International Council for the
Exploration of the Sea

C.M. 1968/F:12

Demersal Fish (Northern) Committee

The Effect of Fattening and Fatness Features on Haddock Migrations in the Barents Sea

by

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As compared to the 1930's, in the 1950's and 1960's the eastern border of the haddock distribution area was considerably displaced to the west; the length of the eastward migrations was reduced; the feeding places and wintering grounds changed, as well as times for and duration of its staying in some parts of the Barents Sea. The changes in haddock migrations were greatly influenced by the cooling of the Barents Sea, the dynamics of the age-size composition of the populations and by their feeding (Sonina 1958, 1962, 1967a, 1967b, 1967c, 1967d). The present paper briefly presents how the passing of haddock from one kind of food to another has affected their migrations and behaviour in the Barents Sea.

The investigations on haddock feeding began in 1928 by the scientists of GOIN (Idelson, 1929, Dekhtyaryova, 1931). Later these investigations were continued by V.I. Zatsepin (1938) and N.S. Petrova-Grinkevich (1944), scientists of PINRO. As the result of the above-mentioned investigations, which were carried out in the 1920's and 1930's it was concluded that the haddock is a typical benthophage, and that their main object of feeding are various bottom animals, mainly echinoderms, shellfish, worms, and other groups, whereas fish and euphausiidae made up an insignificant part of their diet.

As compared to the 1930's, in the 1950's and 1960's a considerable cooling took place in the Barents Sea. As a result of this the area of capelin spawning changed.

It is known that areas and times of capelin spawning are determined by the thermal conditions (Rass, 1933; Glebov, 1952, 1963; Konstantinov, 1964; Prokhorov, 1957, 1963, 1965). In the 1930's during the maximum heating of Arctic waters, the capelin would come to the coast in small quantities (Maslov, 1944) and apparently the bulk of the stocks stayed in the northern open sea. During this period haddock and capelin areas were separated. Owing to the cooling of the Barents Sea in the 1950's and 1960's the abundance of spawning capelin increased and their area displaced to the south-west; the bulk of them now moved for spawning to the coastal regions of Norway and Murman. Thus, now the areas of haddock and capelin often coincide.

In connection with that the nature of the fattening of the haddock in the southern Barents Sea has changed. In the 1950's and 1960's the haddock has been feeding mainly on capelin and euphausiidae, and the importance of benthos in their diet has decreased sharply (Tseeb, 1960, 1964; Novikova, 1962, 1965; Novikova and Mikhalkovich, 1963).

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Tank observations (Tseeb, 1964; Tseeb and Astafyeva, 1965) revealed that along with polyphagy, the Barents Sea haddock possess a well pronounced ability to choose food organisms. Their favourite food is untubed worms, fish and crustacea. Shellfish, echinodermata, tube worms and other animals having shells or tubes serve as food in case of need. The haddock feed on benthos only when their favourite food objects are absent.

The rate of fatness defines the results of fish fattening. The passing over from one kind of food to another by the haddock was accompanied by changes in the fat-accumulation process. Figure 1 shows that in earlier years haddock reached their maximum fatness after the autumn feeding on benthos; and their fatness was at a minimum in May - June. In 1954-1966 the haddock reached their maximum fatness in March - August after feeding on capelin and euphausiidae. In autumn when the haddock was feeding on benthos their fatness decreased and was at a low level until January. The fatness was at a minimum in February.

Haddock feed on capelin mainly from March to May during the period of their mass migration to the coast for spawning in the western and coastal areas of the Barents Sea. Feeding on euphausiidae is most often observed in the coastal and central regions in June-August, when these crustaceans descend to the bottom layers after spawning. Intensive haddock fattening on benthos is usually observed in the south-eastern parts of the sea in autumn.

The eastward migration of haddock is a feeding one and is first of all determined by the distribution and abundance of its main feeding objects. In the 1930's, while feeding on demersal animals, the haddock fattened in the south-eastern regions where the standing crop of benthos is richer than in the rest of the Barents Sea. In the 1950's and 1960's the greater part of the fattening period is spent in the western, coastal and south-western parts of the central regions; that is, where capelin and euphausiidae are found.

Due to the haddock passing over to other objects of food, their fattening grounds have also changed lately, and consequently their migrations in the southern Barents Sea. The fatness of the haddock at different seasons depends on the feeding conditions, and these vary greatly from year to year. During intensive feeding on capelin, the fatness of haddock is considerably higher in all the seasons than the long-term mean (Figure 2). In the years of poor feeding on capelin, the fatness of haddock in the spring period is usually very low. It becomes higher in July after feeding on euphausiidae. It decreases, however, when the conditions get worse, and increases again in October after feeding on benthos. Therefore, if haddock feed poorly on capelin and euphausiidae, they accumulate fat mainly in the autumn while feeding on benthos. Thus, haddock migrations into the south-eastern regions rich in benthos, are determined by the conditions for previous feeding on capelin and euphausiidae in the coastal, western and central Barents Sea. During years of intensive feeding on capelin and euphausiidae, when the fatness of small and middle-sized haddock in July - August is higher than 5.3%, they feed as a rule rather poorly on benthos in the autumn. They do not migrate in bulk into the south-eastern regions of the sea, and often do not come there at all. Continuous stable concentrations of haddock in these regions are formed in cases when previous feeding on capelin and euphausiidae has been poor. Their fatness in July - August does not exceed 4.0 - 4.5%.

Having accumulated a certain stock of energy, the haddock as a rule, stop feeding. In years of intensive feeding on capelin and euphausiidae, their fatness would considerably increase already by August. Owing to this fact they usually feed poorly in autumn and keep dispersed. The departure of the haddock to wintering and spawning grounds does not depend on their fatness and is often determined by thermal conditions. However, in years of poor feeding on capelin and euphausiidae, when they feed intensively on benthos in the south-eastern regions of the sea in autumn, the duration and time of feeding depend on their fatness as well as on thermal conditions. Usually, the haddock leave benthos feeding grounds when their fatness is no less than 4.6 - 4.5%. The sooner they accumulate a sufficient stock of fat, the earlier they leave the feeding grounds.

Intensive feeding on capelin and euphausiidae causes a considerably greater fatness in all seasons than feeding on benthos (Figures 1 and 2). Therefore, one can suppose that at the end of the 1920's and 1930's, when benthos formed the main part of the haddocks' diet, their fatness was lower than in the 1950's and 1960's. This is confirmed by data on haddock fatness from 1928. (Yesipov, 1931, 1937; Suvorov and Vadova, 1932). It must be taken into consideration that in samples

taken in 1928 specimens 50-80 cm long were dominating, and in our samples 30-60 cm long fish are most common. It is known that along with increase in length of the haddock, the relative weight of their liver increases as well (Novikova, 1963). The fatness of large specimens in 1928, however, was much lower than that of small and medium-sized in the 1950's and 1960's. Therefore, in the 1950's and 1960's the fatness of haddock has increased as compared to the 1930's.

The intensity of fat accumulation and the level of fat supply in fish characterise their security of food (Schulman, 1963). Thus, the increase of fatness in haddock in the 1950's and 1960's is an indication of their better security of food.

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F:12/Sonina

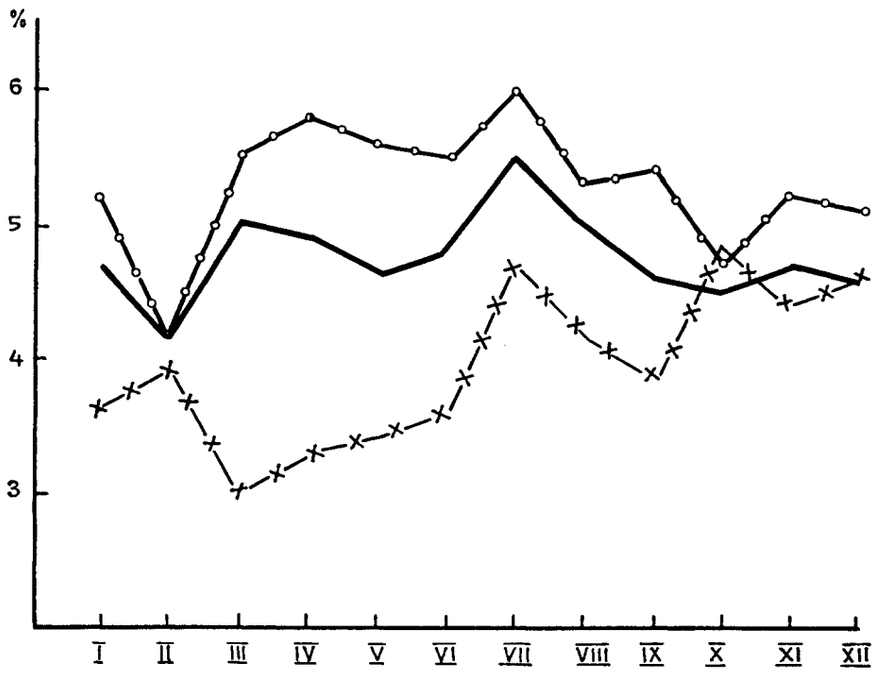

Figure 2. Changes in fatness of haddock by months in the 1950's and 1960's.

1 - long-term mean data for 1954-1966;

2 - in the years of intensive fattening on capelin.

F:12/Sonina

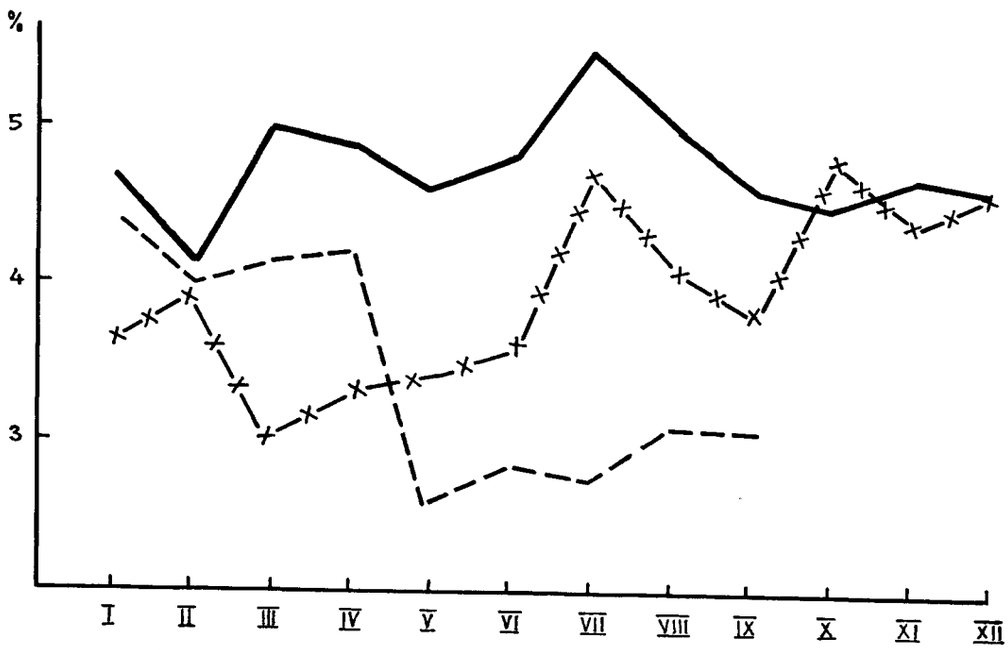

Figure 1. Changes in fatness of haddock by months in 1954-1966 (1) and in 1928 (3).

(2) Fatness of haddock in the years of poor feeding on capelin (1962, 1963, 1964).