INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

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Meeting of Scientific Advisers to Panel 5
Boothbay Harbor, Maine, U.S.A.,
May 20-22, 1963

Participants: Herbert W. Graham, Chairman; J. C. Medcof, Rapporteur.
From Canada: J. L. Hart, L. M. Lauzier and S. N. Tibbo.
From U.S.S.R.: S. A. Studenetsky and G. A. Semin
From U.S.A.: V. C. Anthony, H. C. Boyar, Dean F. Bumpus, J. B. Colton, Jr., J. J. Graham, C. J. Sinderman, K. Sherman, B. E. Skud, A. P. Stickney, J. E. Watson, W. R. Welch and R. L. Wigley.

Chairman's opening

The Chairman welcomed the visitors to the Boothbay Harbor Laboratory of the U.S. Bureau of Commercial Fisheries, especially Dr. Studenetsky and Mr. Semin who were there for the first time.

Selection of Rapporteur

J. C. Medcof of Canada agreed to act as rapporteur.

Previous Meetings

The Chairman reported on two meetings of members of the group which have taken place since the 1962 Annual Meeting - - these were at St. Andrews, N.B., Canada, December 2-4, 1962 (See Meeting Document No. 2, Serial No. 1062H) and at Brewer, Maine, U.S.A., April 29, 1963. (This meeting dealt with standardization of research techniques and methods of reporting.) Both meetings included Canadian and U.S. scientists.

Canadian Environmental Research

L. M. Lauzier reviewed environmental studies in the Bay of Fundy area and eastern Gulf of Maine by the Fisheries Research Board of Canada. These studies pertain mostly to the water property distributions such as temperature and salinity, their seasonal year-to-year variations, and to the surface and bottom non-tidal drift.

At this meeting emphasis was given to the average conditions and to the observed extreme conditions of surface and bottom temperatures in open, as well as protected, semi-enclosed areas. The long-term variations of temperatures along the Atlantic Seaboard were also stressed.

"Closed" and "open" circulation systems in the Bay of Fundy which is adjacent to Sub-area 5, were defined in term of drift bottle and seabed drifter recoveries in the various sectors of the Bay of Fundy-Gulf of Maine area. In general the winter circulation is considered to be "closed" and the summer circulation "open". Seasonal and year-to-year variations in the circulation pattern were shown for the period 1957-1962 with emphasis on the summers of 1960 and 1962 which are considered to be of the "closed" and "open" circulation types respectively. The winter season 1958-59 was noted as an example of an unusual "open" circulation in the winter.

Factors influencing circulation such as land drainage and wind, as well as the effect of circulation on temperature regimes were described. These relationships were illustrated for representative cases of "closed" and "open" circulation.

The plan is to continue this program in close co-operation with scientists of other countries who are participating in environmental studies.

U.S.S.R. Environmental Research

S. A. Studenetsky reported that in 1962 scientists of his country had done relatively little work on environment. Their efforts are summarized in the general report on Soviet Fishery Investigations in the ICNAF Area in 1962 which will be presented to the 13th Meeting of ICNAF, 1963. Observations dealt principally with abundance and distribution of plankton that herring were eating in the areas where fishing was carried out.

The plan is to expand these efforts substantially in 1963 and also take in general observations on temperature, salinity and other factors.

U.S.A. Environmental Research

Dean F. Bumpus reviewed the annual cycle of surface circulation in the Gulf of Maine and Georges Bank as revealed through the use of drift bottles. The basic data were derived through co-operative efforts of many agencies in the U.S.A. and Canada since the 1920's. Woods Hole Oceanographic Institution has been the clearing house and repository for these data and expects soon to present them as a folio in the American Geographical Society's "Atlas of the Marine Environment". The folio will cover the non-tidal surface currents near the continental shelf from Cabot Strait to Florida. Bumpus further discussed results of sea bed drifter returns (only two years' data). These show that bottom drift rate is one tenth to one third that of the surface and predominantly in the same direction as the surface drift with only minor exceptions off southwestern Nova Scotia as mentioned by Lauzier.

Future plans call for continuation of this program together with use of moored current meters and drogued telemetering buoys. The purpose is to delineate the eddy processes which obtain on the continental shelf.

Roland L. Wigley described bottom sediments and benthic fauna as major environmental elements indicating that most commercial fish are either bottom dwellers or are pelagic species which deposit their eggs on the sea bottom. Much is now known about recruitment, migratory movements and growth and mortality rates of these fish and the explanat of variations in these may emerge from bottom studies. Accordingly, a survey is being made of the Gulf of Maine, Georges Bank and the continental shelf south of Martha's Vineyard to measure the kinds and quantities of benthic organisms that may serve as fish food and of bottom sediments whose nature influences the abundance and distribution of benthic species.

Samples are taken at 10-mile intervals using a 0.1 m^2 Smith-McIntyre grab sampler, supplemented with dredge and trawl collections.

Sediments are analysed for particle size and organic content, for number of specimens and weight per unit area of bottom. Identifications of the major phyla have been carried through to family, genus, or species; for minor phyla the identifications are limited to the higher taxa.

Detailed sediment data are available for the Georges Bank region.

The New England continental shelf is moderately rich compared to other parts of the Atlantic and Pacific Oceans as regards biomass of benthic organisms. The standing crop in the Gulf of Maine approximates 75 g/m^2; Georges Bank, 150 and southern New England area, 250.

On Georges Bank, weights and numbers of benthic organisms were lowest at shallowest depths; highest at 60 to 180 m; and diminished with depth beyond 180 m. Based on species composition and abundance the bank has four major benthic faunal communities: Central Georges, Northeast Peak, Western Basin, and Southern Georges. The Central Georges and Northeast Peak are richest.

Illustrations presented were as follows:

1. Station chart showing the locations where samples were collected.
2. Smith-McIntyre bottom sampler.
3. Sediment types in the Georges Bank region.
4. Organic content of Georges Bank bottom sediments.
5. Benthic biomass standing crop in the offshore New England area.
6. Graph showing numbers and weights of organisms versus water depth.
7. Distribution chart of the four major benthic faunal areas in the Georges Bank region.

The Woods Hole Oceanographic Institution and the United States Geological Survey have formed the Atlantic Continental Shelf Geological Research Group which is co-operating in this study with the Bureau of Commercial Fisheri

John B. Colton, Jr. reviewed the analysis his group is conducting of 1940 to 1960 bathythermograph and hydrographic station temperature data collected in an area bounded by latitudes 39° N and 45°30' N, and longitudes 64° W and 72° W. The purpose is to establish temperature norms for specific areas and depths with which cruise data may be compared.

The information source is the file of oceanographic observations at the Woods Hole Oceanographic Institution which has been contributed to by various agencies. The data are being tabulated for 10-minute rectangles at depths of 0, 10, 20, 30, 40, 50, 75, 100, 150, 200, 250, and 275 meters. Approximately 75,000 observations have been processed so far and it appears the data will have to be represented in terms of 30-minute rectangles to provide sound bases for monthly, seasonal, and yearly comparisons. Even with this grouping the results will be inadequate for depths beyond 100 meters and for shallower depths at certain seasons.

In the presentation of these data, it is planned to include horizontal plots of monthly mean values at specific depths, time-depth profiles for each 30-minute rectangle, profiles of selected sections, and temperature anomaly charts for specific years and groups of years.

Mr. Colton also summarized plankton studies in the Gulf of Maine since 1912 paying particular attention to the published papers on this subject. He pointed out that the general biology of the waters of the Gulf is fairly well understood but that continuous observations at fixed points and short-term, synoptic research ship observations would be most useful. More detailed information on the regional and seasonal fluctuations in abundance and distribution of zooplankton and phytoplankton is needed to describe productivity, food chains and effects of circulation on the ecological structure of the plankton communities.

Messrs. J. J. Graham and K. Sherman outlined an ecological study of inshore and estuarine waters of the northern New England coast that has been under way for two years. It stresses salinity and transparency patterns of the sea water and how these are related to abundance and availability larval and immature herring at various seasons.

Species composition and seasonal changes in the zooplankton of the Gulf of Maine have been studied to delineate possible differences in water type. In winter, copepods were the most numerous zooplankters throughout the area and the occasional occurrence of one species (Rhincalanus nasutus) indicates a near-shore winter intrusion of oceanic water in the eastern section.

It is planned to continue and expand these observations possibly including more seaward observations. The object will be to clarify the patterns of mixture of outgoing estuarine water with offshore water and possible effects of these on fish stocks.

Review of Canadian herring research

Mr. S. N. Tibbo documented his report on this subject with, "Review of literature on herring research in the Canadian Atlantic", by S. N. Tibbo and R. A. MacKenzie (Doc. No. 45). This includes a bibliography of published papers and manuscript reports-- the latter with only limited distribution

Although Canada has done little research in Sub-area 5 it has conducted extensive investigations in the contiguous area of the Bay of Fundy. Since 1937, annual landings of Bay of Fundy herring (mostly of sardine size) have varied from a minimum of about 20,000 metric tons in 1955 to a maximum of about 73,000 metric tons in 1960. The 1937-to-1962 average annual catch was about 45,000 metric tons and the catch in 1962 was about 60,000 metric tons. Most of the catches have been made on the New Brunswick side of the Bay of Fundy. However, in recent years catches on the Nova Scotia side have increased and in 1958 and 1961 exceeded the New Brunswick catches. Landings are made throughout the year but are greatest during the summer and early autumn (July to September). Weirs, drag-seines and purse seines are the principal gears used, with weirs being most important. Purse seining is becoming increasingly popular and in some areas purse-seine catches now exceed weir catches.

There have been no recent studies of herring migrations. But 1957 and 1958 Bay of Fundy tagging showed local shorewise movement. There was practically no long distance movement such as Nova Scotia-New Brunswick (or vice versa) crossings of the bay.

Studies during the late 1950's showed that in autumn herring larvae were well distributed in the Bay of Fundy, Gulf of Maine and Georges Bank with greatest concentrations on the northern edge of the bank. The distribution of 5-9 mm larvae indicates that the spawning grounds are located on the northern edge of Georges Bank and in the Trinity-Lurcher area of southwest Nova Scotia. There is evidence of a third spawning area off Digby Neck in Nova Scotia waters. Recent larval studies have been concentrated in the St. Mary Bay area where large numbers of larvae are found in September and October and in May.

Plans for future herring research include a continuation of the study of catches by area and by types of gear and an intensified study of the length and age composition of commercial catches.

Review of U.S.S.R. herring research and plans

S. A. Studenetsky outlined the history of his country's herring fishery in the ICNAF area; the kinds and amounts of gear used; the size and age composition of catches; the seasonal distribution of stocks and their feeding; fattening; sexual maturation and spawning activities.

In the U.S.S.R. fat herrings are the most prized fish. The catch was 67,000 metric tons in 1961. It was 151,000 in 1962, one third of which was frozen and two thirds salted.

Off-bottom trawls of the type used for small herring in the Baltic Sea took about one third the catch. (These trawls are made of a nylon-type fibre and have a stretched mesh of about 40 mm.) The rest of the fish were taken in drift nets measuring 30 x 10.5 m and set at various depths using floats and drop lines up to 10 m long to support the headrope. It is planned to continue the fishery at about the same level in 1963.

The increased 1962 landings are attributed to increased effort. Abundance is believed to have decreased. There were only three important year-classes (1956, 1955 and 1957 as determined from scale readings) in the catch and the maximum age observed was 9 years. The commonest sizes (fork length) in 1961 and 1962 were 25 and 27 cm.

Trawling was a daytime and twilight operation and was most successful after the pre-spawning concentrations stabilized (July-September). In 1962 this was largely at a depth of 100-150 m on the northern and northeastern part of the bank. In April, May and June, drift netting was more rewarding than trawling because then the fish are "up" and feeding and fattening but it was carried on at night July-September. In October the movements of spent herring were capricious and both methods were used. Mid-water trawling has not been successful presumably because the fish are scattered when at mid-depths.

After spawning the fish are believed to scatter possibly in the Gulf of Maine and December-March catches have been relatively poor.

A fuller description of research results is given in "Soviet fishery investigations in the ICNAF area in 1962, presented to the 13th Meeting of ICNAF, 1963" (Doc. 54).

The plan is to follow larvae and plankton more closely in 1963, and to begin a study of distribution and migrations by a small-scale tagging experiment.

Review of U.S.A. herring research and plans

This subject was reviewed jointly by Messrs. Sindermann, J. J. Graham, Anthony, Watson, Boyer, Skud and Stickney. It was documented by a report, "Atlantic herring, U.S. research and suggestions for future programs", which was prepared by the Boothbay Harbor laboratory for the 13th Annual Meeting of ICNAF (Doc. 29). This report contains a bibliography of published reports on U.S. studies.

U.S. research on Atlantic herring began in 1947 and has continued to date with emphasis on immature coastal stocks which supply a major sardine industry. Significant accomplishments include: (1) establishment of a comprehensive statistical system for the fishery; (2) determination of size and age at maturity of herring; (3) determination of location and extent of herring spawning areas in the Gulf of Maine; (4) better understanding of ocean current patterns in the Gulf of Maine; (5) information on movements of immature herring; (6) knowledge of geographic groups of herring; (7) development of methods of ageing herring; (8) better understanding of the importance of disease in herring populations; and (9) determination of swimming speeds of immature herring.

The present major studies concern abundance and distribution of larvae, racial studies, behavior and migrations of immature fish, adult populations, and biostatistics.

Larval sampling cruises along the northern New England coast are carried out every 1-1/2 months, and an estuary-bay complex on the central Maine coast is sampled every 2 weeks. In the fall, herring larvae are distributed with greater relative abundance at approximately the eastern and western ends of the coast than near the center. Small larvae (0.9 mm standard length), perhaps recently spawned, are most abundant in the eastern section of the coast during late September and early October and in the western section during late October to early November. In the estuary-bay complex, larvae were more abundant in an area with lower-estuary characteristics. The peak abundance of larvae, both on the coast and in the estuary-bay complex, was observed in autumn. Catches declined rapidly in the winter and exploration with newly developed gears indicated that in some areas the larvae moved into estuaries and upstream.

Racial studies are designed to determine the spawning source of immature herring stocks, and to assess the discreteness of such stocks. Several approaches have been attempted in this work, including use of morphometric characters such as vertebral and fin-ray counts, use of parasite "tags", and serological-biochemical studies. Some success has been achieved with serological and parasitological characteristics. Parasite tags first suggested the existence of two geographic groups of immature herring on the northern New England coast--one east and one west of Penobscot Bay. Serological study using blood group antigens supports the conclusio from the parasitological evidence but suggests that the boundary between the geographic groups may vary annually. Parasitological study of spawning populations indicates that the Georges Bank stock is distinct both from that on the Nova Scotia coast and in the Gulf of St. Lawrence.

Movements of immature herring have been studied since 1958, using two types of tags. Results suggest that their movements during the fishing season are limited. Larger-scale taggings are planned for 1963. Other aspects of the behavior of immature herring have also been studied. In 1957-59, during a detailed study of Passamaquoddy Bay, information about maximum swimming speed and endurance of herring of various sizes was obtained. These experiments demonstrated a positive rheotaxis and broad tolerance to salinity change. It is planned to study the effects of salinity and temperature on orientation and movements of immature herring.

Adult herring have been collected since 1955 from Georges Bank, Gulf of Maine, and Nova Scotia to study stages of sexual maturity. Georges Bank and Gulf of Maine herring spawn principally during late September and early October, with occasional spawning during late August and early November. Nova Scotia herring begin spawning in May and continue to spawn until October. There seem to be two Nova Scotia spawning maxima-- in May to early July and in late September and early October. Georges Bank, Gulf of Maine and Nova Scotia herring are at least 21.0 cm (standard length) in length by their first spawning, and are generally in their fourth year of life.

Since 1947, data on herring biostatistics have been obtained from processors and from samples obtained from the sardine fishery. Analysis of catch is designed to assess: (1) Mortality rates and population abundance in restricted areas; (2) Causes of catch fluctuations and year-to-year differences in gear distribution due to factors other than fish abundance such as selectivity and economics. Sampling of the fishery is being greatly intensified in 1963. This and catch data should provide better information on age and size composition of stocks, racial characteristics, parasite and disease occurrences, and rates of growth. Young herring are aged by the otolith technique. The method has been validated by aquarium observations and by length frequency distributions.

Two-year-old herring are of greatest demand commercially, and in years of abundance may account for over 90 percent of the catch. In years of scarcity, as 1961, the larger first-year fish and the smaller three-year-olds constituted nearly half the catch.

Co-ordination of research and standardization of techniques

The group discussed the feasibility of frequent informal communication between the scientists actually engaged in research in the Subarea. Although such communications are easily arranged between Canada and the U.S. who have co-operated closely during past years, exchanges between the USSR and North American countries is difficult because of the distance involved and the fact that USSR research in Subarea 5 must necessarily be conducted on ships working long distances from home which involves long term planning. Thus, frequent discussions of research plans and results are not very practical.

However, the group agreed that close communication between the working scientists of the three countries is highly desirable and efforts should be made to consult each other informally as the need arises.

It was pointed out that tagging was a good example of a research technique which might be standardized and improved by direct comparison in the field by investigators possibly working at times from the same vessel. Comparability of tagging results sometimes depends on nice differences in procedure that must be seen to be appreciated. It was agreed that this possibility should be reviewed after the USSR had completed its initial (1963) small-scale tests.

It was agreed that rewards for returns of fish tagged by one country and caught by fishermen of another country should be paid by the latter country in accordance with approved ICNAF procedures.

It was agreed that the conventions for reporting measurements and techniques as proposed by ICES should be adopted except that centimetre instead of half-centimetre size-classes should be used in describing the size-composition of fish stocks.

One of the ICES proposals is that fish landings should be reported in terms of the whole weight of fresh fish--not the weight after gutting and removal of gills.

Canada and the US each submitted a list of papers published by their research workers on the herring of the Northwest Atlantic. The Chairman pointed out that a similar list from the USSR would be most useful. Mr. Studenetsky agreed to submit such a list to Mr. Skud who agreed to combine the three lists into one complete bibliography of herring papers for the Northwest Atlantic. The compilation would include unpublished reports of each national.

An ad hoc committee was appointed by the Chairman to draft a statement of the environmental problems in the Subarea in relation to herring. This committee was composed of Dean Bumpus, Chairman; USA; Noel Tibbo and Louis Lauzier from Canada; S.A. Studenetsky from USSR; and Bernard Skud, USA.

The committee report which follows was approved.

> The fisheries conducted by the Convention countries in Subarea 5 exploit both juvenile and adult herring and possibly several distinct populations of them. To permit better understanding of the biology of the stocks and to aid in planning for their best use, it is recommended that:

1. The areas occupied by the stocks be defined and that racial studies be continued.

2. Studies be made in the subarea of such factors as seem to determine abundance and distribution of herring in all stages of their life cycle, viz.

   (a) Salinity and temperature patterns;

   (b) Currents--tidal and non-tidal

   (c) Food in relation to food requirements

   (d) Such factors as the above in relation to lateral and vertical distributional behaviour

   (e) Predators.

3. Above programs be pursued individually by the participating countries and jointly whenever possible. To encourage this arrangement, working scientists should be advised of scheduled field programs and invited to join in field efforts such as tagging programs, racial studies and food studies whenever possible.

Future Meetings

The advisers agreed that the Boothbay Harbor meeting had been most rewarding, and recommended that a similar block of time be set aside at next year's Annual Meeting for similar discussions on herring and its environment.

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