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I. Canadian Research Report, 1961

B. Subareas 4 and 5, Biology
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The Canadian Research Report for Subareas 4 and 5 differs from that of earlier years in that oceanographic studies and investigations by the Quebec Department of Fisheries are reported separately as Parts C and D. This section, Part B, describes investigations of cod, haddock, American plaice, pollock and scallops by the Biological Station of the Fisheries Research Board of Canada, St. Andrews, N.B.

Cod, Gadus morhua L. The dominant species of the southwestern Gulf of St. Lawrence (4T) is cod. Changes in the methods and intensity of fishing have had major effects on stock and landings. The continuing investigation of this cod resource provides the Commission with forecasts of the fishery and effects of restrictions on fishing.

Definition of cod populations is of basic importance to assessment studies. Cod tagged off eastern Nova Scotia in February 1960 at 80 fathoms in Sydney Bight (937 fish) were returned in significant numbers (147 in 1960 and 1961). During winter months most returns were taken by European trawlers fishing along the western slope of the Laurentian Channel from Scatari Bank to the Magdalen Islands. More returns were taken during summer months by Canadian vessels fishing in the southwestern Gulf of St. Lawrence, particularly in the Chaleur Bay area. Most of these Canadian returns came from otter trawls, but large numbers were also taken by other gears, particularly hook and line. Only two tags were returned from outside the 4T-4V north area, one across the Laurentian Channel (3P north) and one from Banquereau (4V south).

Returns (140) from the Western Bank (4W) cod tagging (506 fish) of March 1960 were mainly taken in the tagging area. None of the returns came from the 4T-4V north area.

About 1,500 cod were tagged in the vicinity of Seven Islands (4S) in October 1961. It is too early to assess the returns. However, it is apparent from a comparison of the biological characteristics of these fish with those of 4T that the cod population sampled in the Seven Islands area does not mix with 4T cod. Age composition, growth, age at maturity, feeding and parasitization differed in the two areas.

Results confirm earlier evidence that the cod of the 4T and 4V north area are distinct from those of 4R, 4S, 4V south and 4W. This cod stock is fished by Canadians in the Magdalen Shallows-Chaleur Bay area of 4T from spring to autumn. During winter months the commercial sizes are found in deeper water along the Laurentian Channel off Cape Breton (4T east and 4V north) where they are fished by European trawlers. Winter ice conditions limit fishing. The unusually large ice coverage in 1961 reduced the amount of winter fishing on this cod stock, and only three tags were returned by European trawlers.

Prior to 1947 about 10 million codfish were landed annually from Division 4T, almost entirely by Canadian line fishermen. Since then, trawling, mainly with small otter trawlers, has become increasingly important to the Canadian fishery. European trawling, mainly with large otter trawlers, has also increased. About half the total landings from this stock are now taken by European fleets during winter

months when cod are concentrated near the 100-fathom depth contour off eastern Nova Scotia. In 1960 total numbers landed by all countries were about 35 million cod.

Studies of catch curves for the years 1956 to 1958 and returns from cod tagged in 1955 and 1956 show high fishing ($F = 0.4$) and total ($Z = 0.5$) mortalities for the late fifties. Catch curves plotted from data collected in research-vessel hauls from 1959 to 1961 suggest still higher mortalities ($Z = 0.7$). With such intensive fishing, 5-year-old cod made up 40% of the cod landed by draggers in Canada in 1961, and cod over 7 years were barely 10% of the landings. The average weight of the cod landed was only 2.7 pounds, gutted, head on. Survey catches show that cod will be even smaller in 1962. The bulk of the landings will be made up of 5-year-old fish of the 1957 year-class with a modal length of about 46 cm. Average length of landed dragger fish will be about 51 cm (2.5 lb. gutted). Catch per hour dragged is expected to be similar to that of 1961, about 500 pounds for late-summer fishing by 50-ton draggers. Total landings will depend on availability of fish as determined by hydrographic conditions, effect of ice cover on winter fishing by Europeans, and the amount of Canadian fishing effort on this population.

The conversion to otter trawling has greatly reduced the size and age at which cod are first captured. Since the traditional fisheries have used large cod for salting, the conversion to small-mesh otter trawls resulted in heavy discards of small unmarketable cod at sea. In order to reduce this waste of fish, the Commission recommended use of $4\frac{1}{2}$ -inch manila meshes, or the equivalent in other types of twine, for cod and haddock dragging in Subarea 4. This mesh size was adopted by Canadian draggers in 1957. The introduction of technological changes, particularly production of fresh fillets and frozen-fish blocks, provided markets for smaller cod. A six-year study (1956 to 1961) of the quantities and sizes of 4T cod discarded at sea by Canadian draggers has shown that these mesh and technological changes have reduced the percentage discarded from 25 to 6 by numbers and from 9 to 2 by weight. It is estimated that total numbers of cod discarded in a dead or dying condition from southwestern Gulf of St. Lawrence cod catches by the international fleet decreased from about 7 million fish in 1956 to about 1 million fish in 1961. Adoption of large-mesh codends reduced the numbers of cod discarded by about $3\frac{1}{2}$ million fish. A further reduction in discards of about $2\frac{1}{2}$ million fish resulted from the change to smaller sizes culled for landing.

Investigations of the effects of changes in the environment and fishing on recruitment, growth and mortalities of 4T cod are continuing in order to provide background for making best use of the resource. Inter-species relationships are taken into account.

Tentative conclusions are that annual landings from the 4T cod population doubled in response to intensive trawling. Landings are now declining from the 1956-1959 peak to a new level.

Haddock, Melanogrammus aeglefinus (L). Good catches of haddock were made by the commercial fleet in the Western-Emerald area (4W) of Nova Scotia banks during the winter and early spring of 1961. A survey cruise by the A. T. Cameron in late April and early May indicated that haddock had been concentrated in water of 3 to 5°C as in 1959 and 1960. In contrast to the earlier years, water of this temperature appeared to cover a much smaller area in 1961. Concentration of haddock in this smaller area of suitable bottom temperatures provided good fishing at depths of 45 to 60 fathoms.

The size and age compositions of research-vessel surveys during the years 1958 to 1961 have been matched against those of commercial landings, as a basis for predicting trends in the Nova Scotia bank haddock fishery.

In 1958 the 1952 year-class was dominant in the fishery, and survey catches showed that strong 1956 and 1957 year-classes could be expected to enter the fishery.

By 1959, the 1956 and 1957 year-classes had grown to modal lengths of 34 and 25 cm, respectively. The two year-classes appeared to be of about equal strength. Commercial landings relied mainly on older haddock, particularly those of the 1952 year-class.

In 1960 the 1956 and 1957 year-classes were again dominant in survey catches. The 1958 year-class was poorly represented and the 1959 year-class was just entering the small-mesh research-vessel catches. Older haddock, particularly the 1955 year-class, provided the basis for the commercial fishery.

By 1961, the 1956 and 1957 year-classes overlapped in size, with a modal length of about 46 to 40 cm. The two year-classes were again of about equal strength, but only the older 1956 year-class contributed significantly to commercial landings. The 1955 and 1954 year-classes were important to the fishery. In research-vessel catches the 1958 year-class was poorly represented, and the 1959 year-class was less abundant than the 1957 year-class at the same age.

The haddock year-classes of 1956 and 1957 should provide good landings in 1962. Landings in 1963 and 1964 will probably decrease because of the poor 1958 and 1959 year-classes.

In addition to fluctuations in landings resulting from variations in year-class strength, hydrographic conditions produce significant changes in availability as observed in 1961. Seasonal fluctuations of this kind are difficult to predict.

American plaice, Hippoglossoides platessoides (Fabr.). The most important species of flounder in commercial landings from Sub-area 4 is the American plaice. This species is second to cod in dragger landings from the southwestern Gulf of St. Lawrence (4T). In 1961 biological studies of plaice were continued in this area.

Winter surveys from the A. T. Cameron in January 1960 and 1961 provided information on winter distribution of plaice. Small catches of immature plaice (less than 40 cm) were taken at all shoal-water stations (28 to 55 fathoms) in both years. At intermediate depths (65 to 100 fathoms) similar catches of small plaice were taken in 1960 at stations off Gaspé and northern New Brunswick. Fishing at these depths was done farther south off the Magdalen Islands in 1961. Plaice of all sizes were caught, with greatest numbers at 100 fathoms. The largest winter catches of all sizes of plaice were taken at depths of 125 to 200 fathoms in 1960.

The winter depth distribution of plaice along the northern sections in 1960 was compared with the depth distribution in June, August and October 1959 as observed from the Harengus. Good catches of all sizes of plaice were taken from shoal water in June and August. By October very few fish were taken there.

It is concluded that plaice have a shoal-water distribution in the Magdalen Shallows/Chaleur Bay area of 4T in spring and summer. In autumn they move to deep water (4°C) along the western slope of the Laurentian Channel where they concentrate in winter. Small plaice (under 40 cm) move with the large fish, but many remain in the below 0°C shoal water throughout the winter.

There is no evidence that plaice migrate south to the Cape Breton area, as described for cod.

Pollock, Pollachius virens (L). Otter-trawler landings of pollock have become increasingly important to the Canadian mainland ground-fish fishery. A study of the biology of pollock at the mouth of the Bay of Fundy was started in 1960 and continued in 1961.

Returns from 991 medium and large pollock (60-85 cm) tagged off Grand Manan and Campobello Islands near the boundary of Divisions 4X and 5Y in the summer of 1960 were 126 or 13% by December 1961. The returns show a southern migration in autumn to the winter spawning area of the southern Gulf of Maine (5Z) (Fig. 1.) In the summer of 1961 a few returns were taken in the "Western Hole" fishery between Browns and LaHave Banks (4X), but most returns came from the tagging area. The returns explain the absence of pollock from the tagging area in winter months by demonstrating a southern migration in autumn months and a return northern migration in spring months.

The summer distribution of pollock at the mouth of the Bay of Fundy was surveyed at sea on draggers and by sampling commercial landings. A similar distribution was observed in the two years. Large fish (65 to 85 cm) were caught in the Wolves Bank-River area on the north side of the Bay of Fundy. Medium fish (60-75 cm) were caught south of Grand Manan Island, on Yankee Bank on the south side of the Bay of Fundy, and in the "Western Hole" area south of western Nova Scotia. Small fish (40-65 cm) were caught on grounds to the west of Nova Scotia. Since otter-trawl and handline catches from the same ground had similar size distributions, it is concluded that gear selection has little influence on the observed schooling pattern of pollock distribution.

Most of the pollock caught by otter trawls were above the sizes released by $4\frac{1}{2}$ -inch manila meshes. Catches of small fish were too low for a study of selectivity and meshing of pollock in $4\frac{1}{2}$ -inch mesh nets.

Sea scallop, Placopecten magellanicus Gmelin. Canadian sea scallop landings by the offshore fleet increased again in 1961 to a record 10.1 million pounds of shucked meats (83.8 million lb round weight). All landings by this fleet came from Georges Bank (5Z). These landings were heavier mainly because more Canadian boats were fishing (28 cfd. 20 in 1960) but also because the boats fished harder and carried more crew for shucking meats. The small-boat inshore fishery in Subarea 4 landed 0.7 million pounds of shucked meats.

Two trips were made on offshore scallop draggers to sample catches and study commercial practices. Unlike 1960, most boats in 1961 reported dragging almost continuously to maintain high landings. Deck loading, which was the most prominent feature of the fishery in 1960, was less common in 1961. This resulted mainly because the extremely large year-class which provided the bumper catches of 1960 had been largely fished out in that year and contributed much less to 1961 catches. The 50% cull point remained the same as in former years, at a shell height of 95-100 mm. As was the case in 1959, discards comprised over 50% of 1961 catches for some areas of the bank. Five boats used drags with 4-inch rings and the remainder of the fleet used 3-inch rings. Evidence of mass mortalities was observed again on certain parts of the bank, although it was not as pronounced as in 1960.

The commercial scallop dragger Cape Eagle was chartered for a research cruise to Georges Bank as part of a joint Canadian-United States investigation of the advisability of introducing a minimum ring size regulation to the Georges Bank scallop fishery. An intensive study was made on the variability of scallop population density within unit areas (10 minutes of latitude and 10 minutes of longitude). A comparison was made of catches by drags with 3-inch and 4-inch rings and by drags with single and multiple linkage. Results of this joint study are reported separately.

A laboratory program, investigating aspects of the biology of the sea scallop, was continued in 1961. Major emphasis was devoted to a study of the sea scallop larval stages which have not previously been described. Scallops were spawned in the laboratory and the larvae reared by feeding them on cultured phytoplankton. Larvae were raised for 42 days but they did not settle in this time. A record of the stages up to this time was made. It is planned to continue this work in 1962 in an effort to explain the cause of variations in year-class strength.

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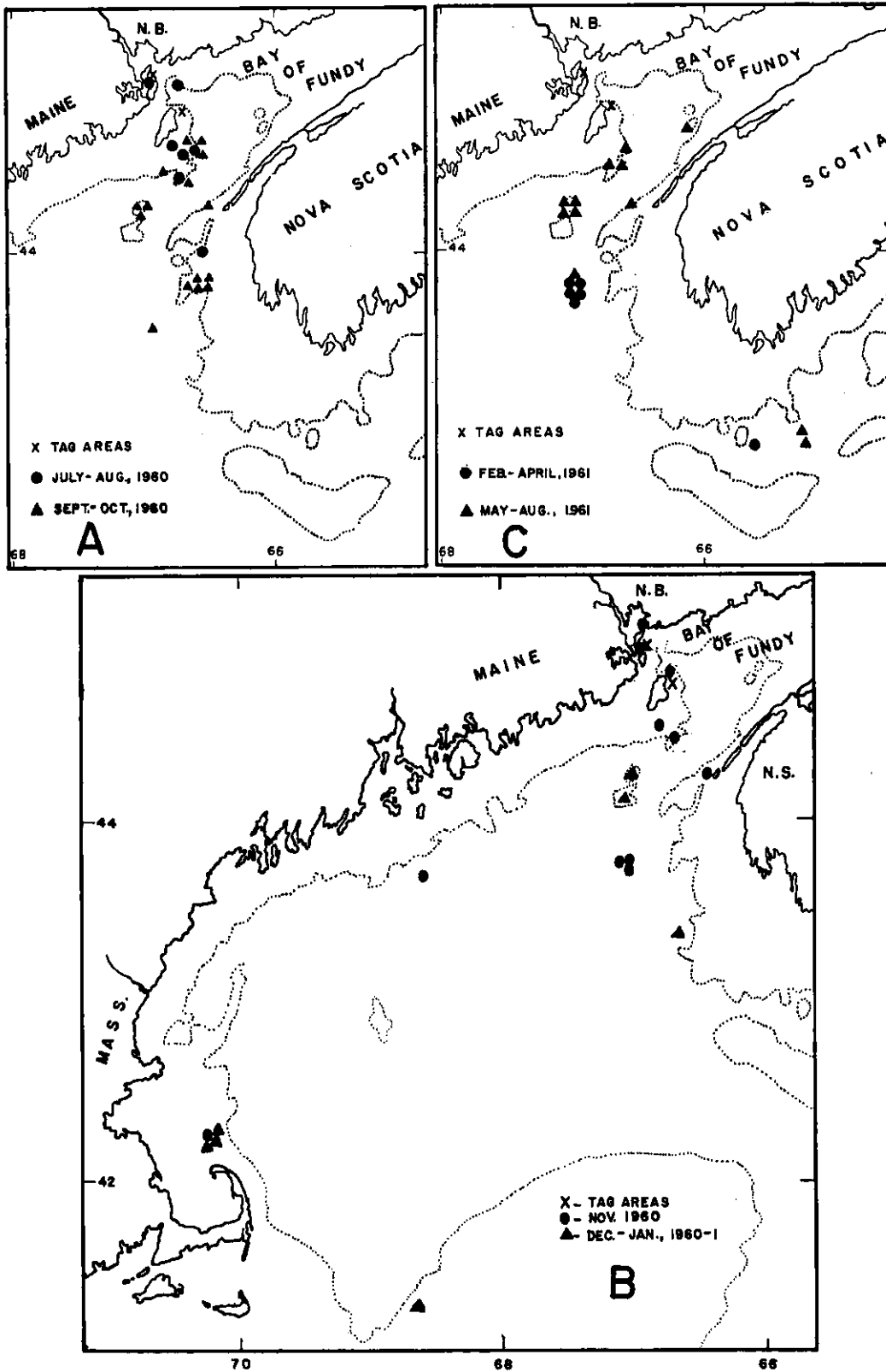


Fig. 1 . Reported locations of recoveries from pollock tagged in summer of 1960 near New Brunswick-Maine boundary at mouth of Bay of Fundy, by seasons.