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RELATIONSHIP OF TOTAL LENGTH, BODY DEPTH, WEIGHT WITH STANDARD LENGTH IN *LEPOMIS GIBBOSUS* (PISCES, PERCIFORMES, CENTRARCHIDAE) FROM FUNDATA LAKE (ROMANIA)

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On analyse les relations entre 4 variables: chez *Lepomis gibbosus*: la longueur totale, la hauteur du corps et le poids, tous dépendant de la longueur standard. On relève les groupes intra-populationnels et on discute l'une de leurs relations.

Lepomis gibbosus was introduced in the French and German waters at the beginning of our century. Then it spread naturally and / or by the help of man (Băcescu, 1942; Bănărescu, 1964; Tandon, 1976) in the eastern and southern Europe.

Its breeding behaviour has been studied by several American and European researchers. A survey of their studies has been drawn up by Breder Jr. and Rosen (1966), who remarked the shape and colour dissimilarities between the groups of population.

Tandon (1976, 1977 b) analysed in some of his papers the variability of this species in Europe, pointing out the differences between the populations from Italy, Romania, Hungary and Slovakia concerning: the maximum depth of the body, the length of the head, the length of the caudal peduncle, the pectoral fin length as compared to the standard length; the eye diameter and the preorbital distance as compared to the head length. These differences appear to be more dependent on the diversity of habitats than on the geographical variation.

The same author studied the growth rate of the standard length with populations from Hungary and Italy, comparing his data to some observations from North America (1977 a, b). He drew the conclusions that the maximum growth rate was placed between ages I and II, while the minimum one between ages III and IV.

The Romanian researchers devoted their studies to the external morphology (Bănărescu, 1964), to the growth, the sexual maturation and the breeding potential (Papadopol and Ignat, 1967), to the feeding (Spătaru, 1967) as well as to the distribution and to the interrelationship with the aboriginal fauna (Băcescu, 1942; Bănărescu, 1964).

The purpose of the present paper is to analyse the variation of the total length, of the body depth and weight, depending upon the standard length. The method that I used is relatively simple and adequate, in my opinion, at least for small size variation intervals.

MATERIAL AND METHODS

The material was collected during the breeding season (May 30—31, 1980) from Fundata Lake (Ialomiţa County) by means of a little seine (13 m long, 1.3 high and 0.8 cm mesh side), from sandy-clayey (particulary the 2nd age specimens) and clayey-silty bottoms (especially the 1st age), near the lakeside. These areas were covered enough by a thick layer of submerged macrophytes.

The size figures regarding the 131 specimens preserved in formalin solution are given in table 1. The histogram of the standard length is also presented with a view to explaining some apparent disagreements between the means of these variables and the regression curves. Mention should be made that with some specimens the caudal fin rays were attacked by a parasite probably belonging to genus *Ichthyophonus*.

The age of the specimens was estimated by studying the scales.

The sex was revealed by dissecting the breeding specimens. In the 1st age specimens, the gonads were in an early development stage.

The variables obtained by measuring and weighing were transformed by means of logarithm — base 10. The linear regressions were then calculated for the transformed variables in each age and sex group.

The relationship between the body depth (measured at the insertion of the dorsal fin — an anatomic point; the maximum body depth is situated in the anterior third of the thorny dorsal fin part — Bănărescu, 1964) and the total length with the standard length was expressed by using the above method in order to emphasize their possible curviliniarity.

The 95% confidence limits were estimated for each regression coefficient by the following formula:

$b - t_{0.05}s_b \leqslant \beta \leqslant b + t_{0.05}s_b$ in which: b — regression coefficient (estimate of β), t — student's distribution values, s_b — standard error of regression coefficient.

Also estimated were the 95% confidence limits of each curve in six regression points.

These sites were situated at an equal distance, two by two, from the half of the interval of the independent transformed variable (the seventh site — at the middle — being the average of the independent variable). The calculations were made according to the following formula:

$$\hat{Y} - t_{0.05}\, s_{\hat{y}} \leqslant \mu_{V} \hat{Y} + t_{0.05}\, s_{\hat{y}}$$

in which: — $\hat{Y}$ the average of the dependent variable (estimate of p)
— $s_{\hat{y}}$ the standard deviation of y sample (in table 2 are indicated the $s_{\bar{y}x}$, s_{yx} and s_b values which lead to the calculation of

$$s^2_{\hat{y}} = s^2_{yx} + s^2_{yx} + s^2_b x^2$$

TABLE I

Main characteristics of the Fundata Lake sample (part 1 of the table) and some characteristics of a Lower Danube sample (part 2, according to Papadopol and Ignat, 1965)

Age	SEX	Number of specimens	Total length (mm): Average	Range		Standard length (mm) Average:	Range		Body* depth (mm) Average:	Range		Weight (grams) Average:	Range	
Part 1														
I	juvenile	49	53.13	40.7	64.6	4 8	33.8	54.9	16.42	11.2	21.4	2.464	0.93	4.57
II	male	45	94.78	82.3	115.5	78.46	60.2	96	33.42	28	42	16.280	10.37	25.75
	female	32	92.61	78.6	116.9	77.13	63.5	100	32.45	25.7	45	16.28	28.61	37.15
III	male	3	129.8	125.5	135.6	108.2	104.5	113.7	49.8	47	52.4	45.6	37.24	55.35
	female	2	—	125	130	—	101	110	—	48.5	49	—	38.22	44.4
Part 2														
II	male	88	103	85	124	83	68	110	—	—	—	27.6	12.7	46.5
	female	26	120	91	132	96	73	120	—	—	—	48.4	16.5	55.0
III	male	5	132	125	140	108	102	120	—	—	—	55.0	47,5	74.0
	female	12	137	125	150	111	102	120	—	—	—	63.5	43.0	84.5

* For this characteristic see Material and methods

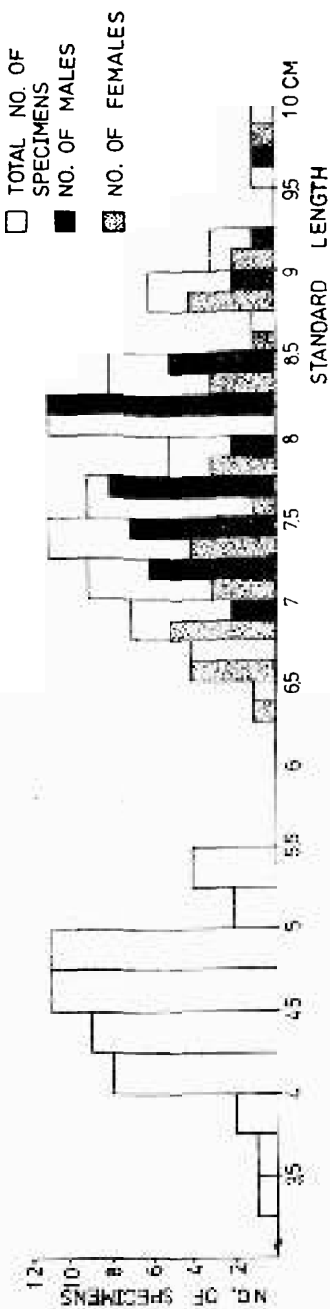

Fig. 1. — Standard length ploted against frequency of specimens, for Fundata Lake sample three-year old specimens excepted

The methods are taken from S n e d e c o r (1965) as well as from M i - h ă i l ă and P o p e s c u (1978). Subsequently, when tracing the curves, I made the exponential re-transformation.

RESULTS AND DISCUSSION

The analysis of the resulting relationship (Table 2) reveals some dissimilarities between the 1st age specimens (juveniles) and the 2nd age ones. As far as the 2nd age group is concerned, the sex differences are not significant as, generally, the confidence limits of the females' regression also include the limits valid for males. I shall however try to analyse the differences between the curves of these four groups because they probably lead to bigger differences between the two groups, at older ages.

As far as the Ist age is concerned the curve of the total length dependent on the standard length grows more slowly and acquires a slightly concave aspect while for the 2nd age the growth is more rapid and almost linear (Table 2 and Fig. 2). The two-year old females show a relatively faster growth of their total length as compared to the males, but they start from less big values. These regression differences allow that, for the same standard length, the females show bigger total lengths only in the upper part of the variation interval.

All the relations between the standard length and the body depth have a slightly convex aspect, the curvature being better marked for the 1st age specimens and almost the same for the 2nd age specimens (Tab. 2 and Fig. 3). On the whole, within the variation interval indicated in table 1, the fastest relative growth of the body depth correlated with the standard length proves to be shown by the males while the slowest one is shown by the juveniles.

The relationship between the standard length and the body weight is convex (Table 2, Fig. 4).

It is the females that show the fastest weight variation while the slowest one is registered in the juveniles.

One should take into account that in females, the weight of gonads participates in the total weight of the body much more than in males. For instance, in the Brăila lakes and marshes, the value of the gonosomatic ratio in the 2nd age specimens was about 8.6% during the same period of the year 1965 (P a p a d o p o l and I g n a t, op. cit.).

An interesting characteristic of species *Lepomis gibbosus* is the well marked polyphenism and polymorphism of the populations. The various groups of the population distinguish themselves temporarily or during more than a year by:

— the colour — more brilliant in males, dull in females, prevailingly blue in juveniles;

— the post-opercular flap — larger and more coloured in males (Reghard after B r e d e r and R o s e n 1966); its posterior spot is red in males, orange in females (T r a u t - m a n, 1957); the black posterior spot larger in males than in females whose flap is smaller; in juveniles the flap is little differentiated;

TABLE 2

Relationship and main values used for 95% confidence limits determination of regression coefficents and of regression(for explanation see: methods).

Age	Sex	Regression	S_{yx}	s_b	$b - t_{0 \cdot 05} s_b$	$b + t_{0 \cdot 05} s_b$	$s_{\bar{y}x}$
I	juvenile	Log T.L. = 0.1539 + 0.894 Log. S.L.	0.0146	0.0510	0.7915	0.9972	0.0020
		Log B.D. = —0.6500 + 1.3156 Log S.L.	0.0199	0.0696	1.1750	1.4557	0.0028
		Log W. = —1.7750 + 3.2750 Log S.L.	0.0567	0.1918	2.8768	3.6746	0.0081
II	male:	Log T.L. = 0.1143 + 0.9625 Log S.L.	0.0075	0.0345	0.8928	1.0322	0.0011
		Log. B.D. = —0.5430 + 1.1918 Log S.L.	0.0094	0.0430	1.1049	1.2787	0.0014
		Log W. = —1.3046 + 2.80571 Log S.L.	0.0265	0.1208	2.5616	3.0498	0.0039
	female	Log T.L. = 0.0799 + 1 Log S.L.	0.0090	0.0315	0.9354	1.0645	0.0016
		Log B.D. = —0.5556 + 1.2025 Log S.L.	0.0140	0.0489	1.1020	1.3023	0.0024
		Log W. = —1.6166 + 3.1625 Log S.L.	0.0587	0.2045	2.7477	3.5827	0.0041

T.L. — Total length, B.D. — Body, depth W. — Weight, S.L. — Standard length

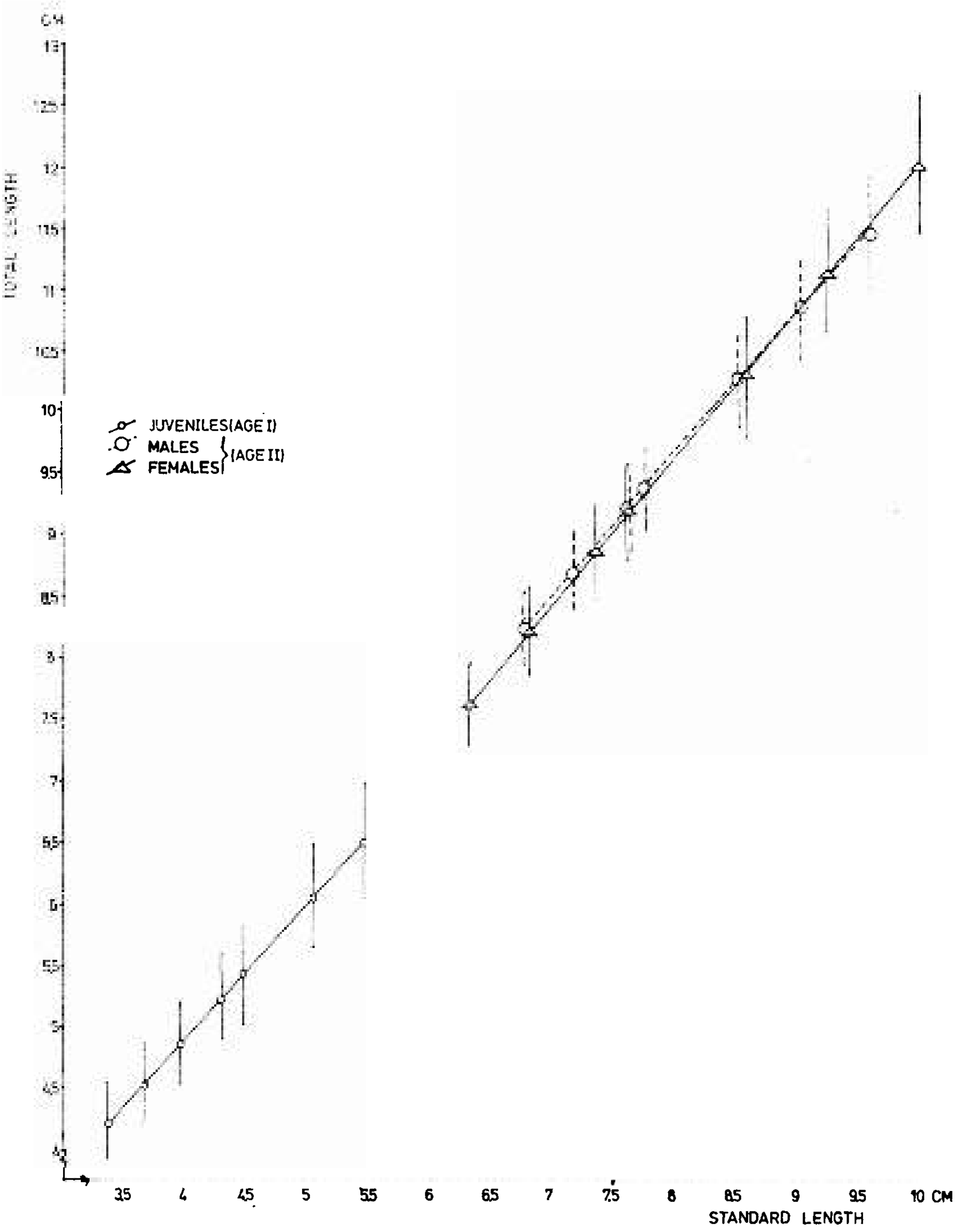

Fig. 2. — Standard length — total length relations for age I and II specimens from Fundata Lake. Vertical lines represent the confidence limits.

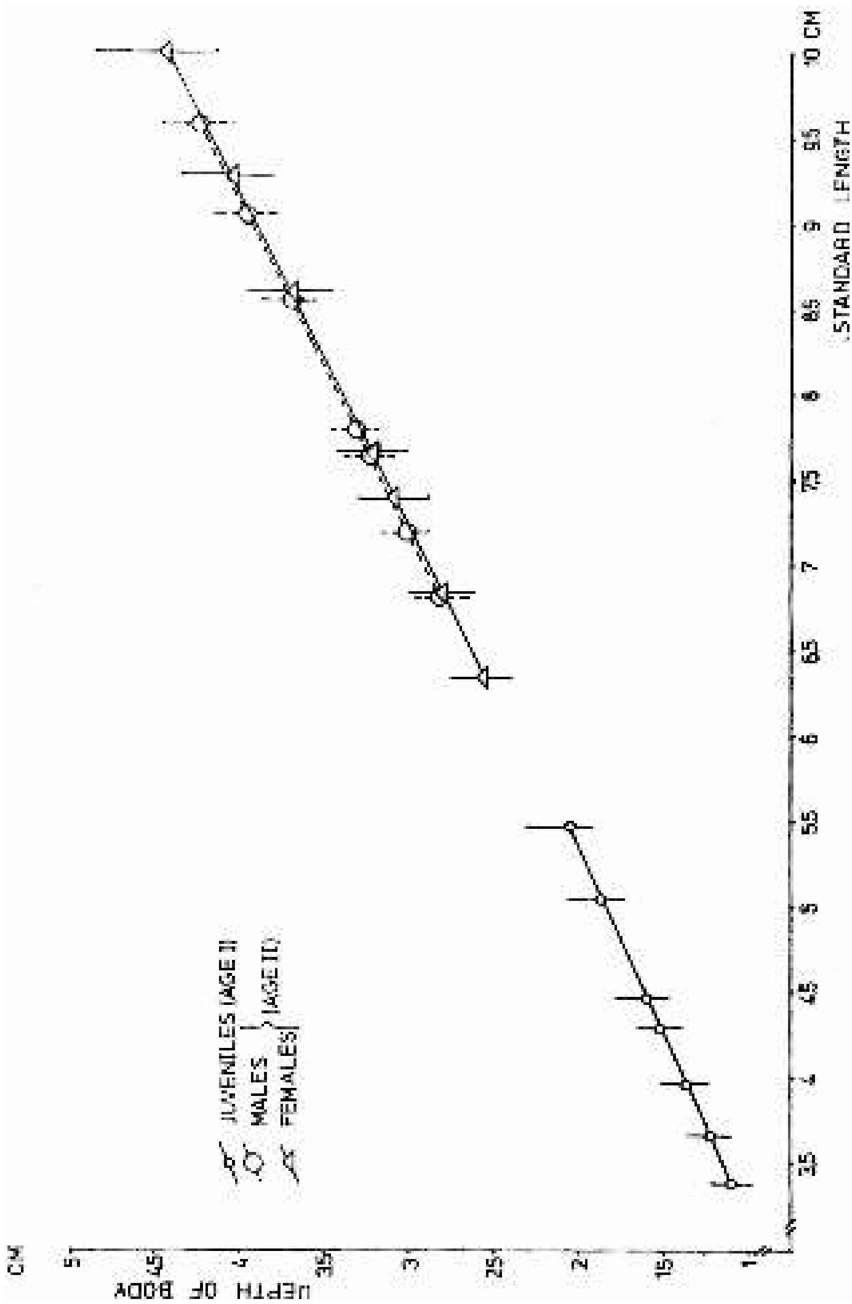

Fig. 3. — Standard length — body depth relations for age I and II specimens from Fundata Lake. Vertical lines represent the confidence limits.

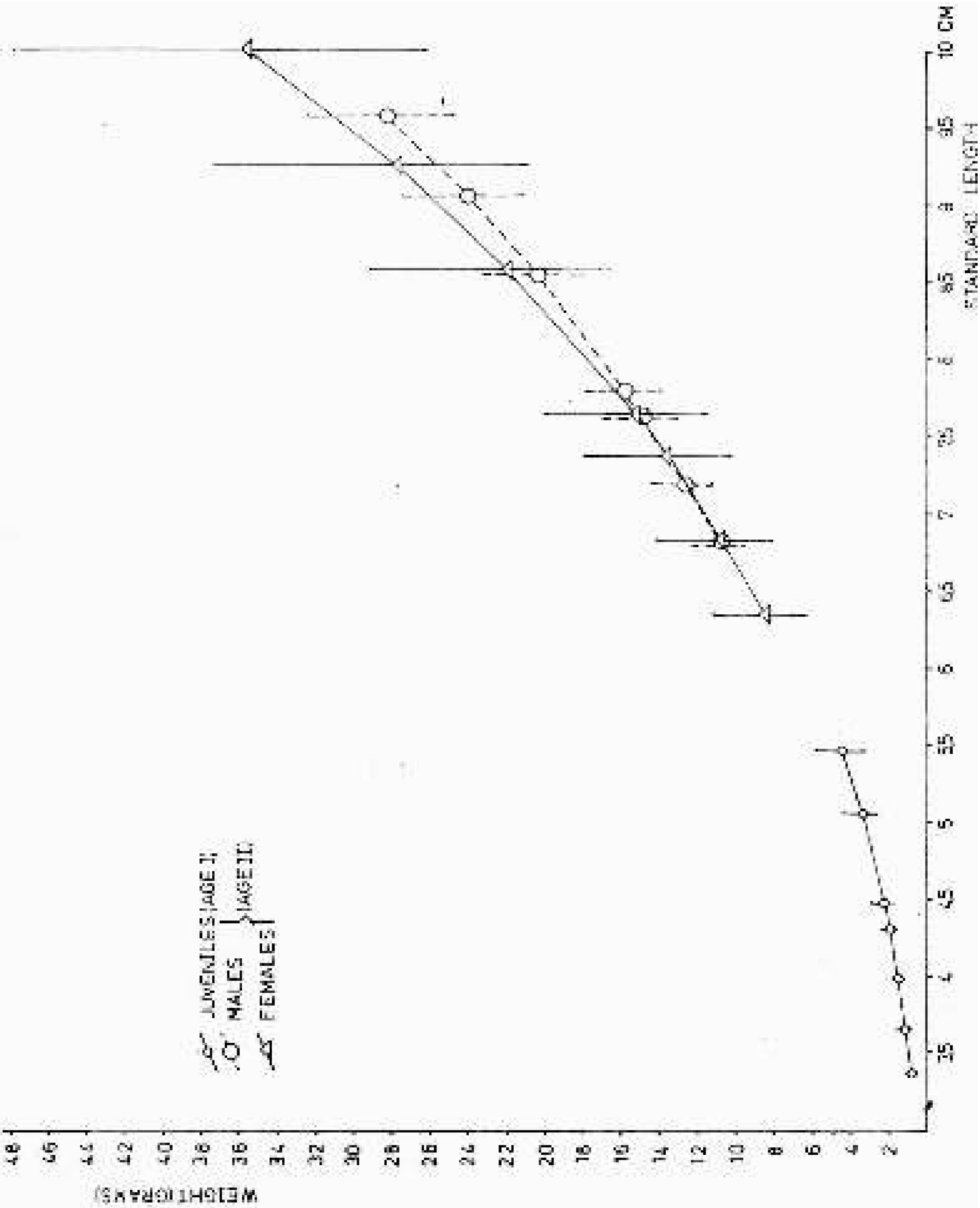

Fig. 4. — Standard length — weight relations for age I and II specimens from Fundata Lake. Vertical lines represent the confidence limits.

— the stripes on the body sides — more visible in juveniles than in females and little differentiated or sometimes absent in males (Breder, 1936 after Breder and Rosen, op. cit; Trautman, op. cit);

— the maximum depth of the body — the ratio between the maximum depth and the standard length is generally 1.9—2.8, the extremes being 1.7 in very large adults and 3 in very small juveniles (Trautman, 1957).

The groups of population generally represent, as Botnariuc, (1976) observed, an adaptation and, at the same time, an expression of the integrality of the population as a system.

I think that the smaller confidence limits of the dependent variables (the vertical lines in Fig. 2, 3 and 4) in males than in females may be interpreted in the sense of the adaptation to the trophic ressources of the medium. This could be the result of a better feeding with this group as compared to its requirements, which leads to a smaller variation (Nikolski, 1962). The better feeding may be the consequence of the existence of ranks (analogous to those found by Alee and coll., 1948 in *Lepomis cyanellus* whose males enjoy a better status than the females).

As a conclusion, I would like to note that *L. gibbosus* has relatively recently appeared in Fundata Lake, as in 1964 Bănărescu did not signal this species north of Ialomiţa River. Its penetration in this lake seems to be connected with the digging of some channels for the lake drainage into the river occasioned by the 1969—1975 abundent precipitations as well as by the very high level of Ialomiţa River in the same period (Gâştescu and coll., 1979).

Thanks to favourable conditions (large littoral dunes covered by submerged macrophytes, apparent absence of *Perca fluviatilis* and of other predators) this population rapidly developed and appears to be numerous, despite the intense fishing (both with the saine and the line). In the ages of the studied sample, the average standard length and weight are smaller than in Brăila lakes and marshes (Papadopol and Ignat) op. cit, table 1) but bigger than in some American populations (Tandon, 1977, a, b).

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RELAŢIILE LUNGIMII TOTALE, ÎNĂLŢIMII CORPULUI, ŞI GREUTĂŢII CU LUNGIMEA STANDARD LA *LEPOMIS GIBBOSUS* (PISCES, PERCIFORMES, CENTRARCHIDAE) DIN LACUL FUNDATA (ROMÂNIA)

REZUMAT

Lucrarea constituie o scurtă analiză a relaţiilor lungimii totale, înălţimii corpului (măsurată la inserţia dorsalei) şi greutăţii cu lungimea standard efectuată pe o probă de *Lepomis gibbosus* din Lacul Fundata (jud. Ialomiţa).

În cadrul discuţiilor este relevată o posibilă urmare a polimorfismului intrapopulaţional pronunţat al acestei specii.

De asemenea, este discutată pătrunderea acestei specii în Lacul Fundata.

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