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Methods of Determining the Age and the Growth
Peculiarities of Baltic Cod

By

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The Baltic cod adapted to habitation in a relatively warm and low-salinity water body has some specific features as compared with the North Atlantic cod. Early maturation, a comparatively short life cycle and a rather long spawning period are characteristic for the Baltic cod. The latter feature, in a rather large measure makes it difficult to determine the age of the fish. A great amount of data has been processed pertaining to the determination of the age of the cod and the growth-rate by means of the otoliths. These data have made it possible to define more accurately the methods of determining the age of the Baltic cod and to determine some of the characteristic peculiarities of its growth.

In the first place the otolith structure was studied and the times at which the annual rings are formed had become known. The otoliths were collected over a number of years and in different seasons of the year.

Altogether 8,000 otoliths collected in the period 1949-1961 have been examined and measured by an ocular micrometer.

The results of this research have shown that otoliths can be used for the calculation of growth-rates of the Baltic cod. The widths of the increments quite adequately reflects the growth of the cod in accordance with the characteristics of species and conditions of existence.

In the southern and south-eastern parts of the Baltic it is possible to speak of the existence of groups of fast- and slow-growing fish by these growth characteristics. (Figures 1 and 2.)

The presence of cod with different growth-rates is without doubt accounted for by the long spawning period and determines the different times of maturation.

Both groups begin to mature at 3 years of age, but the fast-growing fish mature and spawn earlier and, consequently, migrate earlier to the spawning areas. In the same way the formation of increments and annual rings on the otoliths take place at a much earlier date in case of the fast-growing cod than in slow-growing specimens. It should be noted, however, that the fast-growing type usually is prevailing in the stocks and, in characterizing the strength of the stock it is this group that is taken into consideration.

Owing to the different growth-rates the formation of the annual rings in the main bulk of the stock takes place from January to June. In case of young fish this time is more concentrated and falls upon the month of June in the main. This fact makes it particularly hard to evaluate the growth increase in cod caught in July-August, as it is not always possible to see an annual ring already formed on the otoliths of the slow-growing fish by this time of the year. It is very hard in these cases to determine to what calendar year of growth does the last increment belong. Taking this into account, only the specimens selected at the end of the winter and in spring, i.e. when the growth of the main bulk of cod is already completed, should be used when evaluating the composition of the stock.

The growth of cod in the Baltic throughout the year is also very characteristic. The greatest increase is observed in October-November. This period coincides with the most intensive feeding of the cod, a fact which has been noted by many authors. The deceleration of growth in the cod begins in December-January, which is in keeping with the time of maturing of the sexual products. Usually the spring spawning fish mature at the beginning of the autumn, but in case of the Baltic cod maturing takes place during the winter.

The increase in the rate of growth of the Baltic cod in October-November mentioned above, is quite adequately substantiated by the data accumulated in recent years, in contrast with the opinion of some researchers who consider that the cod grows best in summer.

It is well known that the Baltic Sea, owing to the peculiarities of its geographical position, specific topography of the bottom, and for a number of other reasons, is distinguished by great heterogeneity and instable hydrological conditions. The production of food of a water body, the reproduction conditions for the fish and their numbers and growth change according to the changing of the hydrological conditions.

The period 1947-1956 was characterized by a high number of cod in the Baltic. Particularly good growth of the fish was observed in 1947, 1948, 1950, 1954 and 1956 (Fig.3). These years were characterized by severe winters and abundant food because, in such years the arctic species M. mixta and M. entomon, the main food of the cod, are plentiful.

In the period 1958-1961, on account of the aggravating conditions for the cod the stocks decreased and the growth of the fish increased. However, in the period when the cod were numerous no direct dependence of the density of the stock on the rate of growth was observed.

The rate of maturing is closely related to the growth characteristics. As has already been noted, maturing begins in the third year of life. The number of 3 year-old cod, which determines the increase in the fishing stock, increases as a result of better growth conditions of the fish in their second year of life (Table 1).

Table 1. Percentages of 3 year-old cod maturing for the first time

Years of growth	Lengths, cm			Total	Growth indices	Number of fish
	25 - 30	35 - 40	40 - 45			
1949, 1951, 1952	8.6	39.4	52.0	100	bad	396
1948, 1950, 1954	7.2	51.6	41.2	100	good	255
1957 - 1961	6.6	46.1	47.3	100	good	450

It can be assumed that the growth-rate of the cod which, among other things, depends on the abundance of food and the number of competitors will influence the speed of maturation and, if fast, ensure an early entrance of the year-class into the fishable part of the stock.

The analysis of the rate of the commercial exploitation of those year-classes which are characterized by the more rapid rate of maturation, made it possible to arrive at one more important conclusion. The duration of the life cycle of the early maturing year-classes is shorter than that of the later maturing year-classes. This phenomenon is reflected in the rate of exploitation of the different year-classes, as shown in Table 2.

Table 2. Percentage commercial exploitation of the different year-classes

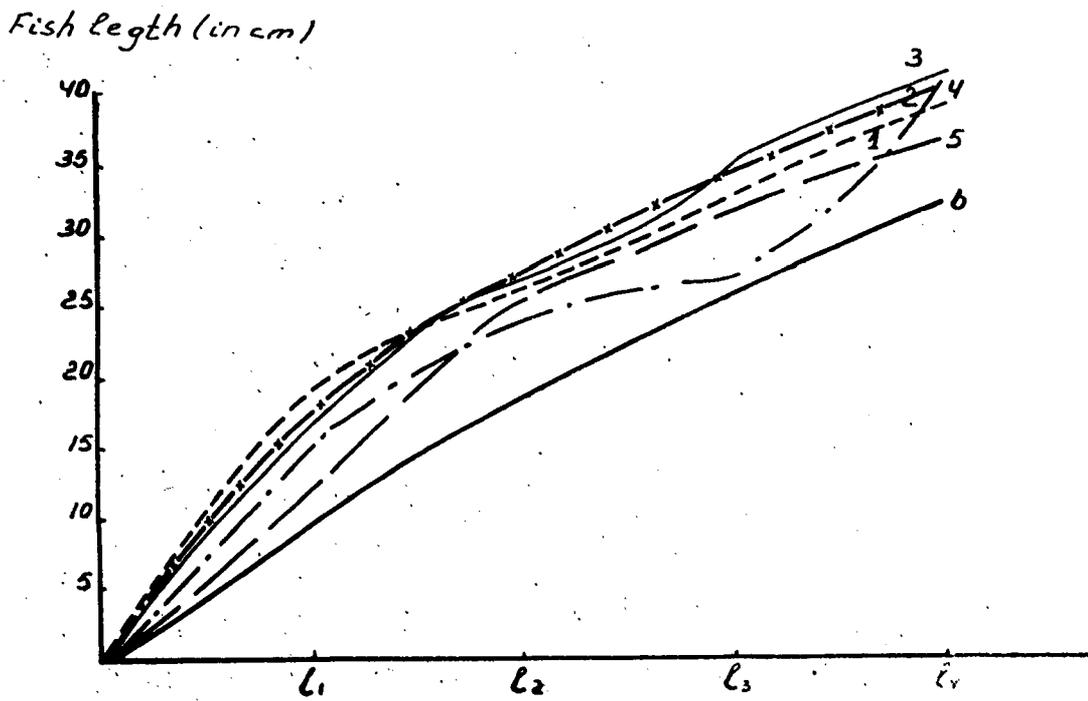
Year-class	Year of growth before maturity	Growth indices	Commercial exploitation of the year-classes	
			3-4 year-olds	5-8 year-olds
1948	1950	good	77.2	22.8
1952	1954	good	71.5	28.5
1953	1955	medium	77.6	22.4
1954	1956	good	70.0	30.0
1955	1957	good	70.9	29.1
1949	1951	bad	58.2	41.8
1950	1952	bad	65.0	35.0
1951	1953	bad	56.4	43.6

This fact must be taken into consideration when the rate of fishing mortality of the Baltic cod is defined and, most probably, also of any other species.

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Fig. 1



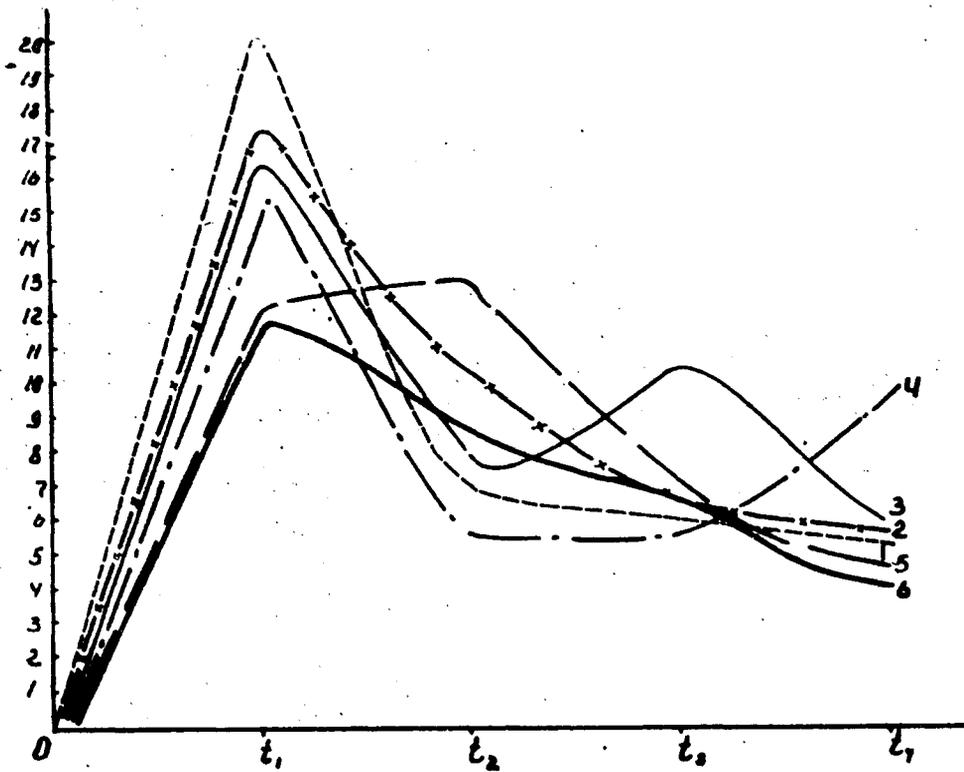
Cod length by age-groups (in cm)

/ back-calculation /

I - 6 cod groups with various spawning periods

Fig. 2

Increase (in cm)

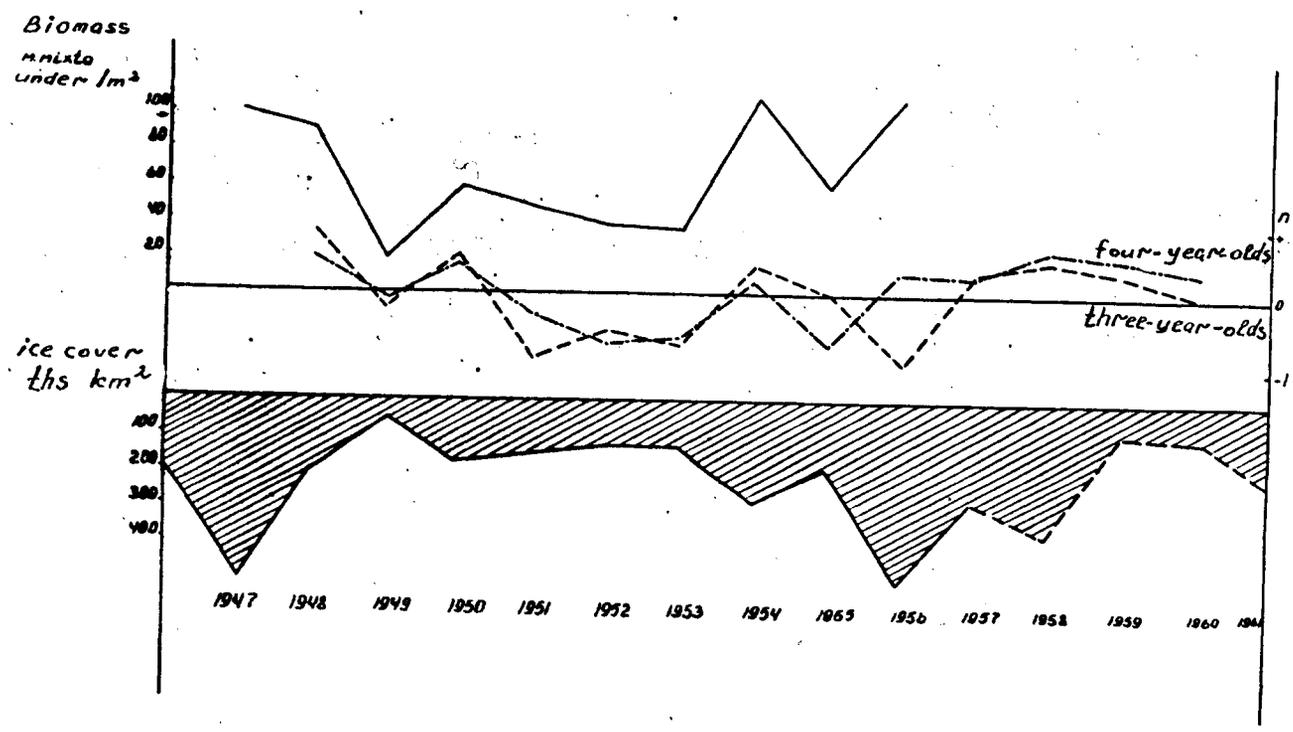


Increase in body length by age-groups (in cm)

/ back-calculation /

I - 6 cod groups with various spawning periods.

Fig. 3



Comparison of increase in cod length with biomass and ice cover

- biomass under/ m^2
- - - - - increase in the three-year-olds length in comparison with the average many-year value
- . - . - . - increase in the four-year-olds length in comparison with the average many-year value