to the Florida State Legislature. The law was not passed, and theft, with other difficulties, ended the experiment.

H. F. Moore of the U.S. Bureau of Fisheries in 1901 set up and maintained extensive experiments in Biscayne Bay and at Sugar Loaf Key. Cuttings were placed on cement discs and on stakes supported by cement triangles. The cuttings on the discs reached market size in about four to five years.

This cultivation experiments and the plantation set up for the Bahamas government by F. G. W. Smith prove that it is entirely practical to culture sponges if care is taken in the selection of the site and if proper methods are used. There is now in operation at Pott Cay, Andros Island, a privately owned sponge cultivation that is producing excellent sponges.

Plantations should be set up for the sheepswool sponge only. They are the most valuable, and are also evidently more resistant to the sponge blight than are the other commercial sponges. The very fact that it is cultivated makes the sponge more valuable, because the surface of the sponge that is in contact with the cement disc becomes very finely felted. This obviates the necessity of trimming any irregularities from the "root" and also permits the sale of cuts of this felted sponge for surgical and other demanding uses.

Although sponges cannot be grafted to produce a more desirable strain, they can be selected for good qualities, and cuttings should be made only from those sponges which possess all of the qualities of softness, water retention and resiliency which are prized in a sheepswool sponge. It is probable that biologists would be able to develop a fast growing and resistant strain of wool sponges which would be of superior market value.

The establishment of a sponge farm is advocated both for the purpose of providing stock for the depleted beds and for encouraging and aiding private enterprise. It must be pointed out, however, that sponge cultivation is not a get-rich-quick or sure-fire venture. It offers limited returns for an investment and requires hard work to establish; in addition, it is subject to greater risks than ordinary agriculture. The early failures were due to lack of experience and knowledge. Any future plantations should be successful if they are properly located and operated, but the possibility of failure must be considered.