Arch. Ryb. Pol.	Archives of Polish Fisheries	Vol. 8	Fasc. 2	225-232	2000

FECUNDITY OF RIVER LAMPREY *LAMPETRA FLUVIATILIS* (L.) IN DRWĘCA RIVER (VISTULA BASIN, NORTHERN POLAND)

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ABSTRACT. Fecundity of river lamprey (*L. fluviatilis*) of autumn and spring run to Drwęca River was studied. The population showed very high fecundity (23460-52072 eggs) related to large individual size of Drwęca lampreys, bigger than in other European rivers. No statistically significant differences were observed between autumn and spring run.

Key words: POLAND, DRWĘCA RIVER, RIVER LAMPREY, FECUNDITY, AUTUMN AND SPRING RUN

INTRODUCTION

Density of river lamprey in Polish rivers is low, which results from considerable environmental pollution, overfishing, and river damming that stop the lampreys on their way to the spawning grounds (Witkowski 1992, 1995). The lampreys are present in northern Poland only, most sites being located in lower Vistula basin, and in some Pomeranian rivers (Witkowski 1996 a, b).

Evaluation of Drwęca lamprey fecundity was undertaken for two reasons: the species became endangered (Witkowski et al. 1999), and no such data have been available for Polish lamprey populations. The information on river lamprey fecundity in other European rivers is scarce (Hardisty 1986).

MATERIAL AND METHODS

River lampreys from the collection of the Wrocław University Museum of Natural History were used for the study. The animals were collected during autumn (Nov. 16, 1992), and spring (Feb. 26-28, 1993) spawning run in the fish pass in Drwęca river (left tributary of the Vistula), near Lubicz (Kuszewski, Witkowski 1995, Witkowski, Kuszewski 1995). The lampreys were preserved in 4% formaldehyde solution. Total number of 10 females of autumn run, and 16 females of spring run were studied.

Total length (*Tl*) of the individuals was measured with 0.1 mm accuracy, and the mass (*M*) with 1 g accuracy. The ovaries were weighed with 1 mg accuracy (*Mgon*). Absolute fecundity (*Fa*), as the number of eggs in the ovary, was estimated from the samples taken from the anterior, central, and posterior parts of the ovary. The eggs were weighed with 1 mg accuracy, and counted. Then, the mass of individual egg was calculated (*Mj*) for each female. The eggs were measured using the eypiece micrometer (with 1 µm accuracy): long (*Sd*), and short (*Sk*) axis of the egg, for the eggs in each part of the ovary. Relative fecundity (Fr) was calculated by dividing total number of eggs per individual by the body mass.

The results were showed as means (x) and standard deviations (SD), and subjected to statistical analysis (ANOVA) to evaluate significance of differences, assuming p=0.05.

RESULTS

ABSOLUTE FECUNDITY (*FA*)

Average fecundity of autumn run females was 36868 eggs. The lowest number of eggs (26530) was found in a female 446.5 mm long, and the highest (52072) in a female of body length 417.9 mm. Average fecundity of the females of spring run was 37177 eggs. Lowest number of eggs (23460) was observed in a 438.9 mm long female, and the highest – in an 462.8 mm long individual (Table 1). Average fecundity of autumn and spring run lampreys did not significantly differ (p=0.27).

TABLE 1

Total body length (*Tl* in mm), body mass (*M* in g), gonad mass (*Mgon* in g), the mass of egg (*Mj* in mg), absolute fecundity (*Fa*), relative fecundity (*Fr*), the length of long (*Sd*), and short (*Sk*) axis of the egg (in mm) of river lamprey females from Drwęca River.

Parameter	Autumn (n=10)		Spring (n=16)	
	x (min-max)	SD	x (min-max)	SD
Tl	432.02 (385.0-460.5)	14.71	405.76 (336.6-462.0)	31.22
M	129.0 (110.0-186.0)	26.87	135.94 (87.0-191.0)	30.01
Mgon	13.75 (11.00-16.50)	3.88	15.58 (11.58-21.15)	2.41
Mj	0.355 (0.250-0.546)	0.081	0.424 (0.336-0.539)	0.056
Fa	36 868 (26 530-52 072)	8640	37 177 (23 460-49 479)	6721
Fr	264.78 (161.76-333.79)	46.56	283.03 (151.35-417.51)	65.47
Sd	0.873 (0.795-0.970)	0.060	0.961 (0.878-1.016)	0.038
Sk	0.730 (0.660-0.791)	0.045	0.803 (0.733-0.856)	0.039

EGG MASS (*MJ*)

Average egg weight of spring run individuals was 0.424 mg, and of autumn run ones 0.355 mg. The analysis of variance revealed significant difference ($p=0.02$).

Average weight of the eggs from anterior, central, and posterior part of the ovary of spring run females were: 0.409 mg, 0.399 mg, and 0.484 mg, respectively. The analysis of variance showed that posterior part eggs were significantly havier than the eggs from anterior and central part of the ovary, at $p=0.01$ and $p<0.01$ respectively.

In the females of autumn run, average mass of the egg from anterior part of gonad was 0.370 mg, from central part – 0.340 mg, and from posterior part – 0.352, and no statistically significant differences occurred ($p=0.73$).

The comparison of the mass of eggs from various parts of gonad between autumn and spring run females revealed that only posterior part eggs of spring run females were significantly heavier than all eggs of autumn run individuals (in all cases $p<0.01$).

EGG DIAMETER

LONG AXIS (*SD*)

Average length of long axis of the egg of spring run females was 0.961 mm, while that of autumn run ones was significantly ($p<0.01$) shorter (0.873 mm).

No significant differences were observed among the eggs from various part of the ovary, for females of the same run ($p=0.84$ for spring, $p=0.96$ for autumn).

Long axes of the eggs of all parts of ovary were significantly longer in the spring run females comparing to the autumn ones (average $p=0.01$).

SHORT AXIS (*SK*)

Average length of short axis of the egg of spring run individuals was 0.803 mm, comparing to the autumn run – 0.730 mm. The diffrence was significant at $p<0.01$.

Comparison of short axes of the eggs from various parts of gonad revealed no differences for any run ($p=0.79$ for spring, and $p=0.32$ for autumn run).

The analysis of variance showed, however, that short axes of the eggs from all parts of the ovary were significantly longer in spring run females, comparing to autumn run ones (average $p=0.02$).

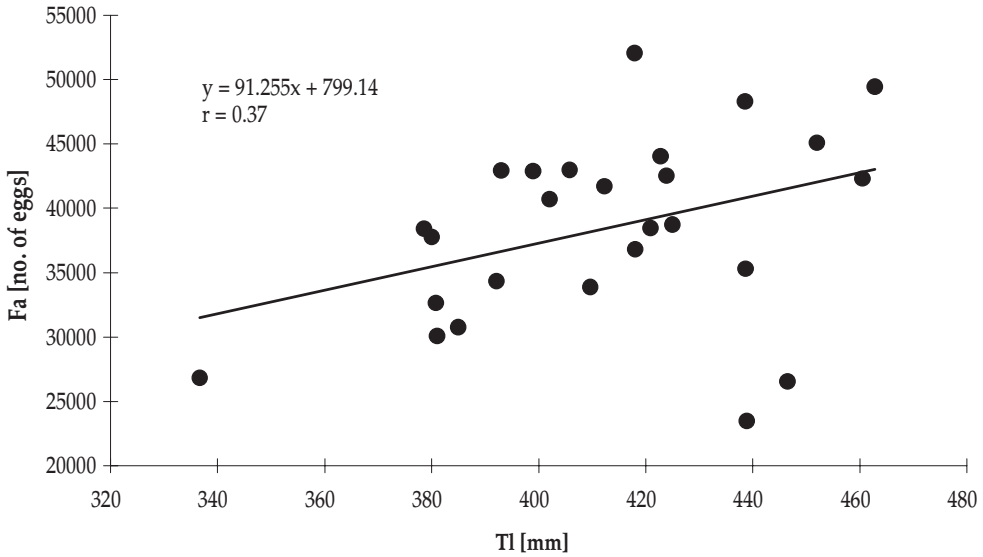

Fig. 1. Relationship between absolute fecundity (*Fa*) and total body length (*Tl*) of the river lamprey females of Drwęca River

RELATIONSHIP BETWEEN TOTAL BODY LENGTH (*TL*), AND FECUNDITY

Relationship between absolute fecundity (*Fa*) and total length (*Tl*) for spring and autumn run females did not significantly differ (p=0.53). Thus, the data were merged, and the relationship between *Tl* and *Fa* for both breeding seasons is shown in Fig. 1. Correlation coefficient r=0.37 shows that *Fa* depends weakly on *Tl*.

The relationship between the mass of ovary (*Mgon*) and total length (*Tl*) is shown in Fig. 2. Correlation is weak for both, spring and autumn runs (r=0.51, and r=0.56 respectively).

In Fig. 3 the relationship between total length (*Tl*) and long axis of the egg (*Sd*) is shown. Correlation coefficient is slightly higher for spring run females (r=0.59) than for autumn run individuals (0.53).

Correlation between the length of short axis of the egg (*Sk*) and total body length (*Tl*) is weak (r=0.40) (Fig. 4).

DISCUSSION

The data on lamprey fecundity are scarce. According to Rolik and Rembiszewski (1987), lampreys in Poland lay from 27500 to 38500 eggs (on average 33875). Jokiel

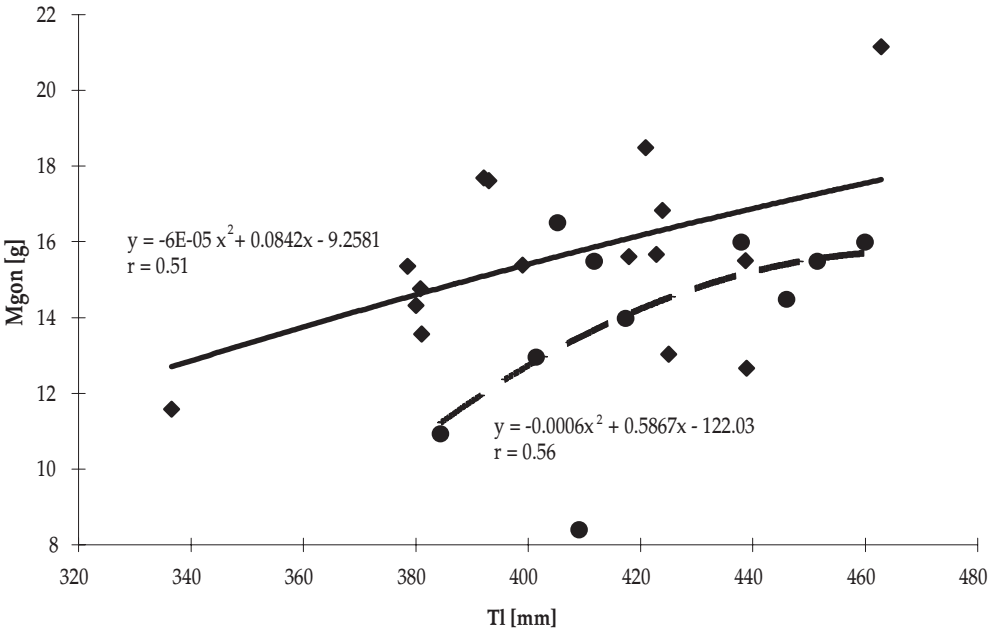

Fig. 2. Relationship between gonad mass (*Mgon*) and total body length (*Tl*) of the river lamprey females of Drwęca River of autumn (circles) and spring (squares) spawning run.

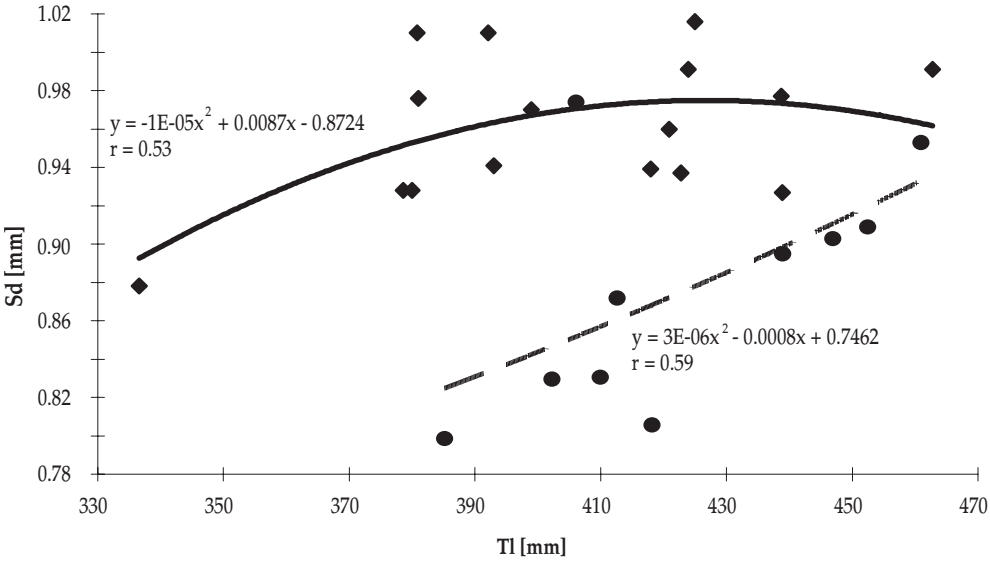

Fig. 3. Relationship between long axis of the egg (*Sd*) and total body length (*Tl*) of the river lamprey females of Drwęca River of autumn (circles) and spring (squares) spawning run.

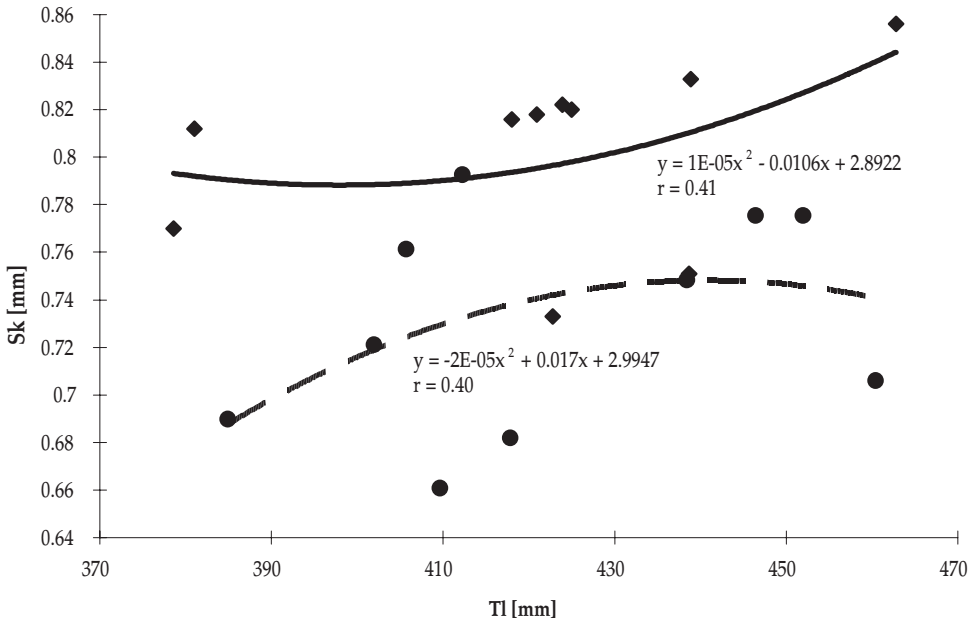

Fig. 4. Relationship between short axis of the egg (*Sk*) and total body length (*Tl*) of the river lamprey females of Drwęca River of autumn (circles) and spring (squares) spawning run.

(1964) reported that fecundity of river lamprey from the Vistula River was high, the females of 95 g producing about 30000 eggs of 0.4 mg. Similar egg mass was obtained for the Drwęca River lampreys of spring run, but average absolute fecundity (of both runs) was considerably higher.

The data on fecundity of river lamprey from other parts of Europe are available for just a few populations. In the lampreys of the Severn and Trent rivers number of eggs ranged from 7500 to 28000, and from 26000 to 41000 (Hardisty 1986). The females of the Neva River produced from 4000 to 40000 eggs, and lampreys from the Rhine from 24000 to 42500. The fecundity of *precox* form (of smaller body size) from Finnish Bay ranged from 650 to 10000 eggs. Similarly low fecundity was shown by *ladogensis* form from Ladoga Lake (10000-16000 eggs) (Ivanova-Berg 1933, 1966).

Comparison of absolute fecundity of river lamprey from the Drwęca and other European rivers revealed much higher fecundity of the Drwęca population. That was probably related to the largest body size (Bartel et al. 2000).

Ivanova-Berg (1933) observed that number of eggs produced by *L. fluviatilis* increased with body size of the females. The fish of 180 and 400 mm (*Tl*) layed 5243,

and 29762 eggs respectively. The data obtained for the Drwęca River lampreys showed that mass of gonads increased with female body size, and that the increase of gonads was related to the increase of egg diameter (mainly of long axis).

The data concerning fecundity are rarely accompanied by the egg size. Ivanova-Berg (1933) and Ryapolova (1972) reported that the length of short egg axis ranged from 0.52 to 0.88 mm, and the length of long axis from 0.56 to 1.03 mm. Short axis lenght of the Drwęca River lampreys ranged from 0.730 to 0.803 mm, and the lenght of long axis from 0.873 to 0.961 mm. Comparison of these data shows that minimum values for both, short and long axes were higher in the Drwęca lamprey population. The eggs of *precox* form are considerably smaller. The length of short axis ranged from 0.47 to 0.65 mm, and that of long axis from 0.52 to 0.72 mm (Ivanova-Berg 1933).

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STRESZCZENIE

PŁODNOŚĆ MINOGA RZECZNEGO *LAMPETRA FLUVIATILIS* (L.) Z RZEKI DRWĘCY

Zbadano płodność minoga rzecznego (*L. fluviatilis*) - 26 osobników - wstępujących do rzeki Drwęcy w okresie jesiennym (listopad) i wiosennym(wiosna). Badana populacja charakteryzuje się bardzo wysoką płodnością, co prawdopodobnie związane jest z tym, że minogi z Drwęcy osiągają największe rozmiary w obrębie tego gatunku. Płodność osobników z jesiennego ciągu tarłowego wynosiła 26 530-52 074 (średnio 36 868), a z wiosennego 23 460-49479 (średnio 37 177) jaj. Nie odnotowano istotnych statystycznie różnic w płodności pomiędzy osobnikami wstępującymi do Drwęcy w obu porach roku. Ponadto stwierdzono, że u samic z ciągu tarłowego wiosennego wzrost średnicy długiej jaj postępuje wraz ze wzrostem długości całkowitej osobników. Wzrost masy gonady postępujący wraz ze wzrostem długości ciała osobnika, wynika ze wzrostu wielkości jaj (ich średnicy długiej), natomiast nie ze wzrostu ich liczby w gonadzie.

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