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Quantitative aspect of the lipid changes in Clupeonella cultriventris (Nordmann), in the Danube mouth zone (Sulina).

By Victor Zinevici

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QUANTITATIVE ASPECT OF THE LIPID CHANGES IN CLUPEONELLA CULTRIVENTRIS (NORDMANN), IN THE DANUBE MOUTH ZONE (SULINA).

Victor Zinevici
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This paper presents data regarding the quantitative evolution of lipid in the anadromous migratory species Clupeonella cultiventris (Nordmann) in relation to certain bidogical characteristics and under the conditions of life in the mouth of the Sulina arm. The purpose of the research was a more thorough biological study of the species mentioned and assessment of their nutritional value . Knowledge of seasonal variations of fat concentration could be useful also in assessing the most suitable way of evaluating the quantities of fish caught during different periods of the year.

The lipid content in fishes reflects in equal measure some common traits of this systematic group as well as the biological characteristics of each species individually (Ciugunova et al., 1961). The survey of deposits of adipose tissue (Bromlei, 1934), the degree of fattening of the body and organs taken separately (Bottesch, 1958; Morawa, 1956), the qualitative aspect of lipids (Kizevetter, 1942), the change in lipid deposits and consumption during different stages of life (Belianina and Makarova, 1965; Cernisev, 1965; Iudanova, 1940) present variations with a specific significance. Due to the great instability of the lipid metabolism, the fat content, simultaneously, indicates the physiological

condition of the organism (Ciugunova et al., 1961) and the life conditions under which the animal had lived (Morawa, 1955; Pora, Rosca & Porumb, 1961). The differences related to the lipid content can also offer indications on the composition of the populations (Ciugunova et al., 1961). Additional aspects can be observed in the case of migratory species (Cerpakova, 1962; Iudanova, 1940; Suliman, 1959).

Our research on the lipid changes in Clupeonella cultriventris (Nordmann) was carried out within the framework of an extensive study of the biology of this species.

Experimental Methods and Materials. p.76

Monthly, during the period April - October 1967, 30-120 samples of Clupeonella cultriventris (Nordmann), comprising a total of 579 samples (Table 1) were collected at the mouth of the Sulina arm. From the mass of collected samples, 102 were selected for lipid determination grouped into 60 tests representing the most characteristic classes of size and development stages of gonads for each sex separately.

The samples, packed separately in impervious plastic little bags, were transported in a thermos cooled beforehand and containing ice cubes.

The lipids were extracted by the Soxhlet method, using ethyl ether as solvent.

The lipid content was expressed in mg. and percentages; the weight of the organism (i.e. of organs analyzed in a wet state) was taken into consideration in the calculation of the percentage.

Composition of shoals of Clupeonella cultriventis (Nordmann) in the mouth of the Sulina arm.

Clupeonella cultriventris (Nordmann) is a species with a great ecological valence. A habitat frequented by these species is constituted by the dips and dalles situated at the mouth of the Danube (Antipa, 1909). The conditions of reproduction and especially those of feeding determine here a concentration of individuals which grows from spring to fall (Leonte and Munteanu, 1957).

A similar migration curve was noted during 1967. The smallest quantities were caught during the first part of May; the largest - in October.

The composition of size classes of samples caught underwent successive modifications (Table 1).

Table 1

Composition of samples collected according to sex and size classes

Tabelul 1

Componența pe sexe și clase de mărime a exemplarelor colectate

data / L. st. (mm)	11 IV		11 V		8 VI		9 VII		18 VIII		16 IX		20 X	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
41—46	—	—	—	—	2	1	—	—	—	1	—	—	—	—
46—51	3	—	2	8	7	4	—	1	8	9	—	1	—	—
51—56	5	4	3	6	14	10	6	3	25	28	7	11	1	2
56—61	30	19	3	5	19	3	14	6	11	1	18	13	19	20
61—66	34	23	3	2	14	4	21	5	5	1	15	2	25	9
66—71	12	12	1	—	5	1	9	1	5	—	5	1	20	3
71—76	—	—	—	—	1	—	5	—	—	—	—	—	—	—
76—81	—	—	—	—	—	—	—	—	—	—	—	—	—	—
81—86	—	—	—	—	1	—	—	—	—	—	—	—	—	—
86—91	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	63	58	12	21	63	23	57	16	54	40	45	28	65	34

L.st.= Standard length

Characteristic for the beginning of April was the clear prevalence p.77 of the superior size classes (56-71 mm.). Regardless of the age and size of the samples, the gonads presented a similar degree of maturity; the majority had gonads in stages IV-V, while a few in stages IV or V.

In May, individuals with a standard length varying between 46 and 51 mm., predominated. In general lines, this population composition was maintained until the end of the spawning period (the first 10 days of July). However, the composition of the maturing stages of gonads became much more heterogeneous than at the beginning of the spawning period with the suplementary appearance of stages V-VI, VI and VI-II.

In August, September and October, the composition of size classes underwent new modifications, as a consequence of migrations of Clupeonella cultriventris (Nordmann) along the shore in search of places most favourable for feeding. Above all, samples of small sizes were fished. In August, the gonads were characterized, again, by a homogeneous development: almost all were in stage II. At the end of October, individuals with gonads in stages II-III and III were encountered in both sexes.

With regards to composition according to sexes, a numerical prevalence of individuals of female sex was noted in most cases (Table 1).

The qualitative aspect of lipid changes in musculature and viscera.

Studies regarding the lipid content, carried out in various species of fishes (Belianina and Makarova, 1965; Cerpakova, 1962; Krivobok and Tarkovskaia, 1960; Suliman, 1959 etc.) emphasized the fact that the efforts connected with the spawning migration as well as the behavior of the individuals during this period require more energy consumption which cannot be compensated by nutrition.

The additional energy is obtained mostly by the consumption of lipids stored in the musculature (Belianina and Makarova, 1965). Maturing of gonads also requires a transfer of fats which affects, first of all, the viscera (Ciugunova et al., 1961).

At the beginning of April, samples of Clupeonella cultriventris (Nordmann) were characterized, on one hand, by a clear predominance of the largest size classes (Table 1); regardless of size, they were characterized, on the other hand, by a similar degree of gonad development and by the existence of some minimal individual differences of lipid concentration in musculature and viscera (Fig.1).

In general, the fat content was fairly high, in view of the lipid consumption from the winter dormant period as well as that around spawning time.

During the rest of the reproductive period, samples of increasigly smaller size (Table 1), with heterogeneously developed gonads, began to prevail. The lipid content in musculature and viscera showed marked individual differences, registering on the whole a larger decrease as compared to the figures recorded at the beginning of April (Fig.1). Decreased figures were registered not only in samples which had already deposited one or two portions of sexual products, but also in those which were near the period when they would deposit the first portion. p.78

From the anlysis of these data, it seems that, in Clupeonella cultriventris (Nordmann), the increase of lipid concentration in musculature and viscera constitutes one of the factors which influence the maturation order of gonads in individuals, i.e. the order of spawning migration to the Danube mouth. Similar data was evident also in the

case of other species. In Osmerus eperlanus it was noted that the samples with a higher lipid content are characterized, on one hand, by a more accentuated rate of growth (both in length and in weight) and, on the other hand, by an earlier maturation of gonads (Belianina and Makarova, 1965).

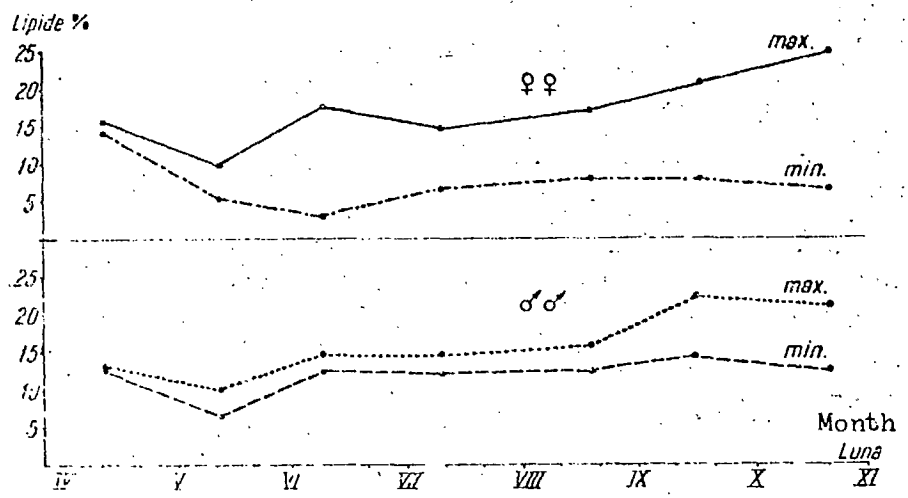

Fig. 1. — Variațiile extreme ale dinamicii lipidelor din musculatură și viscere exprimate în %.

Fig.1.- Extreme variations of lipid changes in musculature and viscera expressed in %.

The lipid content variations during the spawning period, in the representatives of both sexes, showed, besides some similar aspects, also significant differences.

At the beginning of April, the lipid concentration in musculature and viscera in female samples represented 14,05-15,31% of their weight in wet state (Table 2). The lipids in musculature and viscera have constituted approx. 2/3 of the organism's total lipid (Table 5).

Beginning with the month of May and until the end of the reproductive period, the lipid content in musculature and viscera registered on the whole

a significant decrease. The most reduced lipid concentration in musculature and viscera was registered at the beginning of May - 5,24%; in July* it represented only 3,17% and in July 6,58% (Table 2). These values were characteristic of the samples which had already deposited part of the sexual products. However, the samples which had not deposited yet the first portion of the soft roe, also had a relatively low lipid content. Depending on the portions deposited, the value of the plastic and energy consumption of lipids, the fats in musculature and viscera represented 69,90-8247% of the organism's total lipid content (Table 5). p.79

Table 2

Lipid content variation in musculature and viscera in relation to their weigth in wet state in samples of female sex (in mg.&%).

Date Data 1967	n	Age Virsta	Total G. totală (mg) Weight	Weight g. gonadei (mg) gonad	Standard L. St. (mm) length	H = ? (mm)	Stage Stadiul gonadelor gonads	Lipide în musculatură și viscere	
								mg	%
11.IV	3	1+	811,0	80,1	47,7	11,8	IV—V	131,91	15,31
	2	2+	3114,2	392,2	63,2	15,9	IV—V	402,41	14,42
	1	4+	3795,0	405,0	67,4	18,9	IV—V	472,43	13,94
	1	5+	9690,0	2580,0	89,0	22,0	IV—V	1028,96	14,05
11.V	2	1+	1020,0	119,3	49,6	12,1	IV	47,20	5,24
	2	2+	3065,3	348,0	64,0	16,8	IV	157,88	5,81
	1	3+	3481,8	386,0	63,0	16,7	IV—V	183,79	5,93
	1	5+	3551,0	561,0	72,0	18,2	IV	289,83	9,65
8.VI	3	3+	3010,0	20,0	65,0	16,0	VI	309,54	10,35
	2	3+	4420,3	360,1	67,0	18,7	IV	128,71	3,17
	1	4+	3832,0	25,3	68,0	17,0	II	476,22	17,51
	1	5+	7010,7	928,7	85,0	19,0	IV	523,05	8,60
9.VII	2	1+	1602,0	134,2	52,2	12,8	V	147,95	10,08
	2	2+	3195,0	19,9	64,9	16,0	VI	208,93	6,58
	2	2+	3066,0	17,9	64,5	16,6	I	363,63	11,91
	2	3+	3387,0	141,8	67,8	16,0	V*)	221,65	6,83
	2	3+	3993,1	271,6	67,5	17,7	V	389,70	14,65
18.VIII	2	1+	1502,0	6,3	50,1	11,2	II	117,36	7,84
	2	2+	1918,5	6,9	54,5	13,4	II	237,23	12,41
	1	2+	2278,0	11,2	57,0	13,5	II	343,19	15,14
	2	3+	2565,6	12,2	60,0	14,8	II	439,96	17,23
16.IX	2	1+	1538,2	6,5	50,4	11,3	II	118,71	7,75
	3	3+	2124,4	10,9	55,5	15,0	II—III	319,99	15,14
	2	3+	2766,7	15,2	62,0	16,8	II—III	528,02	19,19
	1	3+	3313,9	18,1	64,0	17,0	II—III	584,02	17,72
	1	5+	4153,6	27,4	69,0	18,0	II—III	857,84	20,79
20.X	1	2+	1670,0	11,2	55,0	12,0	II	108,49	6,54
	2	2+	2617,1	17,1	61,4	15,5	II—III	486,72	18,72
	2	4+	3490,5	18,0	68,0	18,5	II—III	812,91	23,41
	1	5+	3832,0	21,3	71,0	19,0	II—III	937,05	24,59

*) porții depuse. = deposited portions

*Appears to be an error - could be June

Some variations presented by the males were similar. On the whole, the values, however, were somewhat lower, and the difference between the maximal figures and the minimal ones, registered at the same time, was more limited (Fig.1).

At the beginning of April, the lipid concentration in the musculature and viscera of male samples represented 12,89-12,99% of the total weight in wet state (Table 3) and 97,31-97,46% of the total lipid (Table 5).

The following month, an important decrease was registered. p.80
The lowest lipid concentration recorded was of 6,62% (Table 3). This decrease, however, was not as extensive as encountered in the case of female samples. At the beginning of June, the fat content in musculature and viscera was already recovered, constituting 12,65-14,51% of their weight in wet state (Table 3). These differences were dependent, probably, on both the biological specific of the two sexes and their different behavior. For the males, the main effort was the reproductive migration and the courtship behavior, while maturation of gonads required a lipid consumption lower than that of females. Also, analysis of the digestive content showed that the males had a more intense rate of nourishment during reproduction than the females.

Upon depositing the last portion of sexual products, the fattening period began.

In June and July, the intestine of the females with the ovaries in stage II was in great part covered with fat. The lipid in musculature and viscera represented 11,91-17,51% of the weight in wet state (Table 2). From August until the end of October, the fat creases in the general cavity became increasingly more evident. The lipid content in muscula- p.81

ture and viscera, continuing to present individual variations, registered, on the whole, successive increases. The highest concentration registered in August was of 17,23%; in September it reached 20,79% and in October 24,59% (Fig.1). During the fattening period, the musculature and viscera in females contained 98,48-99,68% of organism's total lipid (Table 5).

During the period of June-September, the males had a higher fattening rate than the females as a result of more limited lipid losses during the reproduction time. The musculature and viscera contained, on the whole, 12,41-22,18% of their total weight in wet state (Table 3). These quantities concided approximately with the total of the organism's lipid reserves (Table 5).

Table 3

Lipid content variation in musculature and viscera in relation to their weight in wet state in male samples (in mg. & %)

Tabelul 3

Variația cantității de lipide din musculatură și viscere în raport cu greutatea acestora în stare umedă la exemplare de sex masculin (în mg și %)

Date Data 1967	n	Age Vîrsta	Total weight greutatea totală (mg)	Weight gonad greutatea gonadei (mg)	Std. l. st. (mm) length	H (mm) ?	Stage of gonads Stadiul gonadelor	Lipide în musculatură și viscere	
								mg	%
11. IV	3	1+	2372,4	109,6	58,3	14,9	IV—V	291,68	12,89
	1	2+	3757,3	166,5	67,0	17,2	IV—V	437,72	12,99
11. V	1	1+	1486,0	63,0	51,0	13,5	V	143,01	10,05
	3	2+	2262,3	114,5	56,1	14,9	V	142,18	6,62
8. VI	2	2+	2372,5	86,6	56,0	15,0	V	331,69	14,51
	3	3+	3768,2	160,8	65,0	17,4	V	456,34	12,65
9. VII	2	2+	2956,0	1,8	63,1	17,0	II	501,03	16,96
	2	2+	3092,3	33,0	64,9	16,0	V	373,54	12,21
18. VIII	2	1+	1238,2	0,5	48,2	11,2	II	196,06	15,81
	2	2+	1845,0	0,6	51.2	13.1	II	290.68	15,76
	2	2+	2197,0	1,3	56,6	14,0	II	272,49	12,41
16. IX	1	1+	1286,0	0,8	49,1	12,3	II	206,02	16,02
	2	2+	1966,1	0,9	55,3	14,3	II	376,93	19,18
	2	3+	2359,2	1,2	60,0	16,1	II	523,00	22,18
	2	4+	3552,0	9,0	64,9	18,0	II—III	506,65	14,30
20. X	2	2+	1720,3	1,5	54,5	12,5	II	214 85	12,50
	2	3+	2482,5	7,0	60,4	15,0	III	507.73	20,51
	2	4+	3300,3	8,6	65,5	16,6	III	693,39	21,08
	2	4+	3508,6	9,3	67,5	17,1	III	615,88	17,60

At the end of the fattening period, the maximum lipid concentrations in the musculature and viscera of male specimens (21,08%) were lower than similar concentrations in females (Table 2,3).

The research conducted on various species of fishes has indicated the existence of some connection between the value of fat concentration and body size or weight (Ciugunova et al., 1961).

The existence of similar correlations was evident also in Clupeonella cultriventris (Nordmann) specimens collected in the mouth of the Sulina arm. In order to put them in evidence, it was necessary to work on individuals of the same sex with the gonads uniformly developed or presenting an insignificant descrepancy.

The correlation between body length and the fat concentration value presented differences in the representatives of the two sexes. They were more evident during the spawning period as a result of a different plastic and energy consumption.

During the period from the beginning of May until the end of October, a direct proportion between length and fat concentration was established in female specimens (Fig.2). This relation emphasizes the tendency of successive fat substance accumulation with the growth of the organism. The correlation mentioned could not be established, however, at the beginning of April. As shown, a factor which seems to have influended the composition of shoals of Clupeonella cultriventris (Nordmann) at the beginning of the reproductive period in the Sulina arm mouth zone, was the high lipid concentration. Generally, large size specimens correspond to this concentration. Much smaller specimens were encountered in a reduced percentage (Table 1) but with a lipid concentra-

tion very close to that of large specimens; due to this factor, it was difficult to arrive at a firm conclusion regarding the type of proportionality between the standard length and the lipid concentration. The presence at the beginning of the spawning period of a number of specimens of a reduced size but with a high lipid concentration, could be due to their embodiment of some ecological conditions or some physiological characteristics which would give them an advantage in comparison with other specimens of the same size (e.g. a very reduced amplitude of spawning migration). p. 82

Analyses conducted on males during the spawning period, as well as during the following two months, established the existence of a reverse proportion between body length and fat concentration in musculature and viscera.. During the fattening period, however, evolutionary restauration of a direct proportion is established.(Fig.2).

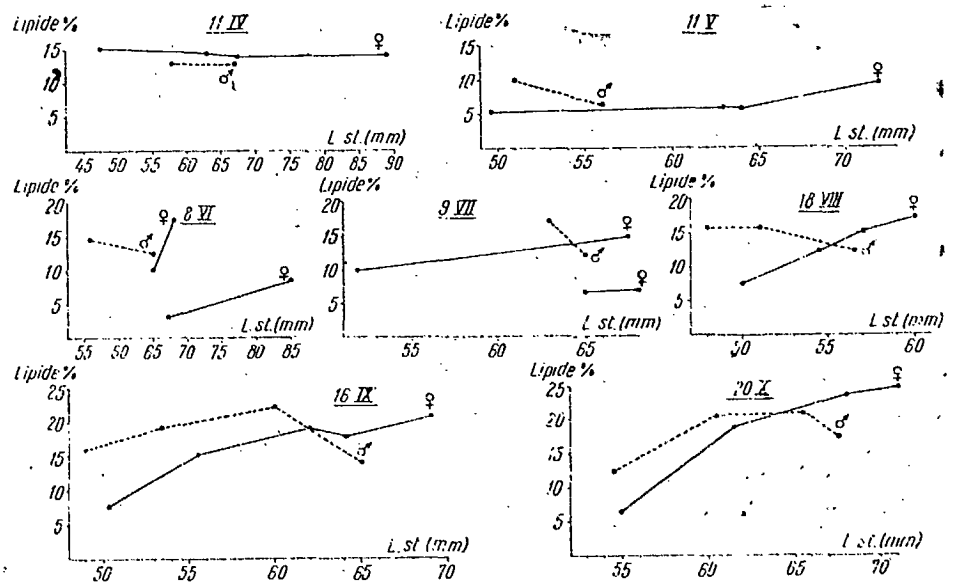

Fig. 2. — Raportul dintre lungimea standard (L. st.) și mărimea concentrației de lipide din musculatură și viscere exprimată în %.

Fig.2 - The ralation between the standard length (L.st.) and the quantity of lipid concentration in musculature and viscera expressed in %.

The reverse relation between the two parameters, stabilized during the spawning period, has indicated an increased lipid consumption in large size individuals as a probable result of a more active courtship behavior.

Similar correlations could be emphasized by replacing the standard length with other parameters: body weight, specimen's age, etc. (Table 2,3).

Quantitative variations of the lipid content in gonads.

At the beginning of April, the ovaries of analyzed specimens were already in an advanced maturation stage, fact supported also by the lipid content which constituted almost $\frac{1}{4}$ of the weight of gonads in wet state. Until the end of the spawning period, the lipid concentration of mature ovaries remained approximately the same with insignificant small individual variations (Table 4). p.83

Table 4

. Quantitative variation of lipid in gonads in relation to their weight in wet state during the reproductive period (in mg.& %)

Tabelul 4

Variația cantității de lipide din gonade în raport cu greutatea acestora în stare umedă, în perioada de reproducere (în mg și %)

Date Data	n of	Stage Stadiul gonadelor	Age Vîrsta	Total weight Greutatea totală (mg)	Weight of gonads Greutatea gonadei (mg)	Std. length Lungimea standard (mm)	H (mm)	Lipide în gonade	
								mg	%
♀♀									
11.IV	1	IV—V	5+	9690,0	2580,0	89,0	22,0	581,53	22,54
11.V	1	IV	5+	3551,0	561,0	72,0	18,2	123,59	22,03
8.VI	3	VI	3+	3010,6	20,0	65,0	16,6	4,31	21,57
9.VII	4	V	1+	1602,0	134,2	52,2	12,8	30,53	22,75
♂♂									
11.IV	6	IV	1+	2372,3	100,6	58,5	15,3	8,05	7,34
	4	IV—V	2+	3757,3	156,5	67,0	17,2	11,34	6,81
11.V	3	V	2+	2262,3	114,5	56,1	14,9	13,45	11,75
8.VI	3	V	3+	3768,2	160,8	65.0	17,4	17,82	11,08
9.VII	5	V	2+	2989.0	38,9	61,9	16,2	5,00	12,85

Depending on the fattening stage of the individuals and the mass of gonads, the lipides in mature ovaries represented 17,53-36% of the total organism's lipid. During the period following reproduction until the end of October, the lipid in ovaries did not exceed 1,52% of the global lipid quantity (Table 5) as a consequence, first of all, of the considerable decrease of the mass of the gonads.

The male gonads analyzed at the beginning of April had not reached yet a maximum lipid concentration (6.18-7,34%). This ulterior occurence was evident beginning the first 10 days in May until the beginning of June. During this period, the lipid concentration in testicles remained within the limits 11,08-12,85 (Table 4).

Having a lower mass and a lipid concentration almost twice smaller than that of the ovaries, the mature testicles contained maximum 9,52% of the global fat quantity of the individuals; during the period which followed reproduction, this contribution became almost negligible (0,02-0,19%) (Table 5).

Variations of global lipid quantity in the organism.

In 1952, the chemical composition of the sea and freshwater principal species of fishes from Romanian waters was analyzed in order to establish their importance as food, ignoring the variations of seasonal and physiological character orthose related to population.(Gheorghe et al., 1952). The 23 species analyzed were divided into 3 categories according to their fat concentration: fat fishes (with over 8% fat), semi-fat (4-8% fat substances) and thin fishes (with a lipid percentage below 4%). The Clupeonella delicatula (cultriventris) (Nordmann) species belong to the

semi-fat category with a lipid concentration of 7,40%. The analyses were carried out at the end of the fattening period. p.85

The specimens fished in Sulina during 1967 had, on the whole, a higher fat content, more evident in the fall.

Table 5

Percentage variations of lipid concentration in musculature and viscera and in gonads in relation to the total lipid concentration in organism.

Tabelul 5

Variația procentuală a concentrației de lipide din musculatură și viscere și a concentrației de lipide din gonade în raport cu concentrația globală a lipidelor din organism

Date / Data	1* ♀ 2* ♀ Lipid concentration							1* ♂ 3* ♂						
	n	Stage / Stadiul gonadei gonads	Age / Vîrsta	G. tot. / g. gon. (mg)	l. tot. / H (mm)	Concentrația lipidică % globală	Concentrația lipidică % musc. și viscere / gonade	n	Stage / Stadiul gonadei gonad	Age / Vîrsta	G. tot. / g. gon. (mg)	l. St. / H (mm)	Concentrația lipidică % globală	Concentrația lipidică % musc. și viscere / gonade
11.IV	—	—	—	—	—	—	—	6	IV—V	1+	2373,2 109,6	58,5 15,3	12,63	97,31 2,69
	1	IV—V	5+	3690,0 2580,0	89,0 22,0	16,62	64,0 36,0	4	IV—V	2+	3757,3 166,5	67,0 17,2	13,27	97,46 2,54
11.V	1	IV	5+	3551,0 561,0	72,0 18,2	11,64	69,90 30,10	3	V	2+	2262,3 114,5	56,1 14,9	5,73	90,48 9,52
8.VI	1	IV	5+	7010,7 928,7	85,0 19,0	10,09	73,89 26,11	—	—	—	—	--	—	—
	3	VI	3+	3010,6 20,0	65,0 16,0	10,42	99,45 0,55	3	V	3+	3768,2 160,8	65,0 17,4	12,57	96,76 2,24
9.VII	2	V	1+	1602 0 134,2	52,2 12,8	11,14	82,47 17,53	5	V	2+	2989,0 38,9	61,9 16,2	12,44	97,06 2,94
18.VIII	2	II	1+	1502,0 6,3	50,1 11,2	7,87±0,02*)	99,21 0,79 ±0,27*)	2	II	2+	2197,0 1,3	56,6 14,0	12,40±0,01*)	99,96 0,04 ±0,02*)
	2	II	3+	2565.6 12.2	60,0 14,8	17,17±0,07*)	99,59 0,41 ±0,14*)	2	II	2+	1845,0 0,6	51,2 13,1	15,76±0,01*)	99,97 0,03 ±0,01*)
16.IX	3	II—III	3+	2124,4 10,9	55,5 15,0	15,14±0,03*)	99,49 0,51 ±0,16*)	2	II—III	4+	3552,0 9,0	64,9 18,0	14,29±0,01*)	99,81 0,19 ±0,06*)
	1	II—III	5+	4153,6 27,4	69,0 18,0	20,75±0,03*)	98,48 1,52 ±0,50*)	2	II	3+	2359,2 12,0	60,0 16,1	22,17±0,00*)	99,98 0,02 ±0,01*)
20.X	1	II	2+	1670,0 11,2	55,0 12,0	6,65±0,05*)	98,48 1,52 ±0,50*)	2	II	2+	1720,3 1,5	54,5 12,5	12,49±0,01*)	99,93 0,07 ±0,02*)
	1	II—III	5+	3832,0 21,3	71,0 19,0	24,54±9,02*)	99,68 0,32 ±0,33*)	2	III	4+	3300,3 8,6	64,5 16,6	21,03±0,02*)	99,98 0,12 ±0,05*)

*) Valori calculate estimativ. = Estimative value calculation

1* Total weight-weight of the gonad 2* Total length- 3* Standard length

The lipid content presented differences from one sex to the other.

The female specimens contained between 3,17 and 24,54% lipid. The highest

values were found in the August-October period.(17,17-24,54%) and at the beginning of the spawning period (16,62%), while the lowest in the May-August period (7,87-11,64). In males, the lipd varied between 5,73 and 22,17%. The highest lipid percentages were recorded during September-October (21,05-22,17%) and the lowest in May (5,73%); during the other months, the fat concentration varied slightly (12,57-15,76%). On the basis of these figures, the Clupeonella cultriventris (Nordmann) population in the Sulina arm mouth can be placed in the fat fishes group of the mentioned classification.

The quantities of Clupeonella cultriventris (Nordmann) fished in Sulina are presently used as human food, in preparation of fish flower or in guanin extraction.

C o n c l u s i o n s

The spawning migration and the spawning proper were effected in a decreasing order of the lipid concentration in musculature and viscera, as a result of the part played by the high lipid concentrations in the early maturing process of the gonads.

At the beginning of April, the individual variations of the lipid content both in females and males were very slight. During the second part of the spawning period and during the fattening period, the differences between the minimal and maximal individual values became more accentuated.

In general, the individual variations, as well as the general ones, were more evident in female specimens than in the males.

Observation of the correlation established between body dimensions and the value of lipid concentration in musculature and viscera, pointed

out to the existence of significant differences in the representatives of the two sexes, more evident during the spawning period, due to a very different plastic and energy consumption of lipids. In females, for most of the time, a direct proportion existed between the mentioned parameters; in males, during reproduction, the proportion was reversed and, then, during the fattening period, evolutionary restauration of a direct relation was established.

The highest lipid concentrations in gonads were evident at the moment of their maturation. The ovaries, at maturation, had a lipid concentration of approx. twice that of testicles. Taking into account also the different mass of gonads in the representatives of the two sexes, their different contribution to the total lipid content in the organism could be explained.

According to the global lipid content, the Clupeonella cultriventris (Nordmann) population in the mouth of the Sulina arm can be included in the class of fat fishes in the classification of Gheorghe et al. (1952).

Knowledge of seasonal variations of fat concentration could serve at estimating the best method to evaluate the fished quantities during the various periods of the year. p. 86

QUANTITATIVE ASPECT OF THE LIPOID DYNAMIC IN *CLUPEONELLA CULTRIVENTRIS* (NORDMANN), IN THE DANUBE MOUTH ZONE (SULINA)

S u m m a r y

The lipoid concentration evolution in musculature, viscera, and gonads and the lipoid global concentration in *Clupeonella cultriventris*. (Nordmann) individuals fished in the arm Sulina mouth in april-october 1967 were studied.

Extraction method: Soxhlet; solvent: ethyl-ether; analyzed individuals: 102; test number: 60. Lipoid content (percentage) was calculated at mass in wet state.

The spawning migration, as well as the spawning itself took place in opposite with lipoid concentration in musculature and viscera (fig. 1).

At the spawning period beginning, individual variations were very little marked; later on this variations are successively accentuated (tab. 2, 3, 5).

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Individual variations ar
in females (tab. 2, 3, 5). In
there was a direct proporti
tration in musculature an
proportion was inverse;
successively direct (fig. 2).

The maximum lipoid
maturation (tab. 4). The lipo
in the body presents eviden

Taking in account the
(Nordmann) population was
of V. and I. Gheorghe,

L'ASPECT QUANTITATIF I
NELLA CULTRIVENTRIS (

On a étudié l'évolution
les viscères et les gonades,
exemplaires de *Clupeonella*
Sulina, en avril-octobre 1967

Méthode d'extraction:
102 ; nombre d'échantillons :
état humide.

On a constaté une dimi
et les viscères lors de la m
période de fraye les variatio
successivement (tab. 2, 3, 5). L
population, ont été plus évi
les femelles on a constaté,
portion directe entre les di
dique dans la musculature e
la proportion a été inverse,
successivement un rapport d

La concentration lipidi
au moment de la maturatio
globale en lipoides de l'orga

D'aprés la teneur glob
a été groupée dans la classe
V. et I. Gheorghe, 1952).

КОЛИЧЕСТВЕ
У *CLUPEONELLA*

Изучалось развитие к
и гонад и общая концентра
(Nordmann) выловленных
Метод извлечения, Со
всего 102 экземпляров и к
Установлено что мин
в нисходящем порядке кон

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