R/V ALBATROSS III RESEARCH PROGRAM

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Overview

Conducting research on offshore marine fisheries from a laboratory ashore has been the lot of fishery biologists in the United States for many years. This fact has made it necessary to build research programs on the data which could be collected from the fish as landed, and more than any other factor has caused the program to be lopsided in favor of the analysis of catch statistics on the principal species. With the commissioning of the ALBATROSS III on March 19, 1948 and with the more recent or soon-to-be-expected use of other vessels on the Pacific coast, we are being provided with the research tools with which we can go to sea. Therefore, it is appropriate to review the methods of fishery research and decide where we go from this point.

Fishery research work in New England has gone through a cycle. The early workers realized the need for a broad approach, and their work was descriptive of the fishes, their habits, and their environment. This culminated with the publication in the 1920's of the work of Dr. Bigelow and his collaborators on the Fishers, Plankton, and Physical Oceanography of the Gulf of Maine.

Since then, Government research, at least, has been concentrated on particular species of importance to the fishery. The cod, haddock, mackerel, flounder, and redfish fisheries, as well as some other inshore fisheries, have each been the subject of major investigations. For the past several years our research on these species, together with the accumulation of general data on all New England fisheries, has been directed at: (1) knowing the current condition of these fish populations; (2) learning the causes of fluctuations in their yield; and (3) developing for each fishery the management methods and practices which will provide the maximum continuous yield. These objectives have been determined and financial support derived largely because of the economic consequences of fluctuations, mostly decreases, in the catch.

Current Status

At the present time some fish populations are seriously reduced. Haddock are as scarce as they ever have been. Redfish have declined greatly in abundance in the Gulf of Maine. The yellowtail flounder catch reached a peak of 70 million pounds in 1942 and has declined to an average of about 25 million pounds annually. In addition to declines in the abundance of fish, the fishing fleet is the largest ever and most of the vessels are relatively new and modern, having been built or rebuilt just before or after the recent war. The value of the landings to the fishermen in New England is now about 50 million dollars a year. Hence, scarcities or gluts are of considerable economic importance.

Many factors have been identified as causes of fluctuations in our fisheries. For example, Sette (1933)[1/] pointed out that mackerel might be present on the fishing grounds, but less accessible to the fishery at certain times. In the haddock fishery, unpublished data indicate a major seasonal cycle in accessibility. Herrington (1944) presented data indicating that competition of adults and young haddock affected the survival of the young. Schuck (unpublished mss.) has shown that the amount of haddock caught this year definitely will affect the amount available next year. Sette (1943) has shown that wind conditions in spawning season may profoundly affect the survival of mackerel. Iselin (1939) pointed out that Georges Bank was vulnerable to marked changes in fertility because of changes in slope-water eddies, and presented evidence of the presence of such eddies.

In addition to these causes of fluctuations in yield, there are some which have been found to be important in other populations of fishes or animals and which are likely to affect these fishes. Competition between species, either as predator and prey or for the same food, seems certain to be a factor. Blooming of certain plankton can cause the death of fishes through the production of toxic substances. A failure of other plankton to bloom might mean the lack of an essential food item for a particular fish. There are probably many others.

In view of these several proven and likely factors influencing the yield of fish populations and because the proven factors have in no case been shown to be the sole cause of the fluctuation, it would seem that complete information can be obtained only by studying the ecology or interrelationships of all of the animals and plants and their environment. To put it in the jargon of the ecologist we should study the entire biocoenosis in its biotope or biochore.

Such an overall study appears to be possible in the near future if the current rate of progress in the development of instruments is continued, and if we have the means to use them. The oceanographers have made great strides in the past decade in the development of instruments which will measure the physical characteristics of the ocean. The biologist in their laboratories ashore have lagged far behind; but with suitable ships and the funds to operate them, it will be possible to develop instruments to measure quantitatively the animals and their foodstuffs.

Enter the Albatross III

The ALBATROSS III is nearly ideal for this purpose. She is 180 feet long, seaworthy enough to cross the oceans, and equipped to handle all of the tools of the oceanographer. In addition, she can handle large-size, otter-trawl gear which will sample the demersal fishers as well as many of the pelagic species from near the shore to a depth of about 200 fathoms. She carries a normal operating crew of 21 men with additional accommodations for 12 scientists. The extra quarters required a sacrifice of hold space which is large enough to ice down only about 60,000 pounds of fish. Part of the hold is mechanically refrigerated. One freezing room can be maintained at $^{-}20^{o}$ F. and another room is used to store fish at 0^{o} F. The main propulsion is a 7-cylinder, 2-cycle Diesel engine rated at 805 horsepower. Three auxiliaries provide electric power for the fishing winch and other equipment. With but few exceptions the equipment is adequate and capable of being modified for the varied requirements of research work.

During the past year we have undertaken numerous research problems. Included have been the following projects:

1. Overall census of the fish on the New England Banks.

2. Operation of savings gear.

3. Refrigeration of fish at sea.

4. Effect of the disposal of waste acid off New York City.

5. Parasites of fishes.

6. Development of oceanographic instruments.

7. Food habits of haddock and whiting.

8. Length-weight relationship of several species.

9. Migrations of haddock and yellowtail.

The major problem, one which has been the objective of about half of the cruises, has been the overall census of the fish on the New England Banks. Learning the causes of fluctuations in a population of fish requires almost the same kind of information that is gathered on the human population by the census taker and the bureaus of vital statistics. We nee to know how many fish of each species, of each age are on each bank, how many immigrate and emigrate, how many are born each year and how many die each year from each cause, and how fast they grow. And when we learn these facts, we will know enough about the death expectancy, for example, to write a life-insurance policy on a haddock at age three, paid up at age six.

When one considers the effort expended in obtaining such statistics for the human population, it seems well-nigh impossible to obtain similar statistics for fish on the banks which cannot even be seen at home, much less interviewed. Fortunately, the work can be simplified enormously by the proper sampling methods. It is unnecessary to employ the methods of total statistics which the census taker uses.

Trial Run

We embarked, early in July, on the first of what we expect to be an annual sampling program with the ALBATROSS III. We modified a No. 1-1/2 Iceland trawl with a belly liner and a cod-end liner of 1-1/2 inch, stretched, cotton mesh in order to catch fish as small as possible; and we have to date fished this net in about 200 locations on the Banks from the Hudson Canyon east to the Northern Edge of Georges Bank. We have fished in from 10 fathoms out to 200 fathoms of water, at locations which were laid out to cover uniformly each depth zone on the bank. At each trawl station we counted and measured all fish taken and obtained complete data on temperature from the top to the bottom.

The mass of data from this census operation will require much thought and labor before it is utilized. It must be correlated with the data of the catch which we are gathering at the ports of

Boston, Gloucester, and New Bedford. Also, it will be most valuable when compared with similar censuses in future years. However, information on haddock is of immediate interest and will serve as an example of the kind of data available.

We obtained good information on the numbers and distribution of all sizes of haddock. Marketable haddock were found to be extremely scarce over most of the southeastern and southwestern parts of Georges Bank, but they were present in good quantities at the Northern

Edge in late July where the Boston fleet was concentrating on them. They were available consistently in moderate quantities in the deep water north of the Cultivator Shoals area. Catches of from 400 to 800 pounds of haddock in a one-half hour tow were made at several different locations in from 100 to 130 fathoms of water. We recommended this area to the industry early in August.

Baby haddock, spawned in 1948 but from 4 to 6 inches long, were found in autumn in good numbers over the southwestern part of the bank and in the vicinity of Nantucket Lightship. There were rare west of Nantucket Lightship except at two stations, both within 20 miles of Ambrose Lightship.

Here we made large catches of baby haddock; in one tow, one-half hour long, there were 570. No adult haddock were taken within 100 miles and the significance of the presence of these young is an enigma.

Yearling haddock were scarce everywhere. It would appear that 1947 was a poor spawning season for the haddock. The significance of this to the fishing industry will not be known definitely until we compute the quantities available from the 1945 and 1946 spawnings, but quite clearly there is no prospective abundance of haddock on Georges Bank. Work on this problem is going along rapidly under the direction of Howard A. Schuck of the Fish and Wildlife Service at Woods Hole, and we plan to publish other articles on the abundance of haddock early in 1949.

The second major project is an extension of the work on "savings gear" which was begun in the United States by William C. Herrington in the early 1930's. Herrington's work, as well as that of numerous European investigators, showed conclusively that larger mesh in the cod end of a net will release most (about 80 percent) of the small haddock now being killed and waster because they are too small for the market. He found that a mesh size of 4-5/8 inches, stretched measure, inside knots, was large enough to release undersized haddock while retaining the marketable sizes in the net. Two problems regarding the use of larger mesh remain. They are (1) the condition of the small fish after going through the net; and (2) the behavior of the net under continued and varied full-scale fishing operations.

On an early cruise of the ALBATROSS III we started an experiment designed to find an answer to the first question. We covered a large-mesh cod end with one of finer mesh which caught the small fish which had passed through the meshes. We tagged and released some of those small fish as well as some of the larger ones that were retained by the large mesh and brought others to the Woods Hole Laboratory alive. The results of this experiment are not yet conclusive.

The principal difficulty arose because it was necessary to subject the small haddock to an extraordinary amount of abuse in addition to their going through the net. After being captured in the net on the bottom, they were decompressed in bringing them to the surface, which frequently caused them to get the "bends" just as divers do. Next, there were big swells running and the small haddock were washed around in the net so much that they were nearly scaled when landed on deck. Despite this abuse, some of these haddock survived long enough to be brought to Woods Hole and lived a day or two in the tanks there. Of those tagged and released at sea, five have been recaptured from one to four months after tagging. This is encouraging, as those are the first haddock tagged from an otter trawler which have ever been recaptured. Further work is indicated.

Future of the Experiment

We plan to repeat the above experiment under better conditions and use greater care in handling the young haddock. Also, planned are studies on the escapement of other kinds of fish through larger-meshed nets. We have on order at the present time a net on which will be placed several different cod ends, and with which we expect to demonstrate more conclusively the escapement of fish through the larger mesh.

As soon as we can place the ALBATROSS III in operation after its present lay up (which has resulted from a lack of funds) we intend to start a full-scale trial of the recommended larger-meshed net in cooperation with large otter trawlers of the Boston fleet. First, we expect to use the larger-meshed net not from the ALBATROSS III while fishing alongside a commercial trawler which is using the standard net. Scientists aboard both vessels will measure the amount and the sizes of fish taken. Later, if possible, we hop to have commercial trawlers also using the larger mesh on a trial basis.

Any far-sighted view of the New England fishing industry includes the possibility of long-range vessels with mechanical refrigeration and provision for processing on board. Varied techniques have been developed in several fisheries of the world, but such techniques still must be adapted to the otter-trawl vessel and to particular species of fish. The ALBATROSS III is well equipped to make the necessary preliminary small-scale studies, and the first of these studies got under way in September 1948 under the direction of Joseph F. Puncochar of the Boston Technological Laboratory, Branch of Commercial Fisheries, Fish and Wildlife Service. This first study, which is scheduled for completion early in 1949, was designed to determine the effect of freezing, thawing, and refreezing on the flesh of several major species, to learn if it is possible to freeze round fish at sea and bring them ashore for filleting and refreezing. Further studies are planned as soon as funds and additional scientific personnel are available.

An extensive study of the effect of the disposal of waste sulphuric acid on fish life is being made jointly by the Fish and Wildlife Service and the Woods Hole Oceanographic Institution. Photographs of the bottom using a submarine camera from the ALBATROSS III have been made to learn if the number of bottom animals has been reduced. The trawl net was operated in the disposal area to learn the kinds of fish present at varying periods after the dumping of the waste was started. The pattern of surface drift is being determined by means of drift bottles. This work at sea is being done simultaneously with a survey of the sport and commercial fisheries of the area. Preliminary reports will be available in a few months.

An important part of the scientific program of the ALBATROSS III will be achieved through cooperation with universities and other scientific institutions. This will take the form of training for fishery students, and of working together on research problems of mutual interest. Fishery students from Harvard have been on cruises as part of their training. Professor Humes of Boston University went on one cruise and made a large collection of the worm and copepod parasites of the commercial fishes. We have been particularly fortunate in having the assistance and cooperation of scientists from the Woods Hole Oceanographic Institution. They have been of great assistance in the oceanographic part of our study and several of their scientists have accompanied the ALBATROSS III in order to study ocean currents and to test new instruments.

The several smaller problems, including those on food habits, rate of growth, and tagging for the study of migrations, are all necessary to a full understanding of the complex life of the fish. The ALBATROSS III is providing a wonderful opportunity to collect these data with a minimum of additional expense and work. Preliminary reports on this project are now being prepared.

The wrecks and other obstacles which tear up his nets are the bane of the existence of every fisherman. Accurate locations on these should be of great assistance. On the ALBATROSS III, in addition to the studies outlined above, we have carefully located all tear-ups with our Loran set. One hang-up which appeared to be the wreck of a large ship was reported to the U.S. Coast and Geodetic Survey. But much more information is needed on the locations of other obstacles which are not classed as wrecks and which nevertheless cause the loss of gear. Now that more and more fishing vessels are being equipped with Loran sets, it will be possible to locate hang-ups accurately. If every fishing captain who loses gear will report the exact location to the Fish and Wildlife Service we will see to it that this information is made available to the fishing fleet. Here is where the use of an electronic instrument and some cooperation should pay off in gear saved and fish caught.

It is on this note of cooperation that I want to end this preliminary report on the ALBATROSS III. Cooperation of scientists and fishermen with a mixture of electronic instruments, biostatistical techniques, and fishing skill will produce information and knowledge, the things we are fishing for with the ALBATROSS III.

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