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Fish biology

CHARACTERISTICS OF THE POPULATION OF *LAMPETRA FLUVIATILIS* (L.) ENTERING THE DRWĘCA AND GRABOWA RIVERS (NORTH POLAND)

CHARAKTERYSTYKA POPULACJI *LAMPETRA FLUVIATILIS* (L.) MIGRUJĄCYCH DO DRWĘCY I GRABOWEJ (PÓŁNOCNA POLSKA)

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The size, length/weight relationship, sex ration and gonadosomatic index of the autumn and spring upstream run populations of the river lamprey have been studied. The size attained by the lampreys from the lower Vistula basin (Drwęca R.) is among the largest recorded for this species. In autumn males in the studied rivers outnumber females. In this period lampreys are bigger than during the spring run. The mass of gonads and the GSI in early spring are higher than in autumn.

INTRODUCTION

In Poland the river lamprey, *L. fluviatilis* - like the anadromous salmonids (*Salmo salar, S. trutta)* - occurs only in coastal Baltic rivers and lower basin of the Vistula River [Bartel 1993; Witkowski 1992 a]. River pollution and dam reservoirs have shut off the fishes' free access to the spawning-grounds situated in the upper catchment area of the Odra and Vistula rivers. Also the excessive fishing exploitation in earlier periods seriously decreases the species abundance [Witkowski 1992 b]. In the between-war period the river lamprey was still numerous in most Polish rivers, constituting an important item of catches [Jokiel 1964; Wyszesławcew 1939]. A rapid decrease in its population after World War II, resulting in unprofitable fishing, made it necessary to stop exploitation of *L.fluviatilis* in several rivers [Poczopko, Słonowski 1958]. At present it is caught only in the lower course of the Vistula river [Jokiel 1983].

Considering the fact that the biology of the river lamprey in the Polish waters has so far been scarcely known, and the hitherto published literature on this species exceptionally poor [Bartley et al. 1993; Jokiel 1964, 1983; Rolik, Rembiszewski 1987], the present paper aims at studying some aspects of its biology and ecology, basing on material from the Drwęca (lower Vistula basin) and Grabowa (a coastal river) rivers, in which the spawning lampreys are still numerous.

MATERIAL AND METHODS

The paper is based on a study of 267 individuals which were caught during their spawning run (the autumn and spring one) in fish passes. Data concerning the time and place of catches are shown in Table 1 and in a paper by Kuszewski, Witkowski [1994].

The lampreys were measured with the 1 mm accuracy and weighed with the accuracy of 1g. Sex was determined after opening of the abdominal cavity and the gonads weighed with the accuracy of 0.1 g. The obtained data have been statistically analysed.

Table 1

Material of the river lamprey used for study

River	Locality	Period	No of specimens
Drwęca	Lubicz	26-28 II 1992 - 16 XI 1992	127 (68m + 59f) 37 (23m + 14f)
Grabowa	Jeżyczki	12 XI 1991	95 (51m + 44f)
Parsęta	Rościno	19 III 1991	4 (3m + 1f)
Wda	Świecie	30 XII 1900	4 (2m + 2f)

RESULTS

Timing of run

The hitherto made observations show that *L. fluviatilis* enters the rivers of North Poland in two periods - in late autumn (November-December) and early spring (February-March). In some of the rivers only one spawning run is observed, the autumn or the spring one.

Of the rivers which have provided fairly exhaustive data, in the Drwęca two run periods are observed, during the spring one lampreys being clearly more numerous (Tab. 2), whereas in the coastal, Grabowa river only one, in late autumn, with the maximum falling in the first half of November. According to the reports of the local people, single individuals of *L. fluviatilis* may be encountered in the lower course of the latter river also at the end of May or beginning of June. They might, however, be individuals that have just spawned and are carried by the water current towards the river mouth.

Sex ratio

The analysis of the material has revealed that in all Polish populations of the river lamprey males slightly exceed females in number, both during the autumn and the spring run (Tab. 3). The sex ratio calculated for the whole material is 1.2:1 with male individuals predominating. In the Drwęca R., for which two run periods have been established, definitely more males occur in autumn than in spring, 1.6:1 and 1.1:1 respectively.

Table 2

Weight of the river lampreys caught in the Drwęca R. in 1987-1992

Year	Spring		Autumn	
	period	kg	period	kg
1987	30 II - 10 IV	500	3 X - 31 XII	946
1988	18 III - 27 III	1015		x
1989	28 II - 18 III	1024		x
1990	22 II - 17 III	900	28 XI - 1 XII	69
1991		xx		x
1992	25 II - 9 III	2125	15 XI - 10 XII	153

x - small amount (to 50 kg)
xx - large amount (c. 1000 kg, no catches).

Table 3

Sex ratio of the river lamprey from the Polish rivers during the upstream migration

River	Male : female	Period
Drwęca	1.1 : 1	spring
	1.6 : 1	autumn
Grabowa	1.2 : 1	autumn
Parsęta	3 : 1	spring
Wda	1 : 1	winter

Size

The data shown in tables 4 and 5 allow generalization that the river lampreys of the Drwęca R. (both males and females) are the longest and of the highest mass while those of the Parsęta and Wda rivers are the smallest. Unfortunately, the material from the latter rivers is rather scanty (n=4 for each river).

A comparison between the lampreys entering the Drwęca in two different periods has shown that though the autumn populations are smaller, they consist of the bigger individuals than the spring populations. Table 6 gives the formulae describing the relation between the mass (w) and length (Tl) in *L. fluvialitilis* represented by two largest populations (of the Drwęca and Grabowa rivers).

Gonadosomatic index (GSI)

Only the most abundant material from the Drwęca river has been studied in detail. The mass of gonads and the GSI in the population entering the river in spring are higher than those obtained in autumn. The mean values of these two parameters calculated for females in spring are respectively: 14.34 (8.5-19.5) g and 13.06 (6.8-17.2) %, in autumn being 13.9 (8.5-17.0) g and 9.2 (6.4-12.5) %. A similar phenomenon is observed in the case of males. In spring the average mass of testes is 6.77(4.0-10.0) g and the GSI - 6.89 (4.08-9.26) %, while in autumn - 6.37 (4.0-8.5) g and 4.85 (3.63-6.45) % respectively. The relationship between the mass of gonads and GSI, and the length and total mass in females and males from the Drwęca R. in both periods are shown in Table 7.

Table 4

Length (Tl in mm) of the river lamprey during the upstream migration into the Polish rivers

River	Period	Males				Females			
		x̄	SE	range	n	x̄	SE	range	n
Drwęca	autumn	400.9	3.06	362.9-427.3	23	416.0	7.40	359.6-460.5	14
	spring	381.2	2.43	431.7-428.0	68	398.3	3.27	336.6-462.8	59
Grabowa	autumn	379.7	3.98	299.7-444.0	51	397.0	3.96	331.8-467.3	44
Parsęta	spring	353.3		333.0-369.0	3	351.0			1
Wda	winter	344.0		336.0-353.0	2	356.0		346.0-367.0	2

Table 5

Weight (in g) of the river lamprey during the upstream migration into the Polish rivers

River	Period	Males				Females			
		x̄	SD	range	n	x̄	SD	range	n
Drwęca	autumn	132.5	2.99	110.0-160.0	23	151.8	6.74	110.0-194.0	14
	spring	103.8	2.20	68.0-151.0	68	120.7	3.17	81.0-191.0	59
Grabowa	autumn	105.2	3.21	45.0-161.0	51	126.7	4.12	66.0-230.0	44
Parsęta	spring	85.3		60.0-108.0	3	90.0			1
Wda	winter	74.0		68.0- 89.0	2	89.0		82.0- 96.0	2

Table 6

Relationship between weight (W in g) and length (Tl in mm) of the river lamprey from the Drwęca i Grabowa rivers

River	Males		Females	
Drwęca	logW= -11.654+2.745logTl	r=0.77	logW= -11.333+2.965logTl	r=0.84
Grabowa	logW=-12.0.39+2.908logTl	=0.92	logW= -12.621+2.915logTl	r=0.91

Table 7

Relation between weight of gonads (wg in g), GSI (in %), and total length (Tl in mm) and weight (W in g) of the river lamprey from the Drwęca R. during the autumn and spring upstream migration

Period	Males		Females	
autumn	wg= -10.383+0.042Tl	r= 0.57	logwg= -10.195+2.124logTl	r= 0.64
spring	wg= - 3.341+0.026Tl	r= 0.29	wg= 1.646+0.032Tl	r= 0.27
autumn	wg= 1.074+0.040W	r= 0.49	wg= 2.440+0.76W	r= 0.69
spring	wg= 1.406+0.054W	r= 0.50	wg= 7.438+0.064W	r= -0.46
autumn	GSI= 2.733+0.005Tl	r= 0.10	GSI= 11.526+0.006Tl	r= -0.10
spring	GSI=15.049-0.021Tl	r= -0.28	GSI= 32.755-0.050Tl	r= -0.48

DISCUSSION

The biology and some population parameters in *L. fluviatilis* from the studied Polish rivers are similar to those reported from other parts of Europe. The time of the lamprey upstream run into spawning rivers of northern Poland is not definitely established yet. The hitherto conducted observations suggested that only in the Drwęca R. two migration periods, the autumn and the spring one, are recorded while in the Grabowa R. only one, in late autumn. Too little information is obtained from other rivers (Parsęta, Wda), which precludes assumption of one or two spawning runs. Differences among other European rivers with regard to the time and number of spawning runs are also recorded [Hardisty 1987]. In the rivers of the NE basin of the Baltic Sea (Sweden, Finland, Russia) migration of *L. fluviatilis* starts in August and lasts through November [Ryapolova 1972; Sjöberg 1980; Tuunainen et al. 1980; Valtonen 1980]. In England (Severn R.) the first migrants appear as early as July-August, the run often lasting till spring [Abou-Seedo, Potter 1979]. In South Europe the river lamprey starts its upstream run later. According to Contronei [1927] and Zanandrea [1957, 1959], the first lampreys appear in the Tiber R. as late as December, the migration peak falling in February and March.

Like in the Drwęca R., in several other rivers (Vantaa, Neva) two upstream runs (autumn, spring) of *L. fluviatilis* have been observed [Ivanova-Berg 1936, 1966; Tuunainen et al. 1980]. Still, there are no reliable data on whether the lampreys migrating into the same river (in autumn and spring) belong to genetically the same population. Sjöberg [1980] holds that a low water temperature and the ice cover make some individuals winter until spring in the lower course of rivers and in the sea. On the other hand, however, considerable differences in body size and proportions between lampreys from those two periods have been noted [Kuszewski, Witkowski 1994]. Although being in a different phase of sexual development may account for those differences, it seems that this problem can be resolved only after a thorough biochemical study.

River lampreys substantially vary in size, both within the neighbouring river systems and among different regions of the area [Hardisty 1987]. In spite of it, a clear variability from the north-east towards the south-west is discernible. Populations from the rivers of the southern Baltic basin have the biggest individuals [Bartel et al. 1993]. Gaigalas, Matskevichus [1968] maintain that the dimensions of this species depend on the sea salinity which increases westwards. A small size is typical of the river lamprey from the southern regions of the species distribution range (rivers of the Mediterranean Basin) whereas individuals from the Drwęca R. population, particularly those appearing in autumn, attain a very large size. Only the lampreys from the Szczecin Firth are slightly bigger [Bartel at al. 1993]. Asplund, Sodergren [1975], Ivanova-Berg [1966] and Sjöberg [1975, 1980] stated that lampreys caught during the beginning of the run had greater mean length and weight than those caught later. A similar observation was also made in the Drwęca R.

In Polish populations prevalence of males over females has been ascertained. Authors elsewhere have also noted males outnumbering female: the sex ratio calculated by Bird, Potter [1979] for the Teme R. was 1.2:1 whereas in the Severn R. this relation was 1.6:1 [Abou-Seedo, Potter 1979]. According to Bartel et al. [1993], males predominate in the rivers of Latvia, Lithuania and Poland, the man value of sex ratio being 1.8:1 (3.0-1.1:1). In the Neman, however, Gaigalas, Matskevichus [1968] noted more females (1.1:1). Moreover, the data obtained by the latter authors suggest that during later periods of the run (spring) the share of males grows.

The mass of gonads and the gonadosomatic index (GSI) in the river lamprey population of the Drwęca R. had lower values in autumn than in spring. Similar observations concern lampreys from the Narev [Genina, Erik 1958] and Neva rivers [Ivanova-Berg 1933].

In autumn the mean mass of testes in males from the Drwęca R. was 6.37g, slightly exceeding that of *L. fluviatilis* from the Narev R. (x=6.1), while in spring the relation was the opposite - 6.77 and 7.9 g respectively. Females from the Drwęca R. (in autumn and spring) had better developed ovaries and a higher mass (13.9 and 14.34) than individuals from the Narev R. - 8.5 g and 10.0 g in autumn and spring respectively. The GSI calculated for males in both periods was higher in the lampreys from the Narev R. than in those from the Drwęca R., and amounted to 7.6, 10.0 and 4.8, 6.9 % respectively. On the contrary, females from the Drwęca R., both in autumn and spring, had those values higher (9.2 and 13.1 %) than those obtained for females from the Narev R. (8.5 and 11.0 %) [Genina, Erik 1958].

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CHARAKTERYSTYKA POPULACJI *LAMPETRA FLUVIATILIS* (L.) MIGRUJĄCYCH DO DRWĘCY I GRABOWEJ (PÓŁNOCNA POLSKA)

STRESZCZENIE

W wyniku zanieczyszczeń i hydrotechnicznej zabudowy rzek występowanie minoga rzecznego w Polsce ogranicza się obecnie już tylko do dolnego dorzecza Wisły i rzek przymorskich. Na podstawie materiału (267 osobników), zebranego w Drwęcy i Grabowej (dopływ Wieprzy), zbadano kilka parametrów populacyjnych, takich jak: rozmiary, zależność długość/masa, stosunek płci oraz stan dojrzałości płciowej. Minogi z rzek północnej Polski osiągają największe rozmiary (w obrębie rzek bałtyckich), szczególnie populacja z Drwęcy. Większe notuje się tylko w Zalewie Szczecińskim. Rozmiary osobników z Drwęcy w obu okresach migracji są lepiej rozwinięte niż u populacji z rzek należących do wschodniej części zlewiska Bałtyku.

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