151 H

ON THE RELATIONSHIP BETWEEN FAT CONTENT IN SALAKA FEMALES (Clupea harengus membras L) AND QUALITY OF ITS EGGS

by L.E. ANOKHINA
Academy of Sciences, USSR.

The Herring Symposium held in 1961 had recommended a number of problems, the solution of which was of the utmost importance. One of the problems is the determining of the influence of the quality of the spawners on the quality of their offspring. There is very little known about this especially in the case with Clupeidae (Nikolsky, 1961, 1962).

I should like to draw the attention in this paper to one special subject - the relationship between the fat content of running females of salaka Clupea harengus membras L. and the quality of its ripe eggs. The knowledge of the peculiarities of this relationship, coupled with the resolving of other problems, will make it possible to comprehend the causes of rich and poor year - classes and so approach the problem of governing, in the future, of natural reproduction of salaka.

Our research is only at its beginning, so this paper may be considered to be of a preliminary nature.

Methodics and material

The work was carried out on the spring and autumn- spawning salaka from the Gulf of Riga. The method of individual analysis of running females and their unfertilized ripe eggs was taken as the basis

of the work. The eggs were removed from the ovaries; salaka's eggs are very adhesive, small and easily damaged.

The fat content of the females (gutted, because there is very little fat in the viscera of the running females - Krivobok and Tarkovskaya,1960), the fat content of their eggs, the per cent of dry substance in eggs, the weight and diameter of individual eggs (and the diameter variation coefficient) were analysed. The egg fat content was expressed not only in relative (per cents of fat in dry and wet weights) units, but also in absolute (milligrams of fat per egg of every female) ones. Soxhlet's apparatus was used to determine the fat content of fish and eggs. The fat samples were fixed by drying at + 65°C, the ensuing processing was done at the same temperature.

A recount was made according to the average weight of one live egg for the determination of the absolute amount of fat in a single egg.

The average weight of a live egg was determined on the basis of the sum total of the weighing of 200-300 eggs on a paper filter of predetermined weight. The eggs were arranged in a single layer, and the filter was dried for the easying of their count.

Thus the data was obtained on the weight and fat content of eggs together with the ovarian liquid. There was very little ovarian liquid in the specimens of salaka analysed, and the amount of it varies insignificantly with every female. Because of that we did not take the ovarian liquid into consideration.

The eggs' diameter was determined from fixed samples. The vessel, in which the eggs were, was

filled to the brim with formaline (a 1 : 19 solution with an admixture of 6.5 grammes of NaCl per litre of the solution) and was vigorously shaken until all the eggs became separated and hardened. 100 eggs taken at random from each sample had been measured with the microscope. The diameter of a single egg (with its shell) was taken to be the mean of two measurements of an egg in perpendicular directions.

The females' age was determined by the scales.

Altogether 49 samples of fish were processed : 32 spring and 17 autumn spawning ones. The length of the females (from the top of the snout to the end of the middle rays of caudal fin) was 15- 16 cm. (47 out of 49 samples), the age was 3 - 6 years, 4 years being the most frequent. The material pertaining to the spring spawning salaka was obtained in May 1960 (beginning of the spawning period) with the help of set seines (traps), and the material on the autumn spawning salaka was collected in September, 1961 (middle of the spawning period) from gill nets. A special comparison was made of the data on the spring and autumn spawners and also the summary analysis of all the fishes, the season and spawning period notwithstanding.

The eggs of the majority of the autumn spawners are less transparent ; their shell is thicker than that of the spring spawners (= 0.014 mm, i.e., not larger than the standard error of our egg measurement).

Results and Discussion

The characteristics of the females and their eggs are given in Table 1. The data on egg fat content practically coincides with the data previously published on the egg fat content of running salaka (Krivobok and

Tarkovskaya, 1960 ; Anokhina, 1961). There is some indications(Levieva & 1952 ; Makarova, 1952) that the average salaka egg fat content varies from 1.26 to 3.46 % in wet weight ; but because the authors of the works quoted had carried out the group analysis of gonads taken whole from females of different (I- V, according to the VI - degree VNIRO's system) stages of maturity direct comparison is impossible.

Salaka's eggs are smaller than the eggs of other forms of Atlantic Herring (Baxter, 1961) ; the eggs diameter, laid in spring and autumn, is the same, in which respect salaka probably differs from the Irish herring (Farran, 1938). The data obtained on the diameter of the unfertilized salaka eggs coincides with that which had been published previonsly (Volodin, 1956; Toom, 1958).

Spring spawning salaka

There is correlation between the female fat content and their egg fat content in fishes of the same age and length (17 specimens, length 15 cm., age 4 years ; $r = + 0.41$, the level of value z, according to Fisher, less than 0.01 ; Rokitsky, 1961).

With the summary analysis of all the specimens, their age and dimensions notwithstanding, it had been determined that with the increase in female fat content there is a tendency in increase of the egg fat content, and also the tendency of increase in the per cent of dry substance in eggs. There may be noted an increase in per cent of defatted remains (probably albumen in the main) with

the increase in the % of dry substance in the eggs.

The absolute amount of fat in one egg of every female very well conforms with the amount of fat in the eggs in per cent (r = + 0.91) and is not related clearly enough to the weight and diameter of the eggs. This is explained by the insignificant variations in the dimensions of the different females eggs (Table 1).

The mean diameter (and its variability) and the average weight of one egg of every female is not related either to the female or egg fat content.

Autumn spawning salaka

No relation was discovered in the autumn spawning females between fish fat content and their egg fat content ; it is probably due to the small amount of material. At the same time there is a tendency of an increase in per cent of dry substance and the defatted remains (Table 2) in eggs with the increase in the female fat content.

The absolute amount of fat in one egg of every female conforms with the per cent of fat in the eggs.

The mean diameter (and its variability) and the average weight of one egg of every female is related neither to the female nor egg fat content.

Comparison of the spring and autumn spawners

A big amplitude in the female (Anokhina 1960, 1961) and egg fat content had been determined in spring and autumn spawning females as well. (Table 1).

The average autumn spawning female fat content is twice that of the spring spawners and the egg fat

content (in per cent of dry and wet weight and in milligrammes per egg) is 1.5 times higher. In determining the average per cent of fat in eggs of females of different fat content, the egg fat content of autumn spawners is higher than that of the spring spawners in the all groups analysed. Thus, if the fishes fat content = 25 - 30 % (in dry weight) the average egg fat content is 4.11 % in autumn and 3.24 % (in dry weight) in spring.

It is understandable from the ecological point of view , as the autumn spawning females, which lay eggs immediately after feeding season, are fatter than spring spawners, and the larvae feeding and other conditions are less favourable in autumn than in spring.

The eggs of the spring and autumn spawners do not differ in the mean diameter (and its variability coefficient of every female eggs), average weight eggs of one female, and per cent of dry egg substance. Detectable difference in the average weight of one egg is statistically unreliable and is probably explained by the fact that the shell of autumn spawners' eggs is thicker (see above). This pertains to the data on the dry substance in eggs as well.

Thus, the real difference between spring and autumn spawning salaka females can be observed only in the fat content of the fish and their eggs.

All females taken together

In the summary analyses of all the material a positive correlation was determined between the fat content of the fish and their eggs (r = + 0.45, table 3). This means that in at least 20 % of the

female population the fat content of their eggs increases without fail with the increase in their own fat content.

There is also a correlation between fish fat content and the absolute amount of fat (in milligramm) per egg of each female. This indice is of particular interest as the absolute amount of fat may to a certain degree serve as a measure of the salaka egg quality, because fat is the main energy resource in the development of fishes' eggs. (Needham, 1931 and others).

Conclusion

The existence of positive relation between the female fat content and their egg fat content expressed in relative (per cents in dry and wet weights) and absolute (milligramms) units was determined. The autumn spawners' egg fat content is 1.5 times higher than that of the spring spawning salaka (in per cents of dry and wet weights and milligramms of fat per egg), and the autumn spawning salaka's fat content is two times higher than that of the spring spawning fish.

There is a tendency in increasing of the per cent of dry substance in eggs (particularly the per cent of the defatted remains) with the increase of fat content in females laying eggs in one spawning season.

Consequently there was determined the advancing of quality of the eggs produced by the females when the feeding conditions of the spawners' stock are improved.

As we have demonstrated before (Anokhina,1960, 1961) in the case of salaka of the same length the

fatter fish are the more fecund.

Therefore, with the improvement of feeding conditions (" nagul " - in Russian) for salaka females the quantity, and the quality (the latter in a lesser degree as shown by the present work) of eggs rises. This fact enhances the increase in salaka stock in favourable circumstances.

References.

Anokhina L.E. 1960. Some data on fecundity of salaka (Clupea harengus membras L.). Paper presented at ICES CM 1960, Herring Committee, No. 210.

Anokhina L.E. 1961. On the peculiarities of salaka, spawning in the Gulf of Riga, fecundity with special reference to the variations in relation to the variations of salaka fat content.
" Trudy Nauchno- issled- instituta rybnogo khozjajstva Sovnarkhoza LSSR ",v.3,Riga.

Baxter I.G. 1959 . The fecundities of winter-spring and summer- autumn herring spawners.
J. du Conseil, v. 25, No.1.

Farran G.P. 1938 On the size and number of the ova in Irish herring . J. du Conseil, v.13,No.1.

Krivobok M.N. and O.L. Tarkovskaya 1960 Determination of salaka's spawning migration time based on the study of its fat metabolism.
" Trudy VNIRO", v. 42.

Levieva L.S. 1952 The weight and chemical compositions of salaka in the Finnish Bay, Neva smelt and brook stickleback.
" Trudy VNIRO ", v. 23.

Makarova A.P. 1952 Technochemical characteristics of the Kaliningrad region salaka. " Trudy VNIRO" , v. 23.

Needham J. 1931 Chemical embriology. Cambrige Univ. Press.

Nikolsky G.V. 1961 On the causes of fluctuations in fish number. " Voprosy ichthyologii ", v.1, No. 4 (";).

Nikol'skiiG.V. 1962 On some adaptations to the regulation of population density of fish species with different types of stock structure. In : The exploitation natural animal populations. Oxford.

Rokitsky P. Ph. 1961 Basis of variational statistics for biologists. Minsk.

Toom M.M. 1958 Experiments in Baltic herring eggs incubation. " Trudy VNIRO ", v. 34.

Volodin V.M. 1956 Embryonic development of autumn salaka and oxygen consumption during its development. " Voprosy ichthyologii ". No. 7.

Table 1.

Characteristics of Running Salaka Females and their Eggs. Average and Limits of Fluctuations

Group	Fish: Fat content % dry substance	Fish: Fat content % wet substance	Eggs: Fat content % dry substance	Eggs: Fat content % wet substance
spring	16,04 8,73-37,52	4,62 1,84-11,47	3,06 1,54-4,41	0,74 0,38-1,03
autumn	33,66 15,56-47,62	9,23 3,28-15,75	4,35 2,81-7,77	1,05 0,58-1,66
M.diff.	>3	>3	>3	>3

Eggs: Fat content fat per 1000 eggs in milligrammes	Eggs: Diameter Average in mm	Eggs: Diameter Variability coeff. in one fish	Average weight of one live egg in milligrammes	dry substance in %	Number of females analyzed
spring					
4,08 2,26-6,84	0,99 0,94-1,05	3,02 2,30-3,99	0,530 0,439 - 0,649	24,45 22,66-26,52	32
autumn					
6,30 3,06-12,10	1,00 0,93-1,07	3,20 2,68 - 4,11	0,593 0,488 - 0,849	21,90 19,19-23,85	17
M.diff.					
>3	<3	<3	<3	<3	

Table 2.

Amount of dry substance, fat and defatted remains in the eggs of autumn - spawning salaka (in per cent of wet weight)

Dry substance	Fat	Defatted remains	Number of fish analysed
20,13	0,73	19,60	3
21,53	1,16	20,37	6
22,51	1,16	21,35	4
23,45	0,71	22,74	3

Table 3.

Correlation chart for the fat content in females and their eggs in per cent of the female's dry substance

Egg fat content	Female fat content								
	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
1-2	1		1		1				
2-3		4	5	1					2
3-4	2	5	5	2	4	2	1		
4-5			1	1			2	1	
5-6			1		1				
6-7			1				1	3	
7-8						1			

r = + 0,45 , t = 3,95, probability - 0,999 ;

z (Fisher) = 0,48, t = 3,26 ; probability -0,999.