

DYNAMICS OF LONGITUDINAL GROWTH AND BODY MASS OF ESOX LUCIUS L., BLICCA BJOERKNA L., AND CARASSIUS AURATUS GIBELIO BLOCH IN THE TISA

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(Received February 1, 1983)

Abstract

In the period 1979—1981, the relation between body length and body mass of *E. lucius*, *B. bjoerkna*, and *C. auratus gibelio*, ranging in age from 2+ to 5+, was investigated. Highly significant and positive correlation between the standard length and body mass was obtained. Correlation coefficients ranged from 0.8671 to 0.9732 (*E. lucius*), from 0.9215 to 0.9621 (*B. bjoerkna*), and from 0.9572 to 0.9250 (*C. auratus gibelio*). The highest fattening coefficient was recorded in *C. auratus gibelio*, then in *B. bjoerkna*, whereas the lowest in *E. lucius*. By calculating the allometric ratios of length to body mass, the differences between measured and calculated values in body mass of certain body length groups were observed, ranging from 0.76 to 7.48% (*E. lucius*), from 0.36 to 2.63% (*B. bjoerkna*), and from 0.18 to 9.65% (*C. auratus gibelio*).

Introduction

The knowledge of the allometric ratio of length to body mass of fish populations is of great importance to determining the length of time required for gaining given body mass as related to body length and age, and therefore have practical value in fish production. The data presented in this paper are the result of an extended study on a predator species *E. lucius* and its prey *B. bjoerkna* and *C. auratus gibelio* being widespread alien species (BUDAKOV et al. 1979, BUDAKOV and MALETIN 1981, MALETIN and BUDAKOV 1982).

Material and Methods

The material was collected in the period 1979—1981. The number of 48 specimens of *E. lucius*, 88 of *B. bjoerkna*, and a 100 specimens of *C. auratus gibelio* was studied. Age of specimens was determined according to year marks on scales (2+ to 5+). Also, the standard body length (in mm) and body mass (in g) were measured. Ratio of length to body mass was presented by a linear regression:

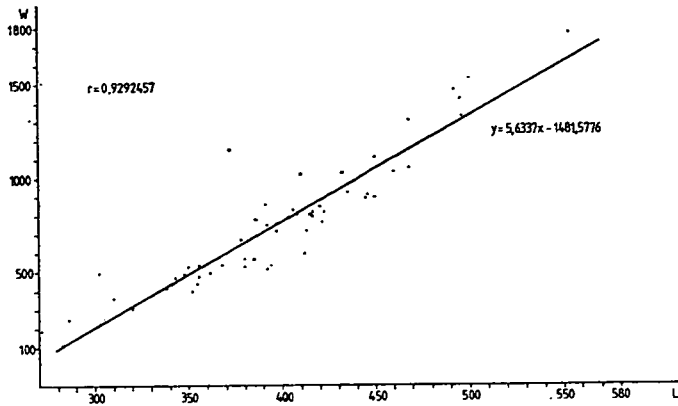
$$y = ax + b$$

Correlation coefficient (r) and fattening coefficient (after Fulton), as related to age, were calculated. Increase in body mass was investigated on the basis of measured values for body mass while ratio of length to body mass was calculated according to the formula:

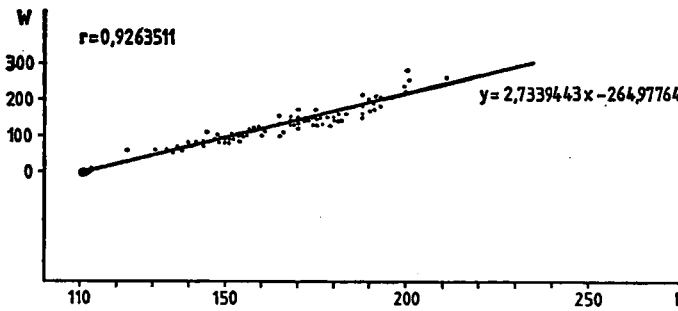
$$\log W = a \log l + b$$

Results and discussion

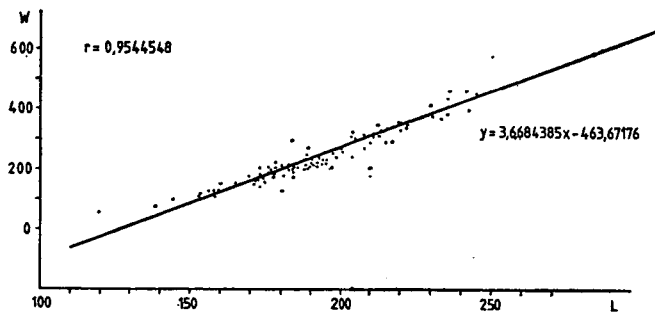
In the graphs 1, 2, and 3, ratio of length to body mass of total sample is expressed by linear regression.



Graph. 1



Graph. 2



Graph. 3

Correlation coefficients of length and body mass were positive and highly significant (*E. lucius*— $r=0.9292$; *B. bjoerkna*— $r=0.9263$; and *C. auratus gibelio*— $r=0.9544$).

Correlation coefficient of *E. lucius* increased as its age increased, ranging from 0.8761 to 0.9732. Fattening coefficient was the lowest at the age of 2+ (0.9546), whereas the highest at 3+ (1.2817, Tab. 1).

Tab. 1. *The correlation of the standard length and weight and the coefficients of the fattening of *Esox lucius* L.*

Age	n	r	Q
2+	1	—	0,9545
3+	12	0,8761315	1,2817
4+	21	0,9484364	1,1502
5+	14	0,9732379	1,2053

Values of fattening coefficient were higher than those suggested by Мохоб (1979).

Correlation and fattening coefficients in *B. bjoerkna* increased as its age increased ($r=0.9215-0.9620$; $Q=2.4678-2.8717$, Tab. 2). The obtained values are higher than that described by Щербуха (1973).

Tab. 2. *The correlation of the standard length and weight and the coefficients of the fattening of *Blicca bjoerkna* L.*

Age	n	r	Q
2+	1	—	2,4678
3+	15	0,9215127	2,6681
4+	41	0,9202878	2,8274
5+	31	0,9620818	2,8717

Correlation coefficient of *C. auratus gibelio*, at the age of 2+ to 4+, was approximately the same ($r=0.9572-0.9599$). At the age of 5+, it decreased slightly (0.9250, Tab. 3). Fattening coefficient decreased as its age increased ($Q=3.5120-3.1810$). Our results are in agreement with the results presented by Кривошеков (1953).

Tab. 3. *The correlation of the standard length and weight and the coefficients of the fattening of *Carassius auratus gibelio* Bloch.*

Age	n	r	Q
2+	16	0,9572272	3,5120
3+	42	0,9547662	3,4465
4+	28	0,9599360	3,3606
5+	14	0,9250333	3,1810

Ratio of length to body mass of *E. lucius* (Tab. 4) was calculated using the formula $\log W=3.0586 \log l-5.1095$. This formula served to calculate body mass of certain length groups. By comparing the deviation between calculated body mass

and body mass obtained by measuring the same length groups, the smallest deviation was found in the length group ranging from 301 to 340, where the difference amounted 2.77 g, i. e. 0.76%, whereas the greatest was in the group ranging from 541 to 580, where the difference of 132.48 g i. e. 7.48% was recorded.

Tab. 4. Real and calculated values of the weight (meadle values for separated length groups) of the *Esox lucius L.*

Lenght group	n	\bar{l}_x	$W\bar{x}$	calculated weight	Wg	W%
261,00—300,00	2	278,50	220,00	233,43	-13,43	6,10
301,00—340,00	3	322,66	363,33	366,10	-2,77	0,76
341,00—380,00	13	362,30	561,53	521,74	39,79	7,08
381,00—420,00	15	403,93	758,00	727,99	30,01	3,95
421,00—460,00	8	440,87	935,00	951,38	-16,38	1,75
461,00—500,00	6	486,50	1345,00	1285,16	59,84	4,44
501,00—540,00	—	—	—	—	—	—
541,00—580,00	1	553,00	1770,00	1902,00	-132,48	7,48

According to the formula for *B. bjoerkna* (Tab. 5) $\log W = 3.1854 \log l - 4.9752$ the smallest deviation was obtained in the length group 141—160 (0.35 g namely 0.36%), whereas the greatest in the group 181—200 (4.87 g namely 2.63%).

Tab. 5. Real and calculated values of the weight (meadle values for separated length groups) of the *Blicca bjoerkna L.*

Length group	n	\bar{l}_x	$W\bar{x}$	calculated weight	Wg	W%
121,00—140,00	5	132,80	62,00	61,33	0,67	1,08
141,00—160,00	31	152,90	95,80	96,15	-0,35	0,36
161,00—180,00	31	170,40	134,83	135,73	-0,90	0,66
181,00—200,00	19	189,00	183,94	188,81	-4,87	2,63
201,00—220,00	2	206,00	255,00	248,41	6,59	2,58

In *C. auratus gibelio*, (the formula $\log W = 2.9693 \log l - 4.4201$), the smallest deviation between measured and calculated body mass was recorded in the length group 181—200 (0.41 g namely 0.18%, Tab. 6), whereas the greatest in the group 121—140 (7.72 g namely 9.65%).

Tab. 6. Real and calculated values of the weight (meadle values for separated length groups) of the *Carassius auratus gibelio* Bloch.

Length group	n	$\bar{l}x$	Wx	calculated weight	Wg	W%
101,00—120,00	1	120,00	60,00	56,67	3,33	5,55
121,00—140,00	1	139,00	80,00	87,72	-7,72	9,65
141,00—160,00	8	155,75	122,25	122,96	-0,71	0,58
161,00—180,00	25	174,40	181,99	172,02	9,97	5,47
181,00—200,00	37	188,97	218,64	218,23	0,41	0,18
201,00—220,00	15	211,53	307,33	305,07	2,26	0,73
221,00—240,00	9	227,77	375,55	379,95	-4,40	1,17
241,00—260,00	3	243,33	436,66	462,32	-25,66	5,87
261,00—280,00	1	270,00	660,00	629,73	30,27	4,58

Conclusion

On the basis of the investigations on the correlation between length and body mass, as well as fattening and allometric ratio of length to body mass in *E. lucius*, *B. bjoerkna*, and *C. auratus gibelio*, the following conclusions are drawn:

Positive and highly significant correlation coefficients of the three species under investigation were obtained.

With respect to age, correlation coefficients of *E. lucius* and *B. bjoerkna* tend to increase, whereas in *C. auratus gibelio* it stagnates.

Fattening coefficient of the three species point to satisfactory fattening.

Differences between measured and calculated body mass in certain length groups fall within tolerant ranges.

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A Tisza folyó *Esox Lucius L.*, *Blicca bjoerkna L.* és *Carassius auratus gibelio Bloch* fajainak testhossz- és testtömeg dinamikája

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Kivonat

A szerzők az 1979—81 között begyűjtött anyag alapján a 2+ -os—5+ -os fejlődési csoportba tartozó *E. lucius*, *B. bjoerkna* és *C. auratus gibelio* testhossz- és testtömeg arányait vizsgálták. Az említett testméretek közötti korreláció pozitív és magasan szignifikáns értékű. A korrelációs koeficiens az *E. lucius*-nál 0,8671—0,9732, a *B. bjoerkna*-nál 0,9215—0,9621 és a *C. auratus gibelio* esetében 0,9572—0,9250. A tápláltság koeficiense az *E. lucius*-nál a legalacsonyabb, a *C. auratus gibelio*-nál pedig a legmagasabb értékeket mutatja. Az egyes korcsoportok lemért és számított testhossz- és testtömeg alometriás arányainak értéke az *E. lucius*-nál 0,76—7,48%, a *B. bjoerkna*-nál 0,36—2,63% és a *C. auratus gibelio*-nál 0,18—9,65%.

Динамика продольного роста и массы *Esox lucius L.*, *Blicca bjoerkna L.* и *Carassius auratus gibelio Bloch* в Тисе

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Резюме

На основании материала собранного в периоде 1979—1981 г. исследовано соотношение продольного роста и массы *E. lucius*, *B. bjoerkna* и *C. auratus gibelio* в возрасте 2+ до 5+. Корреляция между стандартным продольным ростом и массы тела положительна и имеет большое значение. Коэффициент корреляции у *E. lucius* от 0,8671 до 0,9732, у *B. bjoerkna* от 0,9215 до 0,9621 и у *C. auratus gibelio* от 0,9572 до 0,9250. Коэффициент откормленности меньше всех у *E. lucius* затем у *B. bjoerkna* а больше все у *C. auratus gibelio*. Вычислением аллометрических соотношений продольного роста и массы разницы между взвешенными и вычисленными значениями для массы определённой продольной группы составляют для *E. lucius* от 0,76—7,48%, *B. bjoerkna* от 0,36—2,63% и для *C. auratus gibelio* от 0,18—9,65%.

Dinamika dužinskog rasta i mase *Esox lucius L.*, *Blicca bjoerkna L.* i *Carassius auratus gibelio Bloch* u Tisi

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Abstrakt

Na osnovu materijala sakupljenog u periodu 1979—1981. g. ispitivan je odnos dužine i mase *E. lucius*, *B. bjoerkna* i *C. auratus gibelio* uzrasta od 2+ do 5+. Korelacija između standardne dužine i mase tela je pozitivna i visoko značajna. Koeficijent korelacije se kreće kod *E. lucius* od 0,8671 do 0,9732, kod *B. bjoerkna* od 0,9215 do 0,9621 i kod *C. auratus gibelio* od 0,9572 do 0,9250. Koeficijent uhranjenosti je najmanji kod *E. lucius*, zatim kod *B. bjoerkna*, a najveći kod *C. auratus gibelio*. Izračunavanjem alometrijskih nosa dužine i mase tela razlike između izmerenih i izračunatih vrednosti za masu za određene dužinske grupe su za *E. lucius* od 0,76—7,48%, *B. bjoerkna* od 0,36—2,63% i za *C. auratus gibelio* od 0,18—9,65%.