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Results of Cod Tagging Experiments
in the Barents Sea in 1962

by

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In 1962 in the Barents Sea the PINRO investigators have marked 25.820 cod with tags attached to operculum and 3.191 cod with hydrostatic tags. 420 tagged fishes were recaptured. 342 of these were taken by the Murmansk fishermen and 47 and 31 by the British and Norwegian fishermen, respectively. Out of the tagged 420 cod, 257 proved to have been marked with tags attached to gill covers and 146 fishes had hydrostatic tags, which constitutes 0.9% and 4.4%, respectively, of tag return. Besides, in 1962 the Institute received the information from the Murmansk fishermen on recaptures of 165 cod with Norwegian (114) and British (51) tags. For 1962 a total of 524 tagged cod recaptures were reported to the Polar Research Institute of Marine Fisheries and Oceanography. Of this number, 211 tags (117 Soviet and 194 Norwegian and British altogether) were returned to the Institute by the Murmansk fishermen, 46 tags (28 Soviet, 15 Norwegian and 3 British) were recorded by the workers of the Fish Processing Plant in Murmansk and by consumers from Sverdlovsk, Tashkent, Kharkov, Arkhangelsk and other towns. 232 recoveries were supplied with information relating to time and place of recaptures only obtained from radio-reports, cables and other sources, while for 35 tagged cod recaptures it was not possible to determine the type of tags used.

The recaptures of tagged cod allowed to trace the migrating routes followed by the fish in 1962. Cod tagged in November/December, 1961, in the North-Central area and in the adjacent northern grounds of the Murmansk shelf and western edges of the Goose Bank occurred in catches within the mentioned areas till late February - early March. Later with the approach of capelin immature cod started its spring migration towards the Murmansk coast across the shelf (Figure 1)^{x)} Cod tagged in March on the Murmansk shelf occurred in catches in April/May in the coastal zone extending from the Motor Gulf to 37°E L. In catches taken within the same area at the end of April and in May also cod tagged in early April on the Murmansk shelf was observed. From June to August tagged cod occurred in catches taken on the edges of the Murmansk Bank, Murmansk shelf and on its northern slope. In late July individual fishes bearing the tags used in April and June on the North-Eastern slope of the Murmansk Bank were recaptured on the western edge of the Goose Bank. From September till December tagged cod performed only local displacements and was caught near the spots of release within an extensive area from the north-western slope of the Murmansk Bank to the western edge of the Goose Bank.

In 1962 the fattening migration of cod in the southern part of the Barents Sea was similar to that of 1954. The peculiarities of cod migrations in 1956-61 conspicuously illustrated by the results of tagging experiments were described in the Reports of the Academy of Sciences of the USSR, vol.131, No. 6/1960 and in "Annales Biologiques", 18, 1963. The comparison of changes in cod migrations during recent years with variations in temperature of water masses reveals a close relation between those two factors. This relation was pointed out by investigators long time ago. Ju.Ju. Marty (1939) connected the approach of capelin and immature cod towards the coastal line with one and the same factor, i.e., the temperature of water masses. In recent years the relationship between variations of water temperature and migration and distribution of fish have been worked out in detail by the PINRO scientists. Table 1 shows the deviations from the long-term average temperature of water masses along the Kola meridian within the layer from 0 to 200 m:- from November till April (during those months cod moves westwards), from May till October (cod moves eastwards) and for the whole hydrological year (from November till October next).

x) Unfortunately it has not been possible for the Secretariat to reproduce the figures belonging to the present contribution on a stencil.

Table 1 Deviations from the average water temperature along the Kola meridian within the layer from 0 to 200 m since 1953/1954 till 1961/1962.

Y e a r s (from November till October next)	Deviations from the long-term average temperature		
	from November till April	from May till October	Annual
1953/1954	+0.52	+0.62	+0.57
1954/1955	+0.14	+0.06	+0.10
1955/1956	-0.54	-0.64	-0.59
1956/1957	-0.31	0.00	-0.16
1957/1958	-0.49	-0.57	-0.53
1958/1959	-0.23	+0.36	+0.06
1959/1960	+0.11	+0.40	+0.25
1960/1961	-0.23	-0.09	-0.16
1961/1962	+0.08	-0.80	-0.11

The relation between variations in migrations of cod and an extent of cooling water masses from November till April remains most conspicuous. As seen from Table 1 the positive deviations in water temperature since 1954/1955 (from November till April) were observed only in 1959/1960 and 1961/1962. In summer 1960 and particularly in 1962 the vast cod schools migrated in the main stream of the Murmansk current eastward up to the edges of the Goose Bank. Before the migrations took place concentrations of cod were observed in the near western and partially in the central regions of the sea. In autumn the cod returned to the west by the same route as it had previously followed in its eastward fattening migrations.

In the other years listed the deviations in water temperature from November till April were negative. During those years the cod stayed for a long time in the western areas and only part of the fish moved along the coastal stream of the Murmansk current. The cod did not pass in the main stream (east of the Murmansk Bank) during those years, except in 1961, when part of the fish moved into the central regions of the sea in mid-June. Thus, the cooling of water masses from November till April affects not only the speed and the extension of migration of wintering cod moving in a westward direction but also influences the eastward route of fattening migration. The cooler mid-water becomes from November till April the more westward shift wintering grounds of immature cod and the more slowly it moves in eastward direction.

In recent years, even in cases when the cod moved in the main stream of the Murmansk current (1960, 1962), the extension of its fattening migrations eastward is considerably shorter than that in the thirties and forties. The extension of the feeding migrations of cod is closely connected with the size of the fish. The larger cod the more eastward it moves. Table 2 shows that the average size of cod taken by the Murmansk fishermen was 4 - 6 cm and 11 - 13 cm smaller in 1956-1958 and 1959-1962, respectively, as compared with 1948-1949. Diminishing in fish sizes together with changes in water temperature evidently affected the extension of cod feeding migrations in the southern part of the sea.

According to N.A. Maslov many fish up to 50 cm as well as large cod moved to the area of the Novaya Zemlya Island in the thirties and forties. Cod of such sizes is not observed in catches taken from the commercial concentrations in the said area during recent years. The number of fish in a school also seems to exert an influence on the extent of cod feeding migrations. Prof. G.V. Nikolsky (1960) believes that when congregated in large quantity, cod eats food organisms more rapidly and in search of food it covers very long distances. Thus, changes in migrations of cod in the southern part of the sea in different years and comparison with its migrations in the thirties and forties confirm the correctness of the statement made by Ju. Ju. Marty (1961) that the extent of fattening migrations of sea fish is not unchangeable and is connected both with environmental conditions and population abundance.

One of the peculiarities of cod migration in the area of Bear Island - Spitsbergen in 1962 has to be noted:- A bulk of immature cod wintering on the edges of the Bear Bank moved in 1962 (in contrast to the previous years 1959-1961) not to the region of Western Spitsbergen but to the area of Hope Island and contiguous grounds of Sud Kap (Figure 1).

Table 2

	1948	1949	1950	1954	1955	1956	1957	1958	1959	1960	1961	1962
Average size (cm)	60.7	62.75	55.10	49.35	54.95	57.05	56.0	58.45	48.9	49.45	48.65	49.60
Average weight (g)	2733	2466	2592	1299	1773	2612	2241	2045	1660	1518	1486	1202

The wintering grounds of immature cod within the area of Bear Island - Spitsbergen as well as in the southern part of the Barents Sea are conditioned by the temperature regime of water masses from November till April. The results of recent cod tagging experiments in the north-western areas showed that wintering cod moves from the western edge of the Bear Bank to Western Spitsbergen. Cod wintering on the southern edge of Bear Island Bank moved across its eastern edge to Hope Island. Table 3 summarizes the data characterizing the migrating route of cod from Western Spitsbergen to Hope Island across the edges of the Bear Bank. Thus, the route of immature cod from Western Spitsbergen to Hope Island and back lays across the edges of the Bear Bank. The hauls taken from April to mid-August 1962 on the edges of the Bear Bank and later off Hope Island contained cod which had been tagged near Western Spitsbergen in November 1960 and 1961. In the catches taken west and south off Hope Island at the end of August and in September a number of cod occurred which had been marked on the edges of the Bear Bank from May to July (Figure 1). Cod tagged off Hope Island in the period from August till October was found in the hauls on the southern and western edges of the Bear Bank in December.

Figure 2 shows the locations where in 1962 the Murmansk fishermen recaptured mature cod tagged by the Norwegian and British investigators on the spawning grounds off Norway.

Table 3

Tagged off Western Spitsbergen			Recaptured in 1962			
Date	Coordinates		Date	Coordinates		Area
	N.L.	E.L.		N.L.	E.L.	
21.07.61	76°53'	13°40'	30.5	74°53'	16°17'	Western edge of Bear Bank
23.08.60	76°57'	13°26'	23.6	73°45'	18.00'	Southern edge of Bear Bank
22.07.61	76°50'	13°20'	14.8	75°18'	27°07'	Eastern edge of Bear Bank
26.08.59	77°25'	12°00'	30.8	76°95'	28°45'	Off Hope Island

Tagged mature cod was found in catches with immature specimens on the edges of the Murmansk Bank, Murmansk shelf and its northern slope from May till September. In the north-western regions mature fish occurred in catches in August mostly on the eastern edge of the Bear Bank somewhat eastward from the places where immature cod was staying at that time. In September mature cod evidently moved from the eastern edge of the Bear Bank to the east of Hope Island.

The migration routes of mature cod from the north-western areas to the southern part of the Barents Sea after spawning off Norway are shown in Figure 1. It is interesting to note that two cods tagged and released on the western edge of the Bear Bank on March 3, 1961, were recaptured by the British trawler on the Murmansk Bank 8 and 19 December, 1962. The two cods apparently were keeping near to each other all that time and were approaching the spawning grounds for the second time.

This example indicates that the cod schools remain stable at any case for a long period if not for the whole life.