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CHANGES OF FAT CONTENT IN BALTIC SPRAT
DURING THE PAST 25 YEARS

by

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The determination of the fat content in Baltic sprat has been carried out for over a quarter century at the Sea Fisheries Institute. These analyses became beneficial for fishing, trading, and processing companies from 1954 or when the increasing catches of sprat and their rational utilization required more detailed information. The frequency of these analyses also increased during this same period, particularly during the "critical" months /March-April/ of the Spring decrease of fat content.

Varing the whole quarter century a uniform method of determination of the fat content in sprat /described by Jacobs /1938/ after Stansby and Lemon /1937, Ind. Eng.Chem., Annal.Ed., 9, 341// was used permitting full comparison of the results obtained during the total period of observation.

The role of sprat in the biocenosis of the Baltic Sea has been determined through studies on its food. Such studies have been performed by Mańkowski /1947/ on the sprat of the Gdańsk Basin and by Nguyen van Khank, Drzycimski and Chojnacki /1972/ on the sprat of the Bornholm Basin.

These investigations showed that sprat is exclusively a zooplankton eater, feeding on microplanktonic crustaceans mainly from Copepoda /Calanoida/ and partly from Cladocera. The species composition and the ecological nature of the food organisms show that sprat stands nearest to the primary and secondary production in the feeding chain above all other Baltic fish. Consequently reacts most quickly and accurately to any quantitative change in these factors.

One of the elements subject to these changes is the quantity of accumulated fat /Mańkowski, 1947, 1971 - Elwertowski, 1956 - Elwertowski and Maciejczyk, 1959/.

Possessing data for the past 23 years, we decided to study this problem and so partly help elucit the trends in the biocenosis of the Baltic Sea, which have been taking place in the last few years under the influence of increasing pollution by industry, urbanization and agriculture.

In Table 1 are shown the fluctuations of the fat content in sprat :

- a/ for the years 1950 - 1960
- b/ for the years 1966 - 1973

We have considered arbitrarily the first 10 years /1950-1960/ as a period of the "pure" Baltic Sea. In order to simplify and facilitate comparisons we have assumed that the influence of pollution in these years was not to large, at least on life in the open part of the Baltic Sea.

The second eight year period /1966-1973/ is already characterized by a marked increase in pollution and its influence on the biocenosis of coastal and open waters of the Baltic Sea.

Comparing these two periods we can draw the following conclusions from the data contained in Table I :

- 1- during the past eight years /1966-1973/ these has been a marked increase in the fat content of the sprat caught,
- 2- In comparison with the years 1950-1960, sprat actually accumulated more fat during the past-spawning period: from four to five percent,
- 3- during the period of hibernation and maturing of the genital glands the rate of decrease in the content of fat was identical as in the fifties.

The differences shown in Table 1 derive only from the higher level of accumulated fat subject to decomposition processes.

Studies on the dependence between the quantity of accumulated fat and environmental factors have been previously carried out by Mańkowski /1947/, Elwertowski /1960, 1961/ and

Elwertowski, Maciejozyk and Mańkowski /1961, 1962, 1971/. These authors, based mainly on the analysis of abnormal situations /periods of great anomalies which have taken place in the past/, have found that the quantity of accumulated fat depends on the water temperature and on the biomass of microzooplankton. We have performed an analysis of the water temperature measurements made by the Institute of Meteorology on the coast survey station at Hel during last 23 years period /see Table 2/.

Following the distribution of thermic anomalies it is possible to state that :

- 1- During the past 8 years /1966-1973/ in comparison with the 23 years period /1956-1972/ thermic conditions were normal.
- 2- Comparing these data with the older ten year period, 1950-1960, one sees only an insignificant increase in the water temperature in the period of the sprats' feeding in the years 1966-1973. The mean value of this increase, however, was so insignificant that without making any serious mistake, we can assume that thermic conditions of the period of fat accumulation in the past 8 years were similar to those in the past.

We can therefore conclude that winter temperature has not contributed significantly to the observed increase in the quantity of accumulated fat during latter years. We may accordingly attribute this increase in fat content primarily to the improvement in feeding conditions, i.e. the increase of the microplankton biomass in the Baltic Sea.

Our thesis is confirmed by the results obtained by Mańkowski /1971/ in the quantitative investigations on this form of biological production of the Baltic Sea.

Conclusions

- 1- In the fifties sprat from the Gdansk region accumulated the fat reserves about 16 percent of its body weight. In exceptionally favourable feeding conditions /high water temperature and food abundance/ the quantity of accumulated fat reached a level of 19-20 percent.
- 2- In the past 8 years /1966-1973/ the mean quantity of fat increased to about 20-21 percent and in exceptionally favourable conditions of feeding it reached a level of 22-23 percent.
- 3- Due to the fact that water temperature of the Gdansk region was not subject to special changes, the observed increase of fat content should be connected with the significant augmentation of the abundance of food organisms composed exclusively of microplanktonic crustaceans /Copepoda and Cladocera/.

Table 1

Fat content in the sprat from the Gdańsk region in the years 1950-1973

Living processes of the sprat	Month	1950-1960		1966-1973		Differences between the periods
		From-to	average	from - to	average	
% of wet mass						
Decomposition of fat reserves and maturing of genital glands	January	8.48 - 19.32	12.98	14.70 - 19.40	16.87	+ 3.89
	February	8.86 - 14.06	11.50	9.50 - 16.78	13.35	+ 1.85
	March	5.17 - 11.27	8.49	7.57 - 15.20	11.21	+ 2.72
Portional spawning interrupted by small periods of feeding	April	4.09 - 9.35	5.52	6.01 - 12.20	8.96	+ 3.44
	May	3.33 - 6.71	4.37	5.32 - 9.54	7.09	+ 3.72
	June	2.10 - 6.18	4.41	4.39 - 9.90	6.24	+ 1.83
Post-spawning feeding and accumu- lation of fat	July	2.00 - 9.48	4.39	6.90 - 13.30	9.16	+ 4.77
	August	/2.65 - 7.23/	/7.23/	/15.20 - 17.37/	/ 16.26/	/ + 9.03/
	September	8.10 - 19.85	14.71	16.10 - 23.20	19.78	+ 5.07
	October	13.06 - 19.16	15.88	18.90 - 21.90	20.80	+ 4.92
	November	11.80 - 17.60	15.32	17.50 - 21.80	19.70	+ 4.38
	December	12.40 - 16.00	14.13	10.40 - 22.50	17.61	+ 3.48

Table 2

Mean temperature of water in the Bay of Gdańsk in the years 1950-1960 and 1966-1973

/according to measurements carried out by the Institute of Meteorology
at the coastal station in Hel/

Life phases of the sprat	Months	1950-1972	1950-1960	1966-1973	Thermic anomalies of the period 1966-1973 referring to the years:	
					1950-1972	1950-1960
$t^{\circ}\text{C}$						
Hibernation and maturing of genital glands	January	1.7	2.0	1.4	- 0.3	- 0.6
	February	1.1	1.1	1.2	+ 0.1	+ 0.1
	March	1.7	1.7	2.0	+ 0.3	+ 0.3
Portional spawning and period of small feeding	April	4.5	4.4	4.5	+ 0.0	+ 0.1
	May	8.8	8.6	8.9	+ 0.1	+ 0.3
	June	13.9	13.7	13.9	+ 0.2	+ 0.2
	July	17.4	17.6	17.5	+ 0.1	- 0.1
Period of post- spawning feeding, and accumulation of fat reserves	August	18.5	18.5	18.7	+ 0.2	+ 0.2
	October	12.0	11.9	12.0	0.0	+ 0.1
	November	7.7	7.5	7.7	0.0	+ 0.2
	December	4.1	4.2	4.0	- 0.1	- 0.2

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