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On the Expediency of a Decrease in Yield of Cod on Flemish Cap (ICNAF Div.3M)

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Before 1957 the fishing fleets operated on Flemish Cap irregularly and for a short period of time. Thus, from 1953 to 1956 inclusive, vessels of all countries took a total of about 1,300 metric tons of cod on Flemish Cap.

In autumn 1956, the Soviet freezer trawlers (BMRT) started catching redfish on the southern and southwestern slopes of Flemish Cap. In spring 1957, cod were predominant in catches taken in this area. Since that time fishing trawlers of some European countries fish annually for cod in the southwestern part of the Bank at depths of 250-400 m in February-April. The main part of catches taken by trawls is always mature cod: pre-spawning, spawning and post-spawning. As Table 1 shows, the peak of the cod fishery on Flemish Cap is usually observed in March. Fishing vessels take the largest catch per 1 hour trawling in February, March or April as well. During some years (for instance in 1956, 1965) cod were also caught successfully in autumn, mainly on the northeastern slope of the Bank. Seldom did the fishery peak during any month in summer or winter. The main gear was an otter trawl; longlines were seldom used. As mentioned above, in spring the fishing fleet catches mainly mature cod; during the other seasons immature cod constitute a considerable part of the catches.

On Flemish Cap there is a single cod population that never mixes with cod of the Great Newfoundland Bank. Isolation of the Flemish Cap population is particularly indicated from the results of tagging. Table 2 includes data on some cod that were tagged on board Soviet research vessels on Flemish Cap and were caught by the Soviet fishing vessels and those of the other countries. Only the data from those specimens for which the location of their recapture was known to be reliable were used.

It is easy to see from Table 2 that the tagged cod never migrated from Flemish Cap. There was no record of tagged cod having migrated onto Flemish Cap from other areas, even though Soviet ichthyologists had tagged over 35,000 cod in Subareas 2 and 3 from 1960 to 1966 (Konstantinov, 1967a).

Isolation of the Flemish Cap population of cod makes it possible to find out what influence the fishery can have on the stock of fish. It should also be noted that the size of the cod stock on Flemish Cap could not be very great because of the small area.

Further, one may assume that natural fluctuations of the abundance of year-classes of cod on Flemish Cap are insignificant. This area has extremely invariable oceanological conditions. Throughout the year water temperatures at all depths deviate from 3.5° by only some tenths of a degree. Fluctuations of water temperature between years are also particularly insignificant. Many investigators (Izhevsky, 1961; Antonov, 1964; Kislyakov, 1964; Templeman, 1965) have proved conclusively that there is a close relationship between oceanological conditions and abundance of fish year-classes. Thus, one can expect a relatively constant annual recruitment to a fishable stock of cod. This is indicated to some extent by data collected regularly by the Soviet ichthyologists to determine the abundance of the young in Subareas 2 and 3 (Bulatova, 1968).

Thus, good grounds exist for an assumption that one may estimate the influence of fisheries on cod stocks on Flemish Cap. In the first place, before 1957 a fishery was not practically observed on Flemish Cap but from 1957 to 1967

reliable statistical data on catches and size-age composition of fish are available. In the second place, during each spring, the trawler fleet exploits a quite definite part of the population - mature cod. But an intensive fishery may markedly affect the abundance and size-age composition of mature cod as for example the Arcto-Norwegian stock of cod (Saetersdal and Hylen, 1964). Third, the cod population on Flemish Cap is quite separate and not large. In the fourth place, evidently annual recruitment to the stock is relatively constant; hence the effect of the depleting the stock by the fisheries should be reflected more clearly. It will be recalled that sharp fluctuations of the strength of year-classes can completely overbalance the influence of a fishery on stocks of Gadid fish. Striking examples are cod and haddock of the North Sea (Report of the Working Group on Assessment of Demersal Species in the North Sea, 1969), cod in the Barents Sea (Konstantinov, 1967b, 1969), haddock of the Barents Sea (Sonina, 1969) and cod of the Baltic Sea (Antonov, 1964).

Templeman and Gulland (1965) reasonably note that "In most fisheries, therefore, where there are fluctuations in recruitment or other factors, independent of the amount of fishing, it is difficult to predict what the absolute magnitude of the catch would be with any pattern of fishing, or to say that the catch in any particular year following some regulation (e.g. an increase of mesh size) will necessarily be greater than before the regulation. What is possible is to determine that catches following some regulation will be greater than they would have been if the regulation had not been introduced".

In other words, in most areas of oceanic fisheries it is rather difficult to trace the influence of fisheries on stocks as this is overbalanced by the action of other more important factors. However, the features common to Flemish Cap mentioned above offer particularly favourable conditions to determine the influence of fisheries on cod stocks.

Actually, Fig. 1 clearly illustrates that the age composition of spawning cod changed from 1957 to 1963 with the peak of the age frequency displacing to the left. It is safe to attribute these changes to an increasing yield of cod. Figure 2 shows the relationship between the total yield of cod and the subsequent catch per unit effort. In the figure, the dotted line indicates an average catch per 1 hour trawling by the Soviet BMRT in February-April on the southwestern slope of the Flemish Cap; the solid line, the total yield of cod taken by all the countries over the whole of Flemish Cap during the previous four years. The curves drawn from the data for 1957 to 1962 reflect each other as in a mirror: with increasing total yield of cod there was decreasing productivity of the trawl fishery on the spawning ground. Such a mirror relationship is observed on comparing the data for 1964 and 1967. However, 1963 does not follow the general relationship due to a sharp increase in fishing efficiency. It is difficult to give reasons for this exception. It is probable that some features of environmental conditions (for example, unessential at first glance anomalies of water temperature) may have increased the density and stability of the spawning concentrations. The influence of environmental conditions on the productivity of trawl fisheries is well established for the Barents Sea cod (Konstantinov and Mukhin, 1965; Konstantinov, 1967b, 1969; Mukhin, 1967) and partly cod in the Labrador area (Konstantinov, 1968). As to cod on Flemish Cap after 1963 a further increase in yield was accompanied by a steady decrease in average catch per 1 hour trawling.

The data given enable one to assume that, at present, the cod yield from Flemish Cap exceeds the optimum level. Because of this, a decrease in annual yield would probably help to restore fishery productivity and the length composition of fish in the catches.

Figure 2 shows that as long as the total yield of cod on Flemish Cap did not exceed 10,000-12,000 tons annually (or 40,000-50,000 tons for four years), it was possible that an incidental increase in the average catch per 1 hour trawling could take place in spite of the evident decreasing trend. To increase this catch per 1 hour trawling again, it is probably necessary to set the total annual yield of cod on the Flemish Cap at 10,000 tons.

Decrease in yield will not be a great privation for any country. Thus, the Flemish Cap is an extremely appropriate area for the experimental regulation of fisheries.

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Table 1. Catches of cod in metric tons from Flemish Cap, 1957-1967.

Year	Yield by all countries	Month when the greatest catch was taken	Country which took the greatest number of cod	Average catch per 1 hour trawling by Soviet BMRT in February-April
1957	17,799	March	USSR	3,22
1958	4,615	July	USSR	2,45
1959	6,949	October	USSR	2,34
1960	758	July	USSR	2,00
1961	20,341	March	USSR	-
1962	15,907	January	USSR	1,70
1963	33,413	March	France	4,09
1964	38,797	March	USSR	2,99
1965	53,850	November	USSR	-
1966	28,956	August	Portugal	-
1967	37,069	March	Portugal	1,66

Table 2. Recoveries of cod tagged and released on Flemish Cap by Soviet research vessels, 1961-1966.

	Released				No. of tag	Recaptured				
	Date	Position N	Position W	Length of cod (cm)		Country	Date	Position N	Position W	
I.	23-rd March I96I	46°39'	45°52'	58	7927	USSR	28 June I96I	46°50'	46°05'	-
2.	23 March I96I	46°39'	45°52'	58	793I	France	I4 May I964	46°30'	46°30'	-
3.	I2 March I963	45°26'	45°30'	52	7733	Spain	22 August I963	45°26'	45°30'	54
4.	I4 March I963	46°30'	45°33'	59	20053	France	9 August I963	46°30'	46°00'	60
5.	I4 March I963	46°28'	45°53'	52	2I769	Spain	20 August I963	46°26'	45°30'	54
6.	27 Feb. I965	46°38'	46°06'	53	26925	USSR	5 May I965	46°50'	45°45'	53
7.	28 Feb. I965	46°34'	45°47'	72	3508I	USSR	I0 June I965	46°4I'	45°33'	73
8.	28 Feb. I965	46°34'	45°47'	75	35087	USSR	5 August I965	46°30'	45°I5'	76
9.	28 Feb. I965	46°34'	45°47'	56	35099	USSR	2 June I965	46°50'	45°45'	57,5
I0.	27 Feb. I965	46°39'8	46°I3'9	60	35097	USSR	30 May I965	47°58'	45°03'	-
II.	28 Feb. I965	46°34'3	45°47'4	63	35048	Poland	2I Nov. I965	47°43'	44°43'	66
I2.	II Dec. I966	46°59'	45°35'	58	I06282	Norway	2 June I968	47°00'	45°00'	-
I3.	II Dec. I966	46°59'	45°35'	59	I062I9	Portugal	I5 March I967	46°28'	45°23'	-
I4.	I2 Dec. I966	46°53'	45°29'	64	I06345	England	22 August I967	46°30'	45°40'	-
I5.	I2 Dec. I966	46°55'	45°3I'	65	I06389	Norway	8 Oct. I968	47°00'	45°00'	7I

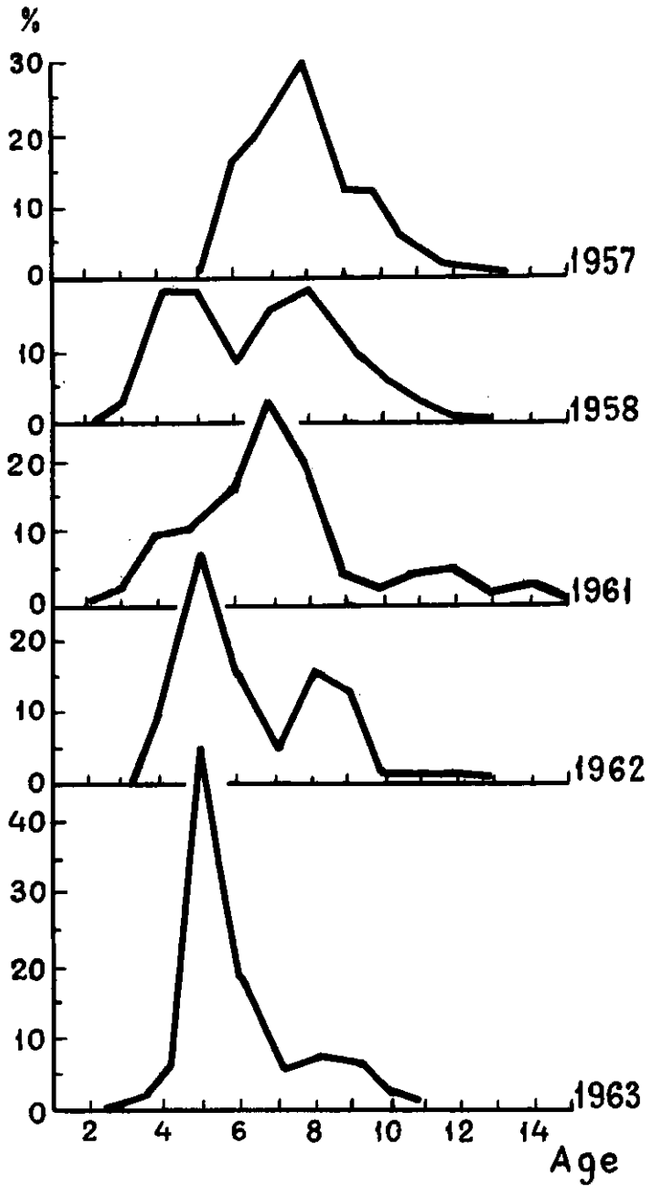

Fig. 1. Age composition of cod on the southwestern slope of Flemish Cap in 1957, 1958, 1961, 1962 and 1963.

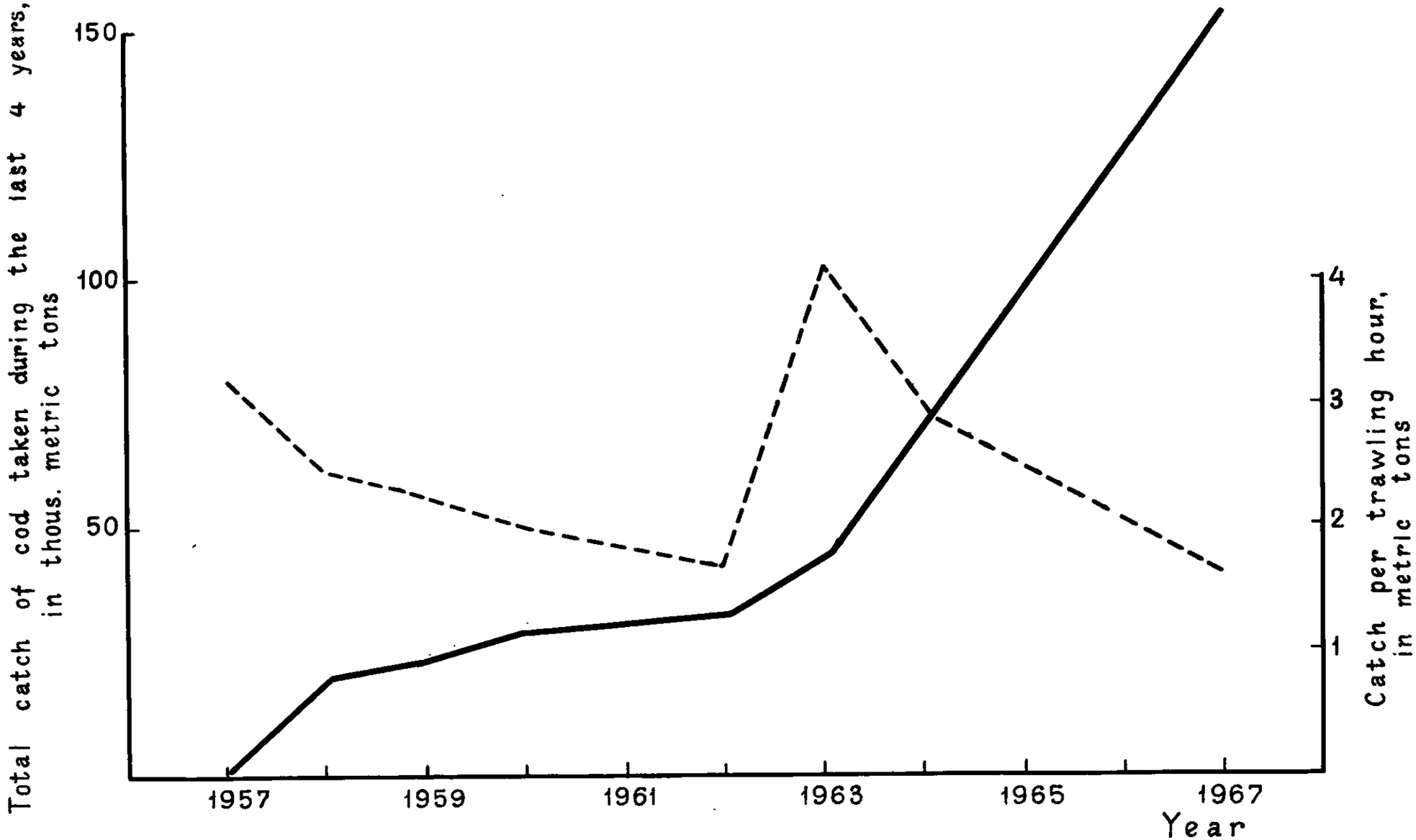

Fig. 2. Total yield of cod by all countries from Flemish Cap during the four years previous to 1957-67 (solid line) and the catch per 1 hour trawling by Soviet BMRT in the southwestern part of Flemish Cap Bank in February-April of 1957-67 (dotted line).