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Fishbiology

FECUNDITY OF TENCH (*TINCA TINCA* L.) IN LAKE PATRYKI

PŁODNOŚĆ LINA (*TINCA TINCA* L.) Z JEZIORA PATRYKI

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Absolute and relative fecundity of 43 tench females from the Lake Patryki (Masurian Lake District, Poland) was correlated with body size, ovary weight, egg diameter, and age. The multiple regression analysis showed the fecundity of the population studied to be best characterised by the total and gutted fish body weights.

INTRODUCTION

Tench, owing to its palatable and nutritionally valuable flesh, is an economically important species of a marked tolerance to environmental conditions, oxygen content and food supply in particular. Thus the knowledge of the species fecundity is of importance as it can contribute to a well-planned and reasonable development of tench culture. The species produces many fine eggs, which makes any study on its fecundity very tedious. Therefore the literature contains only a few papers on the tench fecundity (Brylińska et al., 1979; Kaj et al., 1964; Monič, 1953; Moroz, 1968; Papadopol and Weinberger, 1971; Skóra, 1964; Syrovotskaja, 1927; Zubenko, 1973; Žukov, 1965). Only Brylińska et al. (1979) comprehensively determined relationships between fecundity and selected individual characters in several populations of the species.

The present paper is aimed at determining the absolute and relative fecundity of tench from the Lake Patryki (Masurian Lake District, Poland) and examining relationships

between the absolute and relative fecundity on one hand, and body size, ovary weight, and fish age on the other.

MATERIAL AND METHODS

The study material was collected from the Lake Patryki situated in the vicinity of Olsztyn, a shallow, strongly eutrophic, pond-type water body with a muddy bottom.

43 tench females were caught on June 15, 1977 with gill nets. The individuals caught were measured (l.c.) to the nearest 0.5 cm; body weight was determined to 5.0 g for whole (W) and gutted (Wo) individuals whose ovaries were weighed (O) to 0.1 g. The ovaries were at stage 4 and 5 according to Sakun and Buckaja (1968). For the age (A) determination, scales were collected from the second row above lateral line beneath the dorsal fin. The ovaries were fixed in 4% formalin. 100 oocytes were taken at random from each ovary and their diameters (E) were measured under a stereomicroscope to 0.01 mm. The oocytes larger than 0.31 mm diameter were measured as only these could have been deposited in the spawning grounds during the nearest spawning, had that been effected (Brylińska and Długosz, 1978). After drying the entire gonads, 3 samples of 1000 eggs each were taken from every ovary to determine the absolute fecundity (Fa) according to Brylińska and Bryliński (1973). The relative fecundity (Fr) was calculated from

$$Fr = Fa : Wo$$

The absolute and relative fecundity were treated as dependent variables when correlating them with body length (l.c.), total body weight (W), gutted weight (Wo), ovary weight (O), egg size (E), and age (A), the latter being considered independent variables.

To assess the correlation between the fecundity and selected individual characters, product-moment correlation coefficients (r) were calculated and checked for their significance on raw and logtransformed data. The statistical significance was determined from tables at $\alpha = 0.05$ and $\alpha = 0.01$ with $n-1$ degrees of freedom. Additionally, regression coefficients of equations described by linear ($y = ax + b$) and exponential ($y = bx^a$) functions, the latter transformed to $\log y = a \log x + \log b$,

where $y = Fa$ or Fr ,

x = individual characters (l.c., W, Wo, O, E, A),

a and b = equation coefficients,

were calculated.

The fecundity level is influenced by a number of characters. To determine those most closely related to the fecundity, multiple regression analysis was performed for Fa and Fr . The sub-set of those independent variables that most significantly influence the tench fecundity was determined at $\alpha = 0.05$ significance level (Malec and Caliński, 1973).

RESULTS AND DISCUSSION

Absolute fecundity

The absolute fecundity of 43 tench females from the Lake Patryki ranged within 29,200 to 292,500 eggs (Table 1). As shown by the values in Table 1, the mean absolute fecundity (F_a) increases with the body length (l.c.), mean body weight (W), and mean ovary weight (O), as well as with age (A). The correlation coefficients (Table 2) reveal that, in the tench population studied, an exponential regression equation gives more significance to the association between the absolute fecundity and individual characters than does a linear equation. In other words, the relationships studied are better expressed by an exponential equation. Similarly, the exponential regression yielded more significant results when the absolute fecundity (F_a) was related to fish body weight (W) and length (lc) for 12 populations of tench from the Masurian and Chełm-Dobrzyń Lake Districts (Brylińska et al., 1979) and in other fish species (Bagenal, 1967; Brylińska, 1971; Oosthuizen and Daen, 1974; Pitt, 1964).

In the population studied, the absolute fecundity correlates best with the ovary weight ($r = 0.803$). Similar results were reported by Brylińska et al. (1979) for several tench populations. On the other hand, Oosthuizen and Daen (1974) are of the opinion that the absolute fecundity of cod is more dependent on body weight ($r = 0.87$) than on the ovary weight ($r = 0.80$). The tench females studied showed a closer correlation of the absolute fecundity with body weight ($r = 0.701$) than with body length ($r = 0.654$), similarly to the tench populations studied by Brylińska et al. (1979). The absolute fecundity shows the poorest correlation with egg diameter ($r = 0.441$) and age ($r = 0.431$). The data in Table 2 show close associations between fish age and body length, weight, and ovary weight. The age-dependent increase in fecundity results from the fact that fish size tends to increase with age. A similar relationship was described for other fish species, for instance bream (Brylińska, 1971), rough dab (Pitt, 1964), pike (Terlecki, 1973), and pikeperch (Syrovotskaja, 1927). However, an opinion exists, supported by the results of multiple regression analysis, that there is no significant relationship between age and absolute fecundity.

Correlations between the absolute fecundity and the individual characters examined are presented in Figs. 1, 2, 3, 4, and 5 showing the regression lines based on the equations $y = ax + b$ and $y = bx^a$, the latter transformed to $\log y = a \log x + \log b$. Table 3 lists the equations and regression coefficients.

Fig. 1 illustrates the absolute fecundity (F_a)-body length (l.c.) relationship. A parabolic nature of this relationship proves the increase in fecundity to exceed the length growth. A similar, exponential relationship between the absolute fecundity and body length was found for bream (Białokoz, 1973; Brylińska, 1967), roach (Białokoz, 1973; Załachowski, 1961), herring (Baxter, 1958), flounder (Bagenal, 1967), pikeperch (Terlecki, 1976), and pike (Białokoz, 1973; Terlecki, 1973).

The exponential function in Fig. 2 approximates a straight line with some deviations at

Table 1

Mean absolute fecundity (Fa), relative fecundity (Fr), total body weight (W), gutted weight (Wo), ovary weight (O), egg diameter (E), and age (A) of the Lake Patryki tench by length classes ($lc_1 - lc_n$)

($lc_1 - lc_n$)	n	Fa	Fr	W	Wo	O	E	A
22.1–24.0	1	29.2	97.6	340	299	29	0.63	5
24.1–26.0	1	98.1	272.4	440	360	50	0.65	5
26.1–28.0	0							
28.1–30.0	9	131.2	240.8	686.6	557	83.8	0.64	5.8
30.1–32.0	12	35.5*	77.5*	92.5*	69.7*	20.6*	0.08*	6.1
		179.6	279.0	818.3	651.8	112.9	0.72	
32.1–34.0	16	59.4*	100.0*	83.5*	62.3*	33.9*	0.06*	6.7
		186.5	242.6	957.8	774.1	124.7	0.72	
34.1–36.0	3	58.6*	66.8*	91.5*	70.9*	35.4*	0.06*	6.6
		199.5	254.1	979	810	128.3	0.70	
36.1–38.0	1	292.5	275.9	1360	1060	205.0	0.75	8
22.1–38.0	43	29.2–292.5	97.6–467.8	340–1360	299–1060	29–205	0.55–0.84	5–8

* standard deviation

Table 2

Product-moment correlation coefficients (r) for relationships between absolute fecundity (Fa) as well as relative fecundity (Fr) and body length (Lc.), total weight (W), gutted weight (Wo), ovary weight (O), egg diameter (E), and age (A)

	Fa	Fr.	Lc.	W	Wo	O	E	A
Fa		0.818	0.562	0.642	0.518	0.772	0.471	0.407
Fr	0.843		0.102**	0.121**	0.027**	0.486	0.368*	0.018**
Lc.	0.654	0.188**		0.907	0.919	0.610	0.211**	0.724
W	0.701	0.213**	0.934		0.974	0.720	0.386*	0.739
Wo	0.604	0.080**	0.933	0.983		0.578	0.279**	0.745
O	0.803	0.560	0.680	0.767	0.658		0.570	0.547
E	0.441	0.349*	0.219**	0.392*	0.301**	0.612		0.193**
A	0.431	0.047**	0.717	0.715	0.729	0.549	0.196**	

* correlation insignificant at $\alpha = 0.01$

$r_{0.01} = 0.400$

$n = 43$

** correlation insignificant at $\alpha = 0.05$

$r_{0.05} = 0.310$

Fig. 1. Absolute fecundity (Fa) – body length (Lc) relationship. Regression line plotted from equation in Table 3:
 $a - y = ax + b$; $b - \log y = a \log x + \log b$

Fig. 2. Absolute fecundity (Fa) – body weight (W) relationship. Symbols used as in Fig. 1.

Fig. 3. Absolute fecundity (Fa) – ovary weight (O) relationship. Symbols used in Fig. 1.

Fig. 4. Absolute fecundity (Fa) – egg diameter (E) relationship. Symbols used as in Fig. 1.

Table 3

Regression equation expressing relationships between absolute fecundity (Fa) and body length (Lc.), total weight (W), ovary weight (O), egg diameter (E), and age (A) as well as between relative fecundity (Fr) and ovary weight (O) and egg diameter (E) for tench females.

The coefficients calculated from both raw and log-transformed data

Regression equations for raw data	Coefficients		Regression equations for log-transformed data	Coefficients	
	a	b		a	log b
$Fa = a lc \pm b$	13 613.268	– 256 637.977	$Fa = a \log lc \pm \log b$	3.323	+ 0.229
$Fa = a W \pm b$	216.690	– 12 748.830	$Fa = a \log W \pm \log b$	1.252	+ 1.547
$Fa = a O \pm b$	1 183.741	+ 39 269.246	$Fa = a \log O \pm \log b$	0.869	+ 3.447
$Fa = a E \pm b$	436 489.972	– 139 215.880	$Fa = a \log E \pm \log b$	1.970	+ 5.494
$Fa = a A \pm b$	37 895.428	– 68 137.325	$Fa = a \log A \pm \log b$	1.763	+ 3.791
$Fr = a O \pm b$	0.979	+ 141.671	$Fr = a \log O \pm \log b$	0.485	+ 1.398
$Fr = a E \pm b$	447.578	– 67.394	$Fr = a \log E \pm \log b$	1.246	+ 2.561

the beginning and at the terminal phase. It is therefore acceptable, when presenting the absolute fecundity (F_a)-body weight (W) relationship in tench, to use a linear function and state that the absolute fecundity is proportional to fish body weight. Similarly, a rectilinear nature of this relationship was found in tench (Brylińska et al., 1979), bream (Bagenal, 1967; Brylińska, 1967), roach (Załachowski, 1961), pikeperch (Terlecki, 1976), herring (Baxter, 1958), and pike (Terlecki, 1973).

The exponential functions presented in Figs. 3, 4, and 5 are also approximating a straight line, which indicates a uniform increase of the absolute fecundity with ovary weight, egg size, and age in the tench population studied. The literature contains a variety of opinions on relationships between F_a and the individual characters mentioned. Thus Bagenal (1957) and Pitt (1964) maintain that F_a is exponentially dependent on gonad weight. Similarly, Terlecki (1976) found an exponential nature of the absolute fecundity-ovary weight relationship in pikeperch, while Oosthuizen and Daen (1974) used a linear function to describe the F_a -O relationship.

Most studies have neglected the absolute fecundity-egg size relationship. Terlecki (1976) who examined several pikeperch populations found insignificant correlation coefficients for this relationship. When studying the Atlantic salmon fecundity, Pope et al. (after Bagenal, 1957) found those individuals of a higher fecundity to lay larger eggs. In his review of the pertinent literature Bagenal (1967) maintains that there is a negative correlations between the fecundity and egg size. Bartel (1971) examined the rainbow trout egg size distribution and found no association between egg diameter and absolute

Fig. 5. Absolute fecundity (F_a) – age (A) relationship. Symbols used as in Fig. 1

Table 4

The best sub-sets of variables in multiple regression equations ($y = a + bx_1 + cx_2 + dx_3 + ex_4 + fx_5 + gx_6$)
for relationships between fecundity (Fa and Fr) and body length (Lc.), total weight (W),
gutted weight (Wo), ovary weight (O), egg diameter (E) and age (A)

Dependent variables y = fecundity	Free term a	Independent variables						Determination coefficient R^2 %
		b(Lc) x_1	c(W) x_2	d(Wo) x_3	e(O) x_4	f(E) x_5	g(A) x_6	
Fa	1	+ 12 155.56		+ 910.1885	- 896.0337			64.0070
	2		0.5428			0.9612	0.9566	
Fr	1	+ 248.9783		+ 1.279066	- 1.583303			42.6405
	2		0.5195			0.0766	0.8671	

1 - multiple regression coefficients

2 - partial test levels

values of T statistics		W	Wo
	for Fa	6.4298	5.0293
	for Fr	5.4483	5.3586

tabulated value of T = 2.02

fecundity. Zotina and Zotin (1967) hold the opinion that the relative fecundity should be used to analyse the fecundity-egg size relationship rather than the absolute fecundity.

Most authors are of the opinion that the absolute fecundity increases linearly with age (Bagenal, 1967; Brylińska, 1971; Terlecki, 1976). It was only Pitt (1964) and Achmedi (1974) who showed this increase to be curvilinear in rough dab and pikeperch, respectively.

The multiple regression analysis performed (Table 4) shows that the absolute fecundity of tench can be best described by two characters: the total body weight (W) and gutted weight (W_o). These characters determine the absolute fecundity in 64.01% (R^2). All the characters used in the multiple regression equation tend to determine the absolute fecundity in 66.32%. If we exclude from the equation, one by one, the following: ovary weight, egg diameter, and age, no change in R^2 will be noticeable. The body length is the character to be excluded last; its inclusion in the equation would increase the accuracy of the absolute fecundity determination by 1.93%.

The characters excluded, taken together, exert no significant effect on the absolute fecundity of the tench population studied. Having performed multiple regression analyses for 12 tench populations Brylińska et al. (1979) found the body weight (W) to be a key character for the Fa in two populations, and the ovary weight (O) to be decisive in two populations as well. Most often, however, the absolute fecundity was determined by two characters combined: ovary weight + body length (3 populations), ovary weight + body weight (2 populations), and egg diameter + body weight (1 population). Terlecki (1976) found the body size (mainly weight) to be decisive in determining the absolute fecundity of pikeperch females. Bagenal (1957) maintains that the absolute fecundity is best assessed by a multiple regression equation incorporating body and ovary weights together. Similarly, Oosthuizen and Daen (1974) are of the opinion that the fecundity assessment is more accurate when ovary weight is incorporated in the equation.

Relative fecundity

The Lake Patryki tench relative fecundity was found to range within 97,600–467,800 eggs per 1000 g body weight (Table 1). The correlation coefficients (r) calculated (Table 2) indicate a lack of any straightforward relationship between the relative fecundity (Fr) and body length, weight, and age (correlation coefficients are statistically insignificant). The only significant correlations at $\alpha = 0.05$ were found for the relative fecundity-ovary weight ($r = 0.560$) and -egg diameter ($r = 0.349$).

After studying 12 tench populations, Brylińska et al. (1979) found, similarly to the Lake Patryki tench, significant correlations between the relative fecundity and ovary weight and egg diameter in as many as five populations; in four populations the relative fecundity proved significantly related to body weight and length, and in three – to age. The straightforward relationships found in tench population studied are shown in Figs. 6

Fig. 6. Relative fecundity (Fr) – ovary weight (O) relationship. Symbols used as in Fig. 1

Fig. 7. Relative fecundity (Fr) – egg diameter (E) relationship. Symbols used as in Fig. 1

Table 5

Absolute fecundity (Fa) and relative fecundity (Fr) of tench in various water bodies

Water body	Authority	n	Fa	Fr	l.c.	W
Lower Dniepr Western Siberia lakes	Syrovotskaja, 1927	6	276.0–821.0		30.5–46.0	532.0–1645.0
Lake Górzyńskie	Monic, 1953	35	16.7–291.8	216.8– 466.0		210.5– 873.0
Goczałkowice Reservoir	Kaj et al., 1964	83	22.2–357.1	120.1– 518.4	19.0–42.5	120.0– 850.0
Byelorussian waters	Skóra, 1964		37.7–285.9		27.0–35.0	400.0–1000.0
Danube Delta	Žukov, 1965	13	42.3–594.0	139.0–885.0	18.3–33.0	209.0– 927.0
Danube Delta	Moroz, 1968	70	25.8–351.2		14.0–29.5	83.0– 675.0
Dnieper, Kiev Dam Reservoir	Papadopol, Weinberger, 1971	36	144.0–836.0	346.0–1113.0	22.3–36.0	350.0–1100.0
Lakes of Masurian and		7	38.3–182.0		24.5–30.7	380.0– 792.0
Chełm-Dobrzyń Lake	Zubenko, 1973	108	41.6–710.4		20.6–40.8	251.0–1850.0
Districts	Brylińska et al., 1979	753	8.3–1241.2	54.7–1896.7	14.1–56.0	79.0–2300.0
Lake Patryki	present study	43	29.2– 292.5	97.6– 467.8	22.3–37.2	340.0–1360.0

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and 7. The graphs are plotted from the regression equations in Table 3. The relative fecundity-ovary weight regression line, plotted from the log-transformed exponential function, is a parabola, slightly concave and increasing, which means that relative fecundity increments are decreasing with increasing ovary weight. Similar trends were found by Terlecki (1976) in pikeperch from lakes Wielimie and Omulew.

The relative fecundity-egg diameter relationship in the Lake Patryki tench is rectilinear and increasing. In pikeperch (Terlecki, 1976), the product-moment correlation coefficients were negative, and significant only in the Lake Wielimie, in which case the graph plotted resembled a concave and decreasing parabola (females of a larger fecundity produced smaller eggs). Zotin (1968) as well as Brylińska and Bryliński (1973) maintain that environmental conditions influence the fish relative fecundity through body weight and length growth rates.

As shown by the multiple regression analysis (Table 4), the Lake Patryki tench relative fecundity is best determined by the whole and gutted body weights (W and W_o , respectively), the two characters explaining 42.6% of the relative fecundity variability. Another character which – when incorporated into the regression equation – improves the accuracy of the relative fecundity estimate by 7.5% is the ovary weight. There is thus a clearly marked influence of body weight (W and W_o), ovary weight included, on the relative fecundity level. Similarly, Brylińska et al. (1979) reported the effects of the ovary weight associated with the total body weight in 6 out of 12 tench populations studied. Terlecki (1976) found the ovary weight to be decisive for the pikeperch relative fecundity.

When the absolute and relative fecundity values obtained in this study are compared with the literature data (Table 5), the Lake Patryki tench fecundity appears as a low one and similar to that shown by tench populations from the western Siberia (Monič, 1953), Górzyn Lake District, Poland (Kaj et al., 1964), and the Goczałkowice Reservoir (Skóra, 1964).

CONCLUSIONS

1. The Lake Patryki tench of length and weight ranging within 22.3–37.2 cm and 340–1360 g, respectively, has the absolute fecundity varying from 29,200–292,500 eggs.
2. The absolute fecundity was found to form statistically significant, straightforward relationships with the following individual characters tested (listed in order of significance): ovary weight, total body weight, body length, egg diameter, and age.
3. The relative fecundity of the tench population examined ranged from 97,600 to 467,800 eggs per 1000 g female body weight.
4. There are no straightforward relationships between the relative fecundity on one hand, and total body weight, length, and age on the other. The statistical significance was revealed only for the relative fecundity-ovary weight and egg diameter relationships.

5. The total body weight as well as the gutted weight determined the absolute and relative fecundity levels.
6. The Lake Patryki tench population fecundity is considered low.

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Elżbieta Pimpicka

PŁODNOŚĆ LINA *TINCA TINCA* L. Z JEZIORA PATRYKI

Streszczenie

Materiał do badań pobrano z jeziora Patryki (jeziora Mazurskie). 43 samicom lina zmierzono długość ciała (l.c.), zważono ciężar ciała przed (W) i po wypatroszeniu (Wo), określono ciężar jajnika

(O) i wiek (A). Jajniki konserwowano w 4% formalinie. Na mokro mierzono średnicę (E) 100 jaj, następnie metodą wagową na sucho określono płodność absolutną (Fa) w tys. jaj oraz ze wzoru $Fr = Fa : Wo$ obliczono płodność względną (Fr) w 1000 jaj na 1000 g ciężaru ciała.

Rozpatrzono związki między Fa i Fr potraktowanymi jako zmienne zależne w stosunku do l.c., W, Wo, E, A jako zmiennymi niezależnymi i przeanalizowano istotność współczynników korelacji prostej (r) na liczbach całkowitych i ich logarytmach (Tab. 2). Określono równania regresji dla związków Fa z l.c., W, O, E, A oraz Fr z O i E i umieszczono w tabeli 3.

Płodność absolutna (Fa) badanej populacji lina wahała się od 29,2 do 292,5 tys. jaj, a płodność względną (Fr) 97,6–468,8 tys. jaj na 1000 g ciężaru ciała przy długości ciała (l.c.) 22,1–38,0, ciężarze całkowitym ciała (W) 340–1360 g, ciężarze ciała po wypatroszeniu (Wo) 299–1060 g, ciężarze jajnika (O) 29–205 g, średnicy jaj (E) 0,55–0,94 oraz wieku 5–8 lat (Tab. 1).

Obliczone współczynniki korelacji prostej r (Tab. 2) wskazują, że w badanej populacji lina najściślej jest związek płodności absolutnej (Fa) z ciężarem jajnika (O), ciężarem ciała (W), długością ciała (l.c.) a najmniej ściśła zależność ze średnicą jaj (E) i wiekiem (A), brak natomiast związków prostych między płodnością względną (Fr) a ciężarem i długością ciała oraz wiekiem, istnieje jedynie zależność Fr od ciężaru jajnika (O) i średnicy jaj (E). Badane zależności przedstawiono na rys. 1–7. Większość z nich ma charakter prostoliniowy (rys. 2–5, 7), a jedynie zależność Fa – l.c. oraz Fr – O ma przebieg krzywoliniowy.

Analiza regresji wielokrotnej wykazała, że w zespołowym oddziaływaniu badanych cech osobniczych dla określenia płodności lina wystarczy znajomość 2 cech: ciężaru całkowitego ciała (W) i ciężaru ciała po wypatroszeniu (Wo) (Tab. 4). Cechy te w przypadku płodności absolutnej określają 64,01% dla płodności względnej 42,64% zmienności.

Porównano uzyskane wyniki z danymi z literatury (Tab. 5), co pozwala stwierdzić, że płodność badanej populacji lina jest niska i kształtuje się podobnie jak z jezior Gorzyńskich (Kaj i wsp., 1964), z jezior zachodniej Syberii (Monič, 1953) oraz ze zbiornika Goczałkowickiego (Skóra, 1964).

Э. Пимпицка

ПЛОДОВИТОСТЬ ЛИНЯ (*Tinca tinca* L.) ИЗ ОЗЕРА ПАТРЫКИ

Р е з ю м е

Материал для исследования взяли из озера Патрыки (одно из Мазурских озер). 43 самкам линя измерили длину тела (l.c.), взвесили их перед (W) и после потрошения (Wo), определили вес яичника (O) а также возраст (A). Гонады держали в 4% формалине, во влаге измеряли диаметр (E) 100 яиц а потом весовым методом (после высушения) (9) определяли абсолютную плодовитость (Fa) в тысячах яиц, высчитывали относительную плодовитость (Fr) (из формулы $Fr = Fa : Wo$) в 1000 яиц на 1000 г веса тела. Рассматривали связь между Fa и Fr к которым относились как переменным зависимым по отношению к l.c., W, Wo, E, A – как к переменным независимым и проанализировали существенность коэффициентов прямой корреляции (r) на целых числах и их логарифмах (таб. 2). Определили уравнение регрессии для связи Fa с l.c., W, O, E, A а также Fr с O и E. Результаты даны в таб. 3.

Абсолютная плодовитость (Fa) исследованной популяции линя колебалась от 29,2 до 292,5 тыс. яиц, а относительная плодовитость (Fr) 97,6–467,8 тыс. яиц на 1000 г веса тела при длине тела (l.c.) 22,1–38,0 см, общим ве-

се тела (W) 340–1360 г, весе тела после потрошения (W_0) 299–1060 г, весе гонад (G) 29–205 г, диаметре яиц (E) = 0,55–0,84 и возрасте 5–8 лет (таб.1). Подсчитаны коэффициенты прямой корреляции r (таб.2) показывают, что в исследованной популяции линия наиболее тесная связь происходит между абсолютной плодовитостью (F_a) весом яичника (G): весом тела (W): длиной тела (л.с.), наименее тесная зависимость абсолютной плодовитости с диаметром яиц (E) и возрастом (A). Нет прямых связей между относительной плодовитостью (F_r) и весом, длиной тела, а также возрастом, существует только зависимость F_r от веса яичника (G) и диаметра яиц (E). Исследования зависимости представлены на рис.1–7.

Большинство из них имеет прямолинейный ход (рис.2–5,7) и только зависимость F_a –л.с. а также F_r – G имеет криволинейный ход. Анализ регрессии многократно показал что при коллективном воздействии исследованных индивидуальных черт для определения плодовитости линия достаточно знать 2 черты: общий вес тела (W) и вес тела после потрошения (W_0) (таб.4). Черты эти определяют для абсолютной плодовитости 64,01% изменчивости, для относительной плодовитости 42,64% изменчивости. Полученные результаты сравнивали с данными из литературы (таб.5). Сравнение дает основание судить, что плодовитость исследованной популяции линия является небольшой и определяется на уровне популяции из Гожинских озер (Kaj et al., 1964) из озер западной Сибири (Monie, 1953) а также популяции из Гочалковского водохранилища (Skóra, 1964).

Received: 7 VII 1980

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