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Influence of temperature on the growth  
of Baltic cod in the feeding period

by  
G. KRÜGER

University of Rostock, Section Biology  
WG. Fisherybiology



The growth of fish is affected by various environmental factors, the main factor being the availability of food. Not only the quality and quantity of the available food is of importance; the temperature also affects the metabolism and is partly responsible for the annual growth (MASLOW, 1944; NIKOLAJEW, 1954; HEMPEL, 1958; DEMENTJEW, MANKEVICH, 1965).

The growth and speed of maturity together with the causes leading to their delay or acceleration have been investigated.

A relationship between the available quantity of food and the growth rate can be observed during periods with large cod stocks. This phenomenon cannot be observed during periods when cod stocks are low (TOKAREWA, 1963). The temperature at the feeding grounds plays a decisive part in this case. It affects the intensity of the search for food and on the duration of the feeding period as well as influencing the process of digestion (HEMPEL, 1958; SEMSKAJA, 1961).

Growth in length is generally determined with the aid of the mean fish size of different age groups, although this quantity describes only the general growth trend and says nothing regarding the peculiarities of growth during the preceding years. In order to obtain particulars regarding the growth of a generation during different years, the method of back calculation on the basis of the otoliths has been used. This method assumes that there is a direct proportionality between the size of the otoliths and the size of the fish. The differences in the growth of various generations from the mean for a number of years has been determined so that

relative growth criteria were used. These investigations were performed according to a method suggested by DEMENTJEWA (1952). According to this method, the character of the growth of a series of generations of different age can be compared for a single year. If, for example, for the majority of the individual growth groups a positive deviation of the growth in length from the long-term mean can be observed, the year involved was good for growth; an annual growth lying below the long-term mean indicates unfavourable conditions for growth during the year concerned.

During the investigation period 1971 - 1973, the growth rates of 688 cod (3 - 5 years old) from the Gotland Becken region were investigated. Tabl 1 shows the deviations of the growth rates from the mean for a number of years as a function of the temperature conditions during the feeding period (October to December).

Table 1.

Year	Growth of cod as deviation from the mean growth for several years	Air temperatur during the feeding period (at Visby °C)
1966	(+1.2)	4.6
1967	+0.1	5.2
1968	-0.3	3.7
1969	-0.1	3.8
1970	0	4.3
1971	+0.1	5.2
1972	+0.4	5.9

As the table shows, the growth of cod was worst in 1968 and 1969. The lowest temperatures during the feeding period were also recorded in these years. The cod grew better during the relatively autumnal temperatures of 1966, 1967, 1971 and 1972. This leads us to the conclusion that the annual growth rate of cod in a fished population is mainly dependent on the temperature during the feeding period. Our investigations corroborate the results obtained by TOKOREWA (1968).

An attempt has been made to correlate the change in the growth rate of cod with the age at which the fish reach maturity.

In Baltic cod, growth during the first year of life is considerable and thereafter continues to affect the length of the fish. It has been found, that the number of fish reaching maturity during their third year

of life depends on the growth rate during the first year, The relative number of three-year-old fish in the spawning stocks can be used to draw conclusions regarding the rate at which maturity is reached.

Calculations have shown that the generations 1966 and 1967 grew relatively well during their first year of life and accounted for 19 % and 16.8 % respectively of the catches at an age of three years. The 1968 generation grew badly during its first year and accounted for only 9.2 % of the catches (at an age of three years) (figure 1).

The recruitment of the cod stocks at the spawning grounds depends not only on the growth rate but also on the size of the generations. The number of individuals in Year class III increases if the spawning stocks are replenished by a mature generation.

An increase in the number of three-year-old fish in the spawning stocks can also be observed if the fishing intensity is increased. If we assume that the fishing intensity remained constant during our investigations and no particularly numerous generation occurred, it may be concluded that the recruitment of the spawning stocks depends on the age at which maturity is reached.

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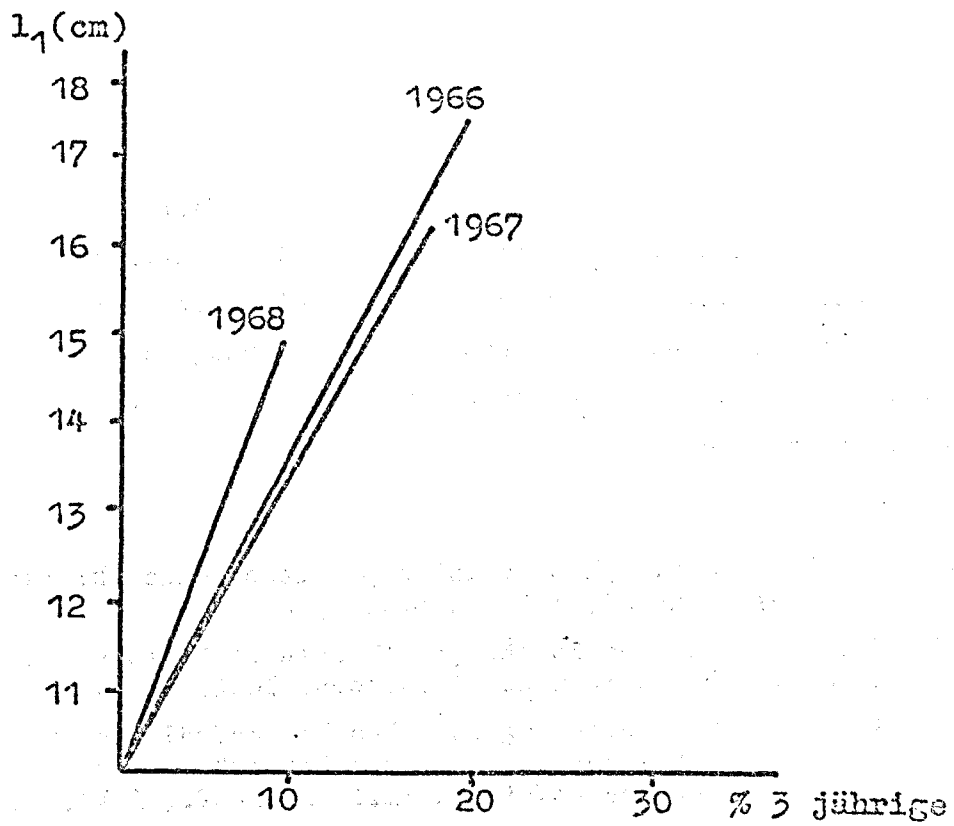


Figure 1