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Fish biology

MORPHOMETRICS OF THE AUTUMN SPRING RUN POPULATIONS OF THE RIVER LAMPREY, *LAMPETRA FLUVIATILIS* (LINNAEUS, 1758) FROM THE POLISH RIVERS

MORFOMETRIA MIGRUJĄCYCH JESIENNYCH I WIOSENNYCH POPULACJI MINOGA RZECZNEGO *LAMPETRA FLUVIATILIS* (LINNAEUS, 1758) Z RZEK POLSKI

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The plastic and meristic characters of the river lamprey were studied in 145 specimens of the autumn and spring run populations from the north-Polish rivers (the Grabowa, Drwęca, Wda, Parsęta). Among the examined lamprey populations entering the Polish rivers in autumn no essential differences in body proportions are observed. In comparison with autumn populations, the lampreys that start their spawning migration as late as spring differ more considerably with respect to body proportions. Besides, they are characterized by more marked sexual dimorphism, which can be related to more advanced development of gonads.

INTRODUCTION

The river lamprey, *Lampetra fluviatilis* (L.) is one of four species representing the Petromyzontiformes in the Polish inland and sea waters. Due to the gradually proceeding degradation of water environment (pollution, hydrotechnical constructions), further existence of this group of vertebrates is severely endangered, three species having already been entered in the Polish Red Data Book of Animals [Głowaciński 1992]. Anadromous *L.fluviatilis* is particularly threatened with extinction as in many rivers the species' access to the spawning grounds situated in their upper course has been shut off. The excessive fishing exploitation of the river lamprey in earlier periods was another factor contributing to the substantial reduction in its population [Witkowski 1992a]. At present the occurrence of this species in Poland is restricted to a northern part of this country, where lampreys are found merely in a few coastal rivers and in the lower course of the Vistula [Witkowski 1992b].

Considering the above mentioned reasons and the fact that in our literature detailed data on the river lamprey's biometry (except for several characters discussed in a monograph by Rolik, Rembiszewski 1987), morphology, inter-populational variability and sexual dimorphism are lacking, research on this species was developed, based on material from rivers that are still its spawning grounds.

MATERIAL AND METHODS

The paper is based on a random sample of 145 individuals caught in the Drwęca, Grabowa, Parsęta and Wda rivers. The catches were conducted in the fish passes on those rivers during the lamprey spawning run. Data concerning the size, time and place of catches are shown in Table 1 and Figure 1.

Table 1

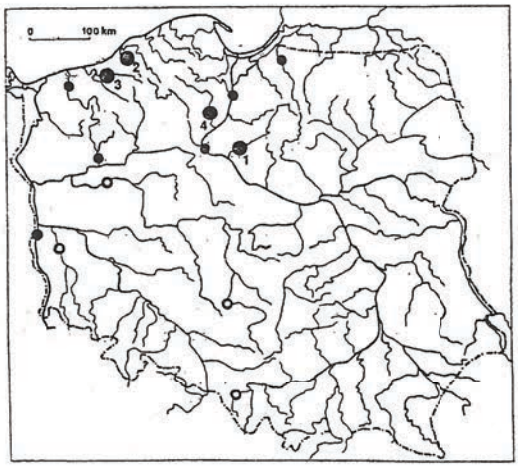
Material of *L.fluviatilis* used for study

River	Locality	Period	Males	Females	Collectors
Drwęca	Lubicz 53°03'N 18°46'E	26-28 II 1992	28	22	Z.Szczepański J.Kuszewski J.Kusznierz
		16 XI 1992	23	14	Z.Szczepański J.Kuszewski
Grabowa	Jeżyczki 54°20'N 16°24'E	12 XI 1991 13 XI 1992	24	26	A.Witkowski B.Kokurewicz J.Kusznierz
Parsęta	Rościno 54°00'N 15°35'E	19 III 1991	3	1	J.Kitlarz
Wda	Świecie 53°25'N 18°26'E	30 XII 1990	2	2	W.Dębicki

The material, preserved in a 4%-formaline solution, is kept in the ichthyological collection of the Wrocław University Natural History Museum.

Measurements of the plastic and counts of the meristic (teeth formulae, number of myomeres) features were carried out basing on the scheme by Hardisty [1987a]. Since the tables make use of abbreviations, below are the entire names of the particular characters.

A. Plastic features: a-C - tail length; B1-B2 - interbranchial opening distance; B1-B7 - bronchial length; B7-a - trunk length; B7-C - postbranchial length; d - disc length; d-a - distance between disc and anus; d-eD1 - distance between disc and posterior end of the first dorsal fin; d-n - prenostril length; d-B1 - prebranchial length; d-D1 - predorsal distance; d-D2 - distance between disc and base of the second dorsal fin; d-O - preocular length; D-D - distance between dorsal fins; D2-C - dorsal part of caudal fin length; hco - head depth; hD1 - first dorsal fin height; hD2 - second dorsal fin height; H - body depth; io - interocular distance; lD1 - first dorsal fin length; lD2 - second dorsal fin length; O - eye length; O-B1 - postocular length; Tl - total length.



Solid circles currently existing localities (the numbers denote the rivers in which material was collected: 1. Drwęca, 2. Grabowa, 3. Parsęta, 4.Wda)
Emty circles localities where L.fluviatilis occurs no more

Fig.1 Distribution of *Lampetra fluviatilis* in Poland (according to Witkowski 1992a, b-slightly modified)

B. Meristic features: AC - anterior teeth (external, No of rows); AC1 - anterior teeth (internal row, No of teeth); End - endolateral teeth (right side, No of peaks on a tooth); Ens - endolateral teeth (left side, No of peaks on a tooth); IO - infraoral lamina (No of peaks on a tooth); MG - marginal teeth (No of rows); SO - supraoral lamina (No of peaks).

The lampreys were measured with the accuracy of 0.1 mm. Sex was determined after opening the abdominal cavity.

The data obtained were statistically analysed. For the examined features mean values (x), standard error (SE) and standard deviation (SD) were calculated. Also an analysis of regression, based on a comparison between plastic characters (expressed as %) and total length (Tl) was performed.

RESULTS

Plastic features

1. Morphological variability

A comparison among plastic features of *L.fluviatilis* from four rivers is given in Table 2. Only the two largest samples, i.e. from the Drwęca (n=87) and Grabowa (n=50) rivers, were analysed. The two remaining ones, from the Parsęta and Wda, were not thoroughly examined due to their small size (n= 4 for each one).

The two populations (Drwęca and Grabowa), studied in the same season (autumn), display strong similarity with respect to a vast majority of plastic characters. Both their variability ranges and mean values approximated to each other. However, the slight differences observed seem worth emphasising. Beside larger dimensions, lampreys from the Drwęca are characterised by higher values of prebranchial, tail and second dorsal fin length.

Table 2

Plastic characters of *Lampetra fluviatilis* from the Polish rivers

River	Drwęca (n=87)			t	Grabowa (n=50)			Parsęta (n=4)			Wda (n=4)		
Character	$\bar{x}$	range	SD		$\bar{x}$	range	SD	$\bar{x}$	range	SD	$\bar{x}$	range	SD
Tl in mm	396.3	336.6 - 462.8	25.95	1.51	388.8	299.7 - 467.3	29.04	352.7	330.0 - 369.0	16.90	350.5	336.0 - 367.0	13.03
in % Tl:													
d-B1	10.4	9.4 - 11.7	0.42	10.00	9.8	9.2 - 10.6	0.29	10.2	9.9 - 10.6	0.31	10.7	10.2 - 11.2	0.42
B1-B7	10.3	9.6 - 11.3	0.36	3.27	10.1	9.3 - 10.8	0.33	10.3	9.8 - 10.7	0.38	10.7	10.3 - 11.1	0.42
B7-a	52.1	49.1 - 55.0	1.19	7.22	53.4	51.9 - 55.2	0.95	52.5	51.6 - 53.0	0.61	53.1	52.0 - 54.3	1.01
B7-C	79.8	78.2 - 80.9	0.60	6.00	80.4	78.6 - 81.6	0.55	79.2	78.4 - 80.0	0.68	78.6	78.1 - 79.6	0.64
a-C	27.6	24.3 - 29.9	1.11	2.32	27.1	24.6 - 32.7	1.27	26.6	25.1 - 28.2	1.30	25.6	24.1 - 27.2	1.39
d-a	72.2	69.9 - 75.7	1.15	3.73	73.0	67.4 - 75.3	1.24	73.0	71.2 - 74.1	1.25	74.3	72.9 - 75.6	1.29
H	6.7	5.7 - 7.6	0.35	3.33	6.9	6.2 - 7.6	0.39	6.0	5.8 - 6.3	0.24	6.3	6.0 - 6.7	0.29
d-D1	49.4	46.1 - 51.9	1.09	2.98	50.0	46.9 - 52.3	1.15	50.3	49.7 - 50.6	0.41	51.3	50.8 - 52.4	0.74
d-eD1	63.4	59.9 - 66.5	1.17	1.99	63.8	61.2 - 66.1	1.12	63.9	63.3 - 64.7	0.64	64.5	63.0 - 66.0	1.52
d-D2	66.4	63.0 - 69.6	1.28	2.37	66.9	64.7 - 69.5	1.13	66.6	65.5 - 67.5	0.93	67.2	65.3 - 68.6	1.64
D2-C	33.5	30.2 - 36.8	1.27	0.94	33.3	30.5 - 35.4	1.15	32.8	31.8 - 33.7	0.90	32.9	31.5 - 34.5	1.53
D-D	3.0	1.3 - 4.4	0.69	0.79	3.1	1.3 - 4.9	0.72	2.7	1.9 - 3.4	0.65	2.7	1.9 - 3.4	0.64
lD1	14.1	12.1 - 16.7	0.87	0.55	14.0	11.4 - 16.8	1.09	13.7	13.1 - 14.2	0.49	13.3	12.3 - 15.0	1.26
hD1	2.9	2.2 - 3.5	0.33	0.00	2.9	2.4 - 3.4	0.25	2.6	2.4 - 2.8	0.23	2.8	2.4 - 3.1	0.25
lD2	24.5	22.2 - 27.4	1.01	2.43	24.1	21.8 - 25.9	0.87	23.2	22.2 - 23.7	0.68	24.4	23.6 - 25.2	0.75
hD2	6.0	5.2 - 6.9	0.39	0.00	6.0	4.9 - 6.8	0.46	5.5	5.1 - 5.8	0.34	5.6	5.3 - 6.0	0.35
d	4.1	3.4 - 4.8	0.34	8.51	4.5	4.0 - 5.0	0.20	4.0	3.9 - 4.2	0.17	4.0	3.9 - 4.1	0.11
d-O	6.8	4.3 - 7.6	0.41	5.45	6.5	5.9 - 7.0	0.24	6.7	6.7 - 6.8	0.06	7.1	6.7 - 7.7	0.44
O	1.6	1.4 - 1.8	0.10	0.00	1.6	1.5 - 1.8	0.09	1.7	1.4 - 1.9	0.08	1.6	1.4 - 1.8	0.12
O-B1	2.7	2.3 - 3.0	0.15	10.00	2.3	1.8 - 2.7	0.25	2.6	2.3 - 2.8	0.25	2.7	2.4 - 2.8	0.17
B1-B2	1.6	1.4 - 1.8	0.09	0.00	1.6	1.5 - 1.7	0.07	1.7	1.6 - 1.8	0.10	1.7	1.5 - 1.8	0.12
hco	4.4	3.9 - 5.2	0.25	4.00	4.6	4.0 - 5.1	0.27	4.3	4.2 - 4.6	0.18	4.0	3.6 - 4.5	0.35
d-n	5.7	5.1 - 6.4	0.28	2.00	5.6	4.8 - 6.1	0.30	5.5	5.3 - 5.7	0.18	5.8	5.6 - 6.1	0.21
io	3.9	3.4 - 4.5	0.22	0.00	3.9	3.4 - 4.4	0.22	3.7	3.6 - 3.8	0.10	3.5	3.3 - 3.6	0.15

While individuals from the Grabowa have greater values of trunk and postbranchial length, distance between disc and anus, predorsal distance, distance between disc and base of the second dorsal fin, and of disc diameter.

2. Differences between autumn and spring "populations"

Only in the Drwęca river two spawning runs, in autumn and spring, are observed. Table 3 presents plastic features of the Drwęca autumn and spring "populations". This comparison shows that there are differences in size between lampreys, both males and females, entering this river in different periods. Total length of individuals of both sexes that migrate into the river in autumn are noticeably higher. Other differences concern a number of body proportions; males have higher values of the following features; trunk length, predorsal distance, distance between disc and base of the second dorsal fin, distance between disc and anus, and body depth.

The prebranchial length as well as the length of tail, dorsal part of caudal fin, first dorsal fin and of disc recorded for males during the spring run are higher than those obtained for autumn populations.

During the autumn run females have higher values of trunk and postbranchial length, distance between disc and anus, predorsal distance, dorsal part of caudal fin and second dorsal fin length. In spring higher values were recorded for the following features: tail length, distance between disc and posterior end of the first dorsal fin, distance between disc and base of the second dorsal fin, first dorsal fin length, height of the first and second dorsal fin, and disc length.

A regression analysis of the plastic characters of the Drwęca autumn and spring "populations" reveals the course and character of the changes in body proportions that *L. fluviatilis* undergoes in these two periods (Tab. 4 and 5).

Those changes, both in the case of lampreys entering the river in autumn and in spring, not always follow a similar course. In males features such as: branchial length, trunk length, distance between disc and anus, body depth, predorsal distance, distance between disc and posterior end of the first dorsal fin, distance between disc and base of the second dorsal fin, disc length, head depth and interocular distance tend to decrease in autumn, whereas in spring an increase in their values is observed which accompanies the increase in total length (Tl). In females a similar phenomenon concerns trunk length, distance between disc and anus, and disc length. The contrary is observed, both in males and females, in the case of tail length and dorsal part of caudal fin length.

In respect of certain features the character of changes in body proportions is similar in the two periods, though particular values are lower or higher. In autumn higher values are recorded for males and females in postbranchial length, in females also in body depth. In spring males markedly higher values of prebranchial and first dorsal fin length, second dorsal fin height and preocular length, whereas females - those of predorsal distance, distance between disc and posterior end of the first dorsal fin, first dorsal fin length, height of the first and second dorsal fin, and preocular length,

The most substantial changes in body proportions in *L. fluviatilis* concern trunk length in females, preocular length in males, and height of both dorsal fins and disc length in both sexes.

3. Sexual dimorphism

In autumn males and females do not differ significantly in body proportions, differences lying mainly in total length. In both populations (Drwęca, Grabowa) females were markedly larger (Tab. 3 and 6) and slightly higher.

Table 3

Plastic characters of autumn and spring population of *Lampetra fluviatilis* from the Drwęca river

Character	Autumn							Spring						
	Males (n=23)			Females (n=14)			t	Males (n=28)			Females (n=22)			t
	$\bar{x}$	range	SD	$\bar{x}$	range	SD		$\bar{x}$	range	SD	$\bar{x}$	range	SD	
Tl in mm	400.9	362.3 - 427.3	14.67	416.0	359.6 - 460.5	27.71	4.14	378.4	341.7 - 410.0	20.00	401.7	336.6 - 462.8	28.32	3.27
in % Tl:														
d-B1	10.3	9.5 - 11.2	0.37	10.3	9.4 - 11.1	0.51	0.00	10.6	10.0 - 11.7	0.37	10.4	9.9 - 11.6	0.40	1.80
B1-B7	10.4	9.9 - 11.0	0.32	10.3	9.8 - 10.8	0.25	0.38	10.3	9.6 - 11.3	0.41	10.4	9.7 - 11.1	0.40	0.86
B7-a	52.3	50.1 - 55.0	1.15	52.7	51.1 - 54.1	0.78	1.29	51.7	49.1 - 54.9	1.31	52.1	49.7 - 53.9	1.17	1.14
B7-C	80.0	79.2 - 80.9	0.51	79.9	78.8 - 80.9	0.63	0.53	79.7	78.5 - 80.7	0.54	79.6	78.2 - 80.8	0.67	0.57
a-C	27.7	25.3 - 29.5	1.04	27.2	25.5 - 29.2	0.94	1.51	27.9	24.3 - 29.9	1.19	27.6	25.4 - 29.8	1.12	0.91
d-a	72.3	70.5 - 74.6	1.08	72.8	70.7 - 74.3	0.93	1.51	72.0	69.9 - 75.7	1.25	72.2	70.1 - 70.4	1.17	0.58
H	6.7	6.3 - 7.3	0.27	6.9	6.4 - 7.5	0.32	1.96	6.5	5.7 - 7.1	0.33	6.8	6.2 - 7.6	0.34	3.14
d-D1	49.5	48.3 - 51.3	0.69	49.9	47.6 - 51.9	1.24	1.11	48.9	46.1 - 51.1	1.12	49.6	47.4 - 51.6	1.09	2.29
d-eD1	63.2	61.9 - 65.2	0.88	63.4	61.7 - 65.4	0.95	0.64	63.0	59.9 - 66.4	1.25	64.0	61.5 - 66.5	1.30	2.75
d-D2	66.2	64.9 - 68.4	0.88	66.4	63.4 - 68.3	1.38	0.48	65.8	63.0 - 69.2	1.34	67.1	64.6 - 69.9	1.26	3.52
D2-C	33.7	31.3 - 35.1	0.87	33.4	31.4 - 36.8	1.38	0.73	34.0	30.8 - 36.5	1.32	32.7	30.2 - 34.4	1.18	3.67
D-D	3.1	1.3 - 4.0	0.63	3.0	1.6 - 4.4	0.88	0.37	2.8	1.8 - 4.0	0.55	3.2	1.5 - 4.3	0.78	2.04
lD1	13.8	12.8 - 15.0	0.57	13.6	21.1 - 15.1	0.86	0.77	14.2	12.5 - 16.0	0.92	14.9	13.1 - 16.7	0.86	2.80
hD1	2.7	2.3 - 3.3	0.29	2.5	2.2 - 2.8	0.18	2.56	3.1	2.7 - 3.5	0.23	3.0	2.6 - 3.5	0.25	1.47
lD2	24.7	22.4 - 25.7	0.76	24.6	22.8 - 27.3	1.24	0.28	24.8	22.8 - 27.4	1.04	24.0	22.2 - 26.0	0.89	2.96
hD2	5.9	5.2 - 6.9	0.38	5.8	5.4 - 6.6	0.34	0.83	6.1	5.5 - 6.7	0.36	6.2	5.3 - 6.8	0.34	1.01
d	3.9	3.5 - 4.3	0.21	3.8	3.4 - 4.1	0.22	1.37	4.4	3.7 - 4.8	0.24	4.2	3.8 - 4.6	0.24	2.90
d-O	6.6	4.3 - 7.6	0.56	6.7	6.2 -	0.41	0.62	6.8	6.0 - 7.2	0.28	6.8	6.3 - 7.5	0.34	0.00
O	1.6	1.4 - 1.9	0.08	1.6	1.3 - 1.8	0.08	0.00	1.7	1.6 - 1.7	0.11	1.7	1.6 - 1.8	0.09	0.00
O-B1	2.7	2.3 - 3.0	0.16	2.7	2.4 - 2.9	0.13	0.00	2.7	2.4 - 3.0	0.15	2.6	2.4 - 2.9	0.15	2.35
B1-B2	1.6	1.4 - 1.8	0.11	1.6	1.5 - 1.7	0.10	0.00	1.6	1.5 - 1.8	0.07	1.6	1.4 - 1.8	0.09	0.00
hco	4.5	4.0 - 5.2	0.28	4.4	4.0 - 4.6	0.22	1.20	4.4	4.0 - 4.7	0.18	4.3	3.9 - 5.0	0.31	1.34
d-n	5.6	5.2 - 6.1	0.23	5.7	5.2 - 6.4	0.37	0.31	5.9	5.5 - 6.3	0.20	5.7	5.1 - 6.4	0.27	2.89
io	3.9	3.5 - 4.2	0.21	3.8	3.4 - 4.1	0.25	1.25	3.9	3.4 - 4.5	0.20	3.8	3.4 - 4.3	0.25	1.54

Table 4

Regression equations and coefficient of correlation for the relationship between total length (Tl in mm) and the particular morphometric characters (in %Tl) in males of *L.fluviatilis* during autumn and spring migration into the Drwęca R.

Character	Autumn		Spring	
	regression	r	regression	r
d-B1	11.782 - 0.0036 Tl	- 0.15	11.377 - 0.0020 Tl	- 0.11
B1-B7	11.954 - 0.0039 Tl	- 0.17	7.515 + 0.0733 Tl	0.36
B7-a	51.940 + 0.0008 Tl	0.01	47.034 + 0.0123 Tl	0.19
B7-C	78.308 + 0.0043 Tl	0.12	78.188 + 0.0039 Tl	0.14
a-C	26.780 + 0.0022 Tl	0.03	34.186 - 0.0165 Tl	0.28
d-a	73.602 - 0.0032 Tl	- 0.04	66.266 + 0.0152 Tl	0.24
H	9.359 - 0.0066 Tl	- 0.35	5.395 + 0.0030 Tl	0.18
d-D1	52.615 - 0.0059 Tl	- 0.17	43.757 + 0.0136 Tl	0.24
d-eD1	71.038 - 0.0196 Tl	- 0.32	60.672 + 0.0062 Tl	0.09
d-D2	68.977 - 0.0068 Tl	- 0.11	60.656 + 0.0137 Tl	0.20
D2-C	31.967 + 0.0044 Tl	0.07	39.567 - 0.0147 Tl	- 0.22
D-D	- 1.498 + 0.0113 Tl	0.26	0.749 + 0.0055 Tl	0.20
lD1	18.490 - 0.0117 Tl	- 0.30	18.330 - 0.0109 Tl	- 0.24
hD1	6.186 - 0.0088 Tl	- 0.45	3.176 - 0.0003 Tl	- 0.02
lD2	26.155 - 0.0037 Tl	- 0.07	32.108 - 0.0193 Tl	- 0.37
hD2	7.976 - 0.0053 Tl	- 0.20	7.509 - 0.0038 Tl	- 0.21
d	4.619 - 0.0019 Tl	- 0.13	3.955 - 0.0011 Tl	- 0.09
d-O	5.838 - 0.0019 Tl	0.05	6.801 + 0.0005 Tl	0.03
O	2.417 - 0.0033 Tl	- 0.39	2.123 - 0.0026 Tl	- 0.33
O-B1	3.357 - 0.0018 Tl	- 0.16	3.482 - 0.0021 Tl	- 0.29
B1-B2	2.572 - 0.0024 Tl	- 0.33	1.609 + 0.0004 Tl	0.01
hco	5.057 - 0.0015 Tl	- 0.08	3.465 + 0.0024 Tl	0.27
d-n	5.557 + 0.0009 Tl	0.05	5.810 + 0.0003 Tl	0.03
io	5.569 - 0.0042 Tl	- 0.29	3.682 + 0.0016 Tl	0.17

The differences between individuals of both sexes observed in spring (3-4 months before the spawning period) are more conspicuous and concern a greater number of features. Apart from what has been mentioned above, females have a longer distance between disc and base of the second dorsal fin, while males are characterised by a longer dorsal part of caudal fin. Sexual dimorphism manifests itself also in the curve of tail, which in males is bent downwards while in females - most often upwards, occasionally being straight.

Table 5

Regression equations and coefficient of correlation for the relationship between total length (Tl in mm) and the particular morphometric characters (in % Tl) in females of *L.fluviatilis* during autumn and spring migration into the Drwęca R.

Character	Autumn		Spring	
	regression	r	regression	r
d-B1	14.233 -.0.0059 Tl	- 0.52	13.150 - 0.0068 Tl	- 0.47
B1-B7	11.313 - 0.0025 Tl	- 0.28	10.819 - 0.0011 Tl	- 0.08
B7-a	55.710 - 0.0072 Tl	- 0.26	48.040 + 0.0100 Tl	0.24
B7-C	78.457 + 0.0035 Tl	0.15	78.277 + 0.0032 Tl	0.14
a-C	23.696 + 0.0083 Tl	0.25	29.722 - 0.0054 Tl	- 0.14
d-a	76.709 - 0.0095 Tl	- 0.28	70.023 + 0.0054 Tl	0.13
H	9.323 - 0.0057 Tl	- 0.49	8.289 - 0.0037 Tl	- 0.30
d-D1	53.645 - 0.0090 Tl	- 0.20	50.748 - 0.0027 Tl	- 0.07
d-eD1	67.693 - 0.0102 Tl	- 0.30	65.487 - 0.0037 Tl	0.08
d-D2	70.747 - 0.0104 Tl	- 0.22	66.665 + 0.0011 Tl	0.02
D2-C	31.608 + 0.0043 Tl	0.09	35.057 - 0.0058 Tl	- 0.14
D-D	3.5077 - 0.0013 Tl	- 0.04	1.943 + 0.0030 Tl	0.11
lD1	14.807 - 0.0029 Tl	- 0.09	14.851 - 0.0002 Tl	- 0.07
hD1	3.007 - 0.0011 Tl	- 0.17	3.824 - 0.0019 Tl	- 0.22
lD2	19.444 + 0.0125 Tl	0.27	23.200 + 0.0019 Tl	0.06
hD2	7.483 - 0.0041 Tl	- 0.34	7.039 - 0.0021 Tl	- 0.17
d	4.801 - 0.0025 Tl	- 0.32	4.093 + 0.0004 Tl	0.04
d-O	8.721 - 0.0037 Tl	- 0.25	8.347 - 0.0038 Tl	- 0.32
O	1.956 - 0.0021 Tl	- 0.31	1.718 - 0.0016 Tl	- 0.27
O-B1	4.023 - 0.0032 Tl	- 0.70	3.434 - 0.0020 Tl	- 0.38
B1-B2	2.371 - 0.0019 Tl	- 0.54	1.770 - 0.0004 Tl	- 0.14
hco	5.047 - 0.0016 Tl	- 0.21	5.924 - 0.0040 Tl	- 0.36
d-n	7.283 - 0.0039 Tl	- 0.28	7.269 - 0.0039 Tl	- 0.14
io	5.091 - 0.0030 Tl	- 0.34	4.825 - 0.0024 Tl	- 0.27

Meristic features

1. Number of myomeres

The number of myomeres in all the studied populations is similar, ranging from 61 to 66 (Tab. 7). The mean calculated for individuals from the Drwęca is 63.9 (SD=1.37); 63.8 (SD=1.05) for males and 63.9 (SD=1.37) for females. Lampreys from the Grabowa have 63.8 (SD=1.29) myomeres an average; males - 63.7 (SD=1.27), females - 63.9 (SD=1.32). Individuals from the Parsęta have the mean of 63.7 (SD=0.5) myomeres, and those from the Wda - 64.2 (SD=1.26).

Table 6

Plastic characters in amles and females of *L.fluviatilis* from the Grabowa R.

Character	Males (n=24)			Females (n=26)			t
	$\bar{x}$	range	SD	$\bar{x}$	range	SD	
Tl in mm	374.5	299.7 - 408.5	24.7	401.9	331.8 - 467.3	26.7	3.77
in % Tl:							
d-B1	9.7	9.3 - 10.2	0.27	9.8	9.2 - 10.6	0.32	0.98
B1-B7	10.0	9.3 - 10.8	0.39	10.1	9.7 - 10.6	0.27	1.10
B7-a	53 3	51 9 - 55 2	1 07	53.5	53 5 - 55 1	0 85	0.73
B7-C	80.5	79.7 - 81.5	0.45	80.3	78.6 - 81.6	0.62	1.31
a-C	27.1	24.9 - 28.8	1.02	27.1	24.6 - 32.7	1.48	0.00
d-a	73.0	71.3 - 75.0	0.97	73.0	67.4 - 75.3	1.46	0.00
H	6.7	6.2 - 7.4	0.34	7.1	6.2 - 7.5	0.36	4.04
d-D1	50.0	46.9 - 52.3	1.25	50.0	48.0 - 51.7	1.07	0.00
d-eD1	63.8	61.6 - 65.8	1.13	63.9	60.2 - 66.1	1.27	0.29
d-D2	66.9	64.7 - 69.5	1.23	66.9	64.8 - 68.7	1.04	0.00
D2-C	33.2	30.5 - 35.4	1.26	33.3	31. 4 - 35.4	1.07	0.30
D-D	3.2	1.6 - 4.7	0.69	3.0	1.3 - 4.9	0.75	0.98
lD1	14.0	11.4 - 16.8	1.20	14.0	12.4 - 16.6	1.01	0.00
hD1	2.9	2.5 - 3.4	0.25	4.8	2.4 - 3.2	0.24	1.44
lD2	24.2	21.8 - 25.9	1.04	24.1	23.0 - 26.0	0.69	0.39
hD2	6.0	5.2 - 6.7	0.45	6.0	4.9 - 6.8	0.47	0.00
d	4.5	4.3 - 4.8	0.17	4.5	4.0 - 5.0	0.23	0.00
d-O	6.4	5.9 - 6.7	0.21	6.5	6.0 - 7.0	0.27	1.49
O	1.6	1.3 - 1.8	0.10	1.6	1.4 - 1.7	0.08	0.00
O-B1	2.3	1.8 - 2.7	0.25	2.3	1.8 - 2.7	0.26	0.00
B1-B2	1.6	1.5 - 1.7	0.07	1.6	1.5 - 1.7	0.06	0.00
hco	4.6	4.2 - 4.9	0.23	4.6	4.0 - 5.1	0.30	0.00
d-n	5.6	5.1 - 6.1	0.25	5.6	4.8 - 6.1	0.34	0.00
io	3.8	3.5 - 4.3	0.21	3.9	3.4 - 4.4	0.23	1.60

Table 7

Number of myomeres in *L.fluviatilis* from various regions of Europe

River	Sex	n	$\bar{x}$	Range	Author
Poland:					
Drwęca R.	m	51	63.8	61 - 66	authors
	f	36	63.9	61 - 66	
Grabowa R.	m	24	63.7	62 - 66	authors
	f	26	63.0	61 - 66	
Parsęta R.	m	3	64.0	64	authors
	f	1	63.0	63	
Wda R.	m	2	65.0	64 - 66	authors
	f	2	63.5	63 - 64	
Russia:					
Ladoga L.	m,f	170	62.2	60 - 64	Ivanova-Berg (1966)
Neva R.	m,f	40	62.9	60 - 64	Ivanova-Berg (1966)
Sweden:					
Stensan R.	-	12	64.5	60 - 66	Malmqvist (1978)
Holland:					
Meuse R.	-	-	64.5	62 - 66	Vladykov, Follet (1958)
Great Britain:					
Teme R.	m	-	61.9	58 - 66	Potter, Osborne (1975)
	f	-	62.3	-	
Severn R.	m	-	63.2	-	Potter, Osborne (1975)
	f	-	62.5	-	
Italy					
Arno R.	m,f	140	62.2	59 - 66	Zanandrea (1957)

2. Dentition

The lampreys studied have the teeth formula typical of *L. fluviatilis*. Table 8 provides more detailed data on the disc dentition. Some of the individuals caught had their teeth partly damaged (worn down or broken off) and. therefore, fewer specimens were taken for analysis than in the case of plastic features.

Table 8

Disc dentition in *L.fluviatilis* from the north-Polish rivers

Teeth	River							
	Drwęca (n=84)		Grabowa (n=72)		Parsęta (n=4)		Wda (n=4)	
	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range	$\bar{x}$	range
MC	1.0	1	1.0	1	1.0	1	1.0	1
AC	2.1	2-3	2.2	2-3	2.0	2	2.0	2
AC1	5.3	4-8	5.1	4-7	4.7	4-5	5.7	4-7
Ens1	2.0	2	2.0	2	2.0	2	2.0	2
Ens2	2.9	2-3	2.9	2-3	2.7	2-3	3.0	3
Ens	1.9	1-2	1.9	1-2	2.0	2	3.0	3
E1	2.0	2	1.9	1-2	2.0	2	2.0	2
End2	3.0	3	3.0	3	2.7	2-3	3.0	3
End3	1.9	1-2	1.9	1-2	2.0	2	2.0	2
IO	7.1	6-8	7.0	5-9	7.0	7	7.0	7
IOs	1.8	1-2	1.7	1-2	1.7	1-2	2.0	2
IOd	1.8	1-2	1.6	1-2	1.7	1-2	2.0	2
SO	2.0	2	2.0	2	2.0	2	2.0	2

The teeth formula of the examined populations stands as follows:

- Marginal teeth (MG) - one row around the disc (in 100% of the examined specimens),
- Anterior teeth (AC) two or three rows, most often two (Drwęca - 97%), Grabowa - 79%, Parsęta and Wda - 100% each),
  - internal row of anterior teeth (AC1) - 4-5 teeth (Drwęca - 64%, Grabowa - 67%, Parsęta - 100%, Wda - 25 %) or 6-8 (in the remaining),
- Endolateral teeth (left and right) (Ens, End) - form three pairs. The middle one (Ens2 and End2) usually has three peaks (Drwęca - 99% and 100%, Grabowa - 95% and 100%, Parsęta - 67% and 75%, Wda - 100% and 100%). In the remaining cases three were two peaks. The external pairs (Ens1 and End1 as well as Ens3 and End3) usually have two peaks (75-100%),
- Infraoral lamina (IO) - built of seven fused teeth (Drwęca - 98%, Grabowa - 97%, Parsęta and Wda - 100% each). The external teeth (IOs and IOd), with two peaks, occurred in 64-100% of the specimens,
- Supraoral lamina (SO) - in all examined specimens its lateral edges terminated with one peak.

DISCUSSION

In spite of a wide geographical dispersal over Europe and great economic importance of *L. fluviatilis* (Finland, Russia, Estonia, Latvia), data on the plastic and meristic characters of this species and their variability range are still scarce. Hardisty [1987b] compiles the hitherto obtained results, but only those by Ivanova-Berg [1966] and Zanandrea [1957, 1959] can be used for the purpose of comparison. The authors mentioned also studied river lampreys caught during their spawning run. Unfortunately, they analysed only some of the plastic features.

A comparison reveals that the Polish populations of *L. fluviatilis* (Drwęca, Grabowa) have a lower value of prebranchial length, and a shorter disc and eye diameter than those of the Arno and Neva rivers or Lake Ladoga. On the other hand, they have higher values of trunk and tail length, and of second dorsal fin height.

Table 9

Comparison of selected plastic characters (in % Tl) in *L.fluviatilis* from Poland, Italy and Russia

River	Sex	n	d-B1	B1-B7	B7-a	a-C	d	O	hD2	Author
Arno	m	34	11.0	10.6	50.6	25.9	5.3	1.7	5.3	Zanandrea
	f	26	11.1	10.7	51.2	25.1	5.4	1.7	5.0	(1957,1959)
Drwęca	m	51	10.5	10.3	52.0	27.8	4.1	1.6	6.0	authors
	f	36	10.4	10.3	53.2	27.4	4.1	1.6	6.0	
Grabowa	m	24	9.7	10.0	53.3	27.1	4.5	1.6	6.0	authors
	f	26	9.8	10.1	53.5	27.1	4.5	1.7	6.1	
Parsęta	m	3	10.3	10.2	52.4	26.7	4.1	1.7	5.6	authors
	f	1	10.2	10.7	52.8	26.2	3.9	1.7	5.4	
Wda	m	2	11.0	10.7	53.2	25.1	4.1	1.7	5.7	authors
	f	2	10.5	10.8	53.0	26.1	3.9	1.6	5.6	
Ladoga L.	m	30	11.7	8.9	-	27.0	-	2.2	4.7	Ivanova-Berg
	f	30	11.5	9.0	-	26.8	-	2.1	4.5	(1966)
Neva	m	30	10.8	10.2	-	27.6	-	1.2	4.2	Ivanova-Berg
	f	30	10.9	10.3	-	27.2	-	1.2	4.2	(1966)

The differences observed between autumn and spring populations confirm the data provided by Rolik, Rembiszewski [1987]. Lampreys starting their spawning run in spring have a lower value of trunk length and higher values of prebranchial and branchial length, disc diameter and both dorsal fins heights. Literature concerning the river lamprey includes little data on the plastic features variability depending on the season when the spawning run is undertaken (autumn and spring run populations). According to Ivanova-Berg [1966], differences between individuals that start their spawning run and those that already begin to spawn consist in reduction of the body size (Tl), head dimensions (particularly preocular length) and predorsal distance.

Changes in several characters recorded in *Lampetra fluviatilis* follow a course similar to that found in Lethenteron japonicum {Holčik 1987]. Also in the latter species such characters as branchial length and trunk length demonstrate a tendency to grow, while tail and prebranchial length tend to decrease accompanying the increase in total length and approach of the spawning time.

During the river lamprey spawning run sexual dimorphism is most strongly manifested in total length and weight [Archipceva 1962; Bird, Potter 1979; Gaigalas, Matskevichus 1968; Hardisty 1987b. Ivanova-Berg 1933, 1936, 1966], although at the sea stage individuals of different sex are still hardly distinguishable [Bird, Potter 1979]. the available data on differences in body proportions between males and females are insufficient. According to Hardisty [1987b], Rolik, Rembiszewski [1987], Zanandrea [195], females are characterised by a longer trunk, which is due to a slightly higher myomere mean. It is confirmed by our own study. Among other features that allow to distinguish between individuals of different sex the former authors mention the following: longer predorsal distance and appearance of the "anal fin" just before the spawning period in females, and higher value of tail length and disc diameter in males. An analysis of own data has revealed, however, that at the time of run sexual dimorphism is even more marked, manifesting itself also in a higher value of body depth in females. Further differences become manifest during the spring run, towards the spawning time, in distance between disc and base of the second dorsal fin as well as in dorsal part of caudal fin length.

With regard to the meristic features concerning the disc dentition, the Polish populations of *L. fluviatilis* have their teeth formula similar and values approximating to those given by Berg [1948], Borri [1921], Vladykov, Follett [1958] and Zanandrea [1959], and the number of myomeres slightly exceeding those of the populations from the Arno R. (Italy), Neva R. and Lake Ladoga (Russia) [Ivanova-Berg 1966; Potter, Osborne 1975; Zanandrea 1957].

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MORFOMETRIA MIGRUJĄCYCH JESIENNYCH I WIOSENNYCH POPULACJI MINOGA RZECZNEGO *LAMPETRA FLUVIATILIS* (LINNAEUS, 1758) Z RZEK POLSKI

STRESZCZENIE

Na podstawie materiału liczącego 145 osobników *L. fluviatilis* zebranego w przepławkach w Drwęcy, Grabowej, Wdzie i Parsęcie podczas jesiennej i wiosennej wędrówki tarłowej, badano zmienność cech plastycznych i merystycznych.

Populacje wstępujące do rzek północnej Polski w okresie jesiennym charakteryzują się dużym podobieństwem morfologicznym. Dymorfizm płciowy zaznacza się tylko w przypadku dwóch cech - długości całkowitej (Tl) i wysokości ciała, które są większe u samic. Populacje rozpoczynające wędrówkę na wiosnę charakteryzują się, w porównaniu z populacjami jesiennymi, mniejszymi rozmiarami, silniej objawiającym się dymorfizmem i zmianą proporcji ciała, co związane jest z bardziej zaawansowanym stanem dojrzałości płciowej.

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