

portance. They have excellent shipping facilities, and ice is used liberally in preparing the standard (200-pound boxes) for market, in New York, Philadelphia, and Baltimore.

Mr. S. C. Baum, who is regarded as one of their best citizens and fishermen, informed me that he had many times weighed the fish purposely to ascertain the average weight, and that he had found them to average, all through, $1\frac{1}{2}$ pounds. While he was speaking of the great bulk taken below, I am satisfied, from my recollection, that with those taken in the few scattering pounds near Edenton, the size was not so great as a pound and a half, but nearer a pound each. I am very sorry that I could not reach Roanoke Island till the end of December, for the fishing was then over and I had not the advantage of personal examination. Inquiry led to the belief that the catch about Roanoke Island is not affected with lice on the gills, as it is about Edenton, where *all* specimens seen by me were parasitic. In quality I was told that the rock were poor in September, improved in October, and fat in November. I was surprised to learn from Mr. W. B. Alexander of the success of the gilling business in Alligator River. He informed me that Mr. J. H. Cooper had just taken \$600 worth in that stream, the smaller specimens weighing 50 pounds each. The nets are 12-inch mesh and are made fast to stakes, and catch throughout the winter months in water 6 to 8 feet deep, 25 miles up the stream. This species of gilling had been in vogue for three years.

The results of my photographing on Roanoke Island, as incidental to my trip, were very satisfactory, and comprised the "building of boats there" (very superior small craft), and also represented a very fine seine steam-flat, the property of Mrs. Brinkley.

WASHINGTON, D. C., *June* 1888.

48.—INFORMATION BEARING UPON THE ARTIFICIAL PROPAGATION OF MULLET.

By W. de C. RAVENEL.

The following is the result of a trip to investigate some of the mullet fisheries of North Carolina and Florida, made in accordance with directions from the Commissioner. The instructions were to obtain all available information concerning these fisheries, particularly such as would be of practical value in entering upon the artificial propagation of this species with the view to arresting the rapid decline in the value and production of the South coast fisheries.

The inquiry was particularly addressed to determining the following points:

- (1) The localities where the fish are now found in greatest abundance.
- (2) The habits of the species as to seasons of migration from salt to brackish or fresh water and their return.

(3) The spawning season; as to its varying with the latitude, its extreme limits, and its height.

(4) Spawning places—whether in salt, brackish, or fresh water; kind of eggs—whether floating, free and heavy, or adherent; the period of incubation at a given temperature; and all other facts that will serve to disclose the methods and apparatus necessary for artificial work.

(5) Quantities of eggs that can be obtained from the regular fisheries, and whether it will be necessary to have recourse to apparatus of our own to secure a supply.

On November 21, 1887, I left Washington for Morehead City, N. C., which is situated at the junction of Bogue Sound and Newport River, about 2 miles from Beaufort, and where most of the fishermen have their headquarters. On my arrival the mullet season there was over, only a few small ones being taken for local consumption. From the largest dealers there I learned that the mullet season commences there about June 1 and continues until November 15, during which time there are three distinct runs: small mullet, 4 or 5 inches long, from June to August 30; fat mullet, from September 1 to October 10; and roe mullet, from October 10 to November 15.

The roe mullet appear in large schools, coming from fresh and brackish water and going out to sea, where they are believed to spawn and then go on down the coast, as they are never seen returning, and spent fish are not caught. The fish shipped from this point are caught entirely in salt water, from Bogue Sound out to Cape Lookout and all along the banks down the coast, about 500 gill-nets and 15 or 20 haul-seines being used during the past season. Large mullet seem to be getting more scarce every year, though more fish were actually shipped than for several years, the increase in the amount being due to the immense number of small fish now caught. The total shipment from Morehead City and Beaufort was 900,000 pounds—400,000 fresh and 500,000 salted. One dealer told me that on several occasions he had gotten 4,000 fine fish in the Trent River (fresh water) during the month of January.

Having arrived in Jacksonville, Fla., on the 25th and visited the markets and seen the mullet then being caught (all of which were full-roed), and having interviewed the largest fish-dealers there, I went down the St. John's River to New Berlin and Mayport, the headquarters of most of the men who fish in the Lower St. John's. During my stay at these places I had an opportunity of overhauling all the mullet caught below Jacksonville, and found most of them full-roed, and one or two "galam boties" (as the spent mullet are called by the natives); but did not succeed in getting any ripe fish.

Mr. David Kemp, of New Berlin, who has fished for the past twenty years from Lake George to the mouth of the St. John's, says that mullet have decreased very rapidly in the past ten years, and that unless measures are taken to protect them the fishery will soon be broken up.

According to him, the run of fat mullet, which is the roe-mullet not fully developed, commences about October 15 and continues until November 15, when, as roe-mullet, they come down the river and go out to sea to spawn, and return in a short time as "galam boties." He attributes the decrease mainly to the use of 2½-inch mesh nets in summer and early fall, when quantities of very small fish are taken. Mr. I. V. Balsom, who has fished all his life in the St. John's and along the eastern coast of the State, said that Saint Augustine and Musquito Inlet are the natural spawning-grounds of the mullet, and that he has seen the eggs running from the fish in his cast-net. He is probably the most successful mullet-fisherman on the St. John's, and his catch for this season is 4,500, whereas in 1877 his catch was 13,000, having taken 2,260 at one drift of a 200-fathom gill net.

At Mayport the falling off is even more apparent, only 16,000 having been shipped from that point this season.

About 40 gill-nets and 1 sweep-seine were fished on the Lower St. John's this season, and their entire catch was not over 100,000 large mullet.

As little or no fishing was being done at Saint Augustine I proceeded, after one day, to Mosquito Inlet, arriving there on the 7th. All of the mullet caught during my stay there had spawned, a very large school having gone out at the inlet the week before. Any day small schools of "galam boties" could be seen coming in and working their way up the rivers to the lagoons. Mr. Bartolle Pacetti, who has lived about one mile from the inlet on the Halifax for thirty-five years, and who is the most observant fisherman I met in the State, says there is no doubt about mullet going outside to spawn. The roe-mullet begin to come down from the lagoons and rivers about November 15, and continue until December 31. Forming in large schools, they often swim about near the inlet for several days, and then go out, returning in a few days, sometimes in two tides, nearly every one spent. During January the shores near the inlet are lined with very small mullet about 1 inch or less in length, which gradually form in larger and larger schools, and as the season advances work up the rivers and lagoons, where they remain until they mature. Mr. Pacetti has frequently examined the roe-mullet caught just before going out, and always found it firm, though he has seen the eggs about the size of a mustard-seed run out into the cast nets. Mullet stay all the year inside, only going out to spawn, and they return in much smaller schools; which fact probably accounts for their not being seen to return along the North Carolina coast and in the St. John's River. Owing to the lack of shipping facilities up to this time, fishing has not been conducted on an extensive scale; but as fish can now be shipped by rail from New Smyrna to any point, there is no reason why this industry should not develop rapidly. About 100,000 mullet were shipped this season, besides other fish.

Leaving New Smyrna on the 13th, I arrived at Punta Gorda on the

following day. Punta Gorda is situated near the head of Charlotte Harbor Bay, at the mouth of Pease Creek, about 25 miles from the Gulf. The fish-houses are all built on the South Florida Railway wharf, about 2 miles from the town, where most of the fishermen make their headquarters. The fishing-camps are scattered from Punta Gorda to Boca Grande pass. Mullet have only been caught in considerable quantities in the upper part of the bay since the opening of the South Florida Railroad to this point, about two years ago, though two large ranches for supplying the Havana market with salt mullet have been in operation at the passes for eight or ten years. The dealers here have shipped this season about 1,700,000 pounds, or 800,000 mullet, and could have shipped about double as much if the shipping facilities had been better. The dealers, as a rule, own their boats, nets, etc., and pay the men from 1 to 1½ cents apiece for the fish. When I arrived they were catching mullet in large quantities, full-roed and nearly ripe, and they told me that the fish would begin to spawn about the 20th. Men who have fished and bought fish all along the coast say that mullet are much more abundant here than anywhere else on the Gulf coast. The supply at Cedar Keys and Tampa, which have been up to this time the chief shipping points, having given out, they are now supplied from Suwanee River and Sarasota Bay, which necessitates carrying the fish 30 or 40 miles before they are packed for shipment. Most of the men here believe that mullet go to fresh or brackish water to spawn; and one man said that he had often seen schools of spent fish coming down out of fresh water, and that fishermen always located their camps at the mouth of fresh-water rivers in preference to salt, knowing that the fish had to go there to spawn. All of my observations and the testimony of every man on the Atlantic coast opposed this theory; and after staying there three weeks and visiting the camps and ranches, I could find nothing to substantiate it. On the 20th I left Punta Gorda on a sloop, and after visiting the fishing camps went on to the ranches.

I first visited the Spanish ranch on Cayo Costa Island, near Boca Grande pass. The force consisted of 28 men to work the seine and cure the fish and 6 men to run the smack, all under Captain Tweno, a Spaniard. All of the fish caught are salted, and the roe dried in the sun for shipment to Cuba, where the price is about 4½ cents per pound for the fish and 10 cents for the roes.

The day I arrived at the Spanish ranch I saw several hundred "galam boties" caught, and every day afterwards large numbers were brought into the ranches; but they were considered very inferior for salting purposes.

The captain, who has fished here for eight years, informed me that "galam boties" were always caught either coming in at the pass or working up the bay, but never going out, though he has seen them outside in 15 fathoms of water. The fishing season here lasts from September 15 to January 15. There seems to be no diminution in the sup-

ply of mullet, 10 scow-loads having been landed at one haul this season, each scow holding about 4,000 mullet. The seine used is 125 fathoms long, 6 fathoms deep, 2-inch mesh, and about 200,000 mullet have been taken up to date this season.

I next visited an American ranch on Gasparilla Island, near pass of same name, owned by Capt. John Peacon, of Key West, who has fished here for thirteen years, shipping salted mullet to the Cuban markets, which he regards as more profitable than selling them fresh. During my stay there I saw from 8,000 to 10,000 mullet split, salted, and packed, and had an excellent opportunity of examining them, the fish being often brought in alive. I found none ripe, but one or two seemed nearly so, and I tried to impregnate the eggs, but after keeping them thirty-six hours and seeing no change I concluded they were not sufficiently matured.

Captain Peacon thinks that mullet are as plentiful as ever, but he objects to the fishermen continuing to gather here from other points. On calm days he has seen the Gulf coast literally lined with small mullet about the size of a pin, and in his opinion there is no doubt that the fish spawn outside; that is, in salt water. His catch this season, from September, with a force of 30 men, is about 250,000; seine used, 150 fathoms long, 6 fathoms deep, and 2-inch mesh.

On the 3d of January I left for Cedar Keys, where I learned that the season for mullet was nearly over, and that fish had become so scarce in the immediate vicinity that most of the dealers contemplated removing to the head of Sarasota Bay.

Mr. Dopson, of the Suwanee Gulf Company, informed me that ten years ago a haul of 30,000 mullet was made at their wharf, but now they had to send 20 and 30 miles to procure mullet even of an inferior size. Dr. McElvane, another dealer who was about to move, stated that he was anxious for some steps to be taken to protect and increase the supply of mullet. He was one of the few on the Gulf coast who was of the opinion that mullet spawned in salt water.

The results of this investigation are stated as follows:

(1) Mullet are most abundant on the Atlantic coast at Morehead City, N. C.; in the St. John's River, Mosquito Inlet, and Indian River, Fla.; on the Gulf coast, in Charlotte Harbor Bay, Sarasota Bay, and the Suwanee River. They have decreased greatly on the North Carolina coast, in the St. John's River, and at Tampa and Cedar Keys, and these are the localities where fishing has been done on the most extensive scale up to this time; and the decrease is to be attributed mainly to the use of small-meshed nets, by means of which the fish are destroyed before they come to maturity.

(2) Mullet migrate from fresh and brackish to salt water during the months of October and November in North Carolina, and in November, December, and January along the coast of Florida, for the purpose of spawning, and return to brackish water immediately thereafter.

(3) Mullet spawn in salt water on a falling temperature, spawning later as you go south; commencing in the St. John's, Mosquito Inlet, and at Cedar Keys, about December 1, and continuing until the 31st; at Charlotte Harbor about December 20, and continuing until January 20.

(4) Having failed to obtain any ripe fish it is impossible to say what style of apparatus would be required for the propagation of mullet, or whether their eggs sink or float.

(5) Charlotte Harbor is unquestionably the point where mullet are most abundant, and the best adapted for fish-cultural work, two large ranches being worked at the main entrance to the bay, and sixty or seventy gill-nets fished in salt and brackish water from the passes to Punta Gorda. The vessels engaged in this work could lay in either salt or brackish water as the work required.

WASHINGTON, D. C., *February 21, 1888.*

49.—NOTE ON THE OCCURRENCE OF THE OPAH, *LAMPRIS GUTTATUS*, ON THE GRAND BANKS.

By DAVID S. JORDAN.

I have received from Hon. Everett Smith, of Portland, Me., the description and figure of a "sunfish" recently brought to the Portland market, and reported to have been taken off the "Grand Banks." Mr. Smith gives the following description:

"Length, 60 inches; vertical depth, 25 inches; skin smooth, without scales; mouth, small; opercles, very large; color, steel blue, iridescent, silvery on lower parts, variegated over whole body by oblong, whitish spots of one inch and less in length; fins, yellow."

From this description and an outline drawing kindly furnished by Mr. Smith, it is evident that the species is the Opah, *Lampris guttatus*, Retz., a rare pelagic fish, once before recorded from the Newfoundland Banks.

BLOOMINGTON, IND., *October 26, 1888.*