Scientific Journal of Riga Technical University
Environmental and Climate Technologies
DOI: 10.2478/v10145-011-0025-z *2011*
Volume 7

Anthropogenic Influence on the Dynamics of the River Lamprey *Lampetra fluviatilis* Landings in the River Daugava Basin

Janis Birzaks[1], Kaspars Abersons[2], [1-2]*Institute of Food Safety, Animal Health and Environment "BIOR"*

***Abstract* – The construction of the Daugava hydro power station (HPS) cascade has significantly transformed Latvia's largest river the Daugava, reducing its importance in the natural reproduction of anadromous fish species. Currently in Latvia, as well as in other Baltic Sea countries, the river lamprey catch is decreasing, whereas the landings in the river Daugava have tended to increase. The dynamics of the river lamprey landings show the possible redistribution of lamprey stocks between the rivers Gauja and the Daugava. Possibly, this is a result of anthropogenic influence and changes in the river lamprey resource management may be necessary in the future.**

***Keywords* – River amprey, landing dynamics, spawning stock, resource management**

I. Introduction

Significant changes have taken place in the 20th century to the Daugava, Latvia's largest river, as a result of human intervention. During the period from 1939 to 1974, a cascade of hydroelectric power stations (HPS of Pļaviņu, Ķeguma and Riga) was built on this river. Since the construction of the HPS cascade, the available river lamprey spawning biotopes in the Daugava basin has become very limited (Figure 1).

Nowadays the river lamprey landings in Latvia, as well as in other Baltic Sea countries, are much fewer than in the 1960s and in the beginning of the 1970s. The reasons which have caused a decrease of river lamprey landings in the basin of the Baltic Sea are anthropogenic factors, such as river regulation and damming, water pollution and eutrophication, overfishing, etc. The area of distribution of the river lamprey in the rivers of the Baltic Sea basin has been reduced, and in many countries they have been assigned the status of a protected species.

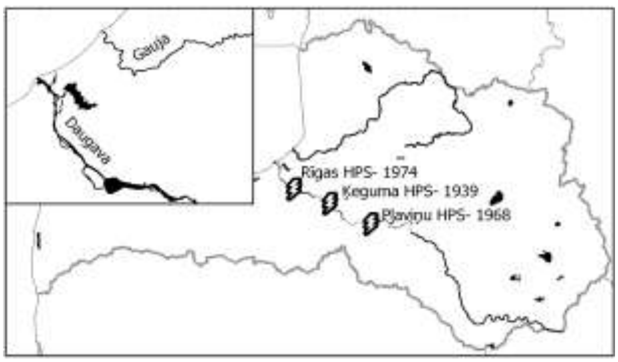

Fig. 1. The outlets of the rivers Daugava and Gauja into the Gulf of Riga and the location of the Daugava HPS cascade stations.

The river lamprey is included in Council Directive 92/43/EEC (21 May 1992) on the conservation of natural habitats and of wild flora and fauna. In Latvia, the river lamprey is included in the Cabinet of Ministers Regulations No.396 dated 14.11.2000, "Regulations on the List of Specially Protected Species and Species with Exploitation Limits". These regulations prescribe that the fishing of river lamprey is allowed in limited amount, if it does not harm the protection of the population of the respective species' favourable protected status in its natural area of distribution. At the same time, the river lamprey is one of the most economically significant species in Latvian inland fisheries. Despite the construction of the Daugava HPS cascade and the overall reduction in the annual lamprey landings in Latvia, the lamprey landing in the river Daugava in recent years has had a tendency to increase.

The changes in the river lamprey landings and the stock dynamics and the reasons for theses changes have been analyzed in this article. The article's authors also provide recommendations for the management of river lamprey stocks in the future.

II. Materials and Methods

Data on the river lamprey landings by individual rivers and for Latvia as a whole have been used to evaluate the long term change in River Lamprey stock.

The oldest historical data on landings is from the late 19th and the early 20th century [2, 3]. Regular data on lamprey landings are available from 1945. This data has been aggregated in publications [1, 2, 3, 10, 14], as well as in reports and archives of the former USSR state institutions involved in the monitoring, research and restocking of fish resources – the Baltic Fisheries Research Institute *(BaltNIIRH)* and the Baltic Fish Conservation and Reproduction Administration *(Baltribvod)*. From 1990, fishing data has been collected and stored in Latvian state institutions and institutes – the Latvian Fisheries Research Institute *(LatFRI)*, Latvian Fish Resources Agency *(LatFRA)* and the Institute of Food Safety, Animal Health and Environment "BIOR". Data in various sources are not identical. Moreover, some of the sources summarized the landings in accordance with the fishing season (usually from August to April of the following year), whereas in others – by the calendar year. The landing data summarized by the calendar year have been used in this paper.

The evaluation of the potentially most significant and influential anthropogenic factors is based on the research results published in the period from 1961 to 1991, and on their analysis.

The cod and herring landing data were taken from the Integrated Control and Information System for Latvian Fisheries

(LZIKIS). The volume of artificially bred river lamprey larvae in the Daugava was taken from official statistical data, which has been published in Latvia's Fisheries yearbooks.

III. Results and Discussion

The river lamprey is a monocyclic, diadromous species. River lamprey spawning in Latvia occurs in May – June, after the spring flooding, when the water temperature exceeds +9°C. Spawning occurs in places with a comparatively strong current flow (1.0 – 1.8 m/sec.) and a sandy-pebbly or gravel bottom. In the first days the hatched larvae move about very little and are taken along with the current, but after about a week they start to move actively and dig down in sandy places in the river bed. Ammocoetes spend four to five years in the river and after reaching a length of 9 – 14.5 cm, they begin their metamorphosis. After metamorphosis, the young lampreys migrate to the sea in April – May and begin to feed on fish. The main food objects of the river lamprey are pelagic sea fish – the Atlantic Herring *(Clupea harengus membras)*, the Baltic Sprat *(Sprattus sprattus balticus)* and the European Smelt *(Osmerus eperlanus)*. Usually lampreys spend one or two years in the sea. After reaching a length of 17 – 49 cm and a weight of 20 – 195 g, mature lampreys migrate to rivers to spawn. The spawning migration starts in July – August and continues practically until spawning in the spring of the following year [13].

As opposed to other countries [6, 18], there is no freshwater population of river lamprey found in Latvia.

The first information on the river lamprey landings is available from the turn of the 19th and 20th century. The landing in the Daugava at this time was assessed as at least 25 t in one spawning migration season. In the period from 1950 to 1960, the lamprey landings in one season varied from 4.1 to 19.9 t [2, 3].

In the period from 1960 to 1975, stable and high annual landings were typical (Figure 2). In the river Daugava landings in this period, on average, exceeded 30 t, but the overall landings of Latvia's rivers even reached 200 t. The most important lamprey river in this period was the Gauja, and a proportion of this river in the overall Latvian annual landings fluctuated from 41% to 79%.

In the following years a rapid decline in landings was observed. This began already in 1975, but in 1976 and 1977 the landings were still quite significant. In the river Daugava, it was 11 t and 9 t respectively, whereas, in the river Gauja, 163 t and 132 t respectively. In the next 10 year period the smallest known landings were observed in separate rivers and in Latvia as a whole. The overall river lamprey landings in Latvia in this period decreased a number of times and did not exceed 57 t a year.

From 1986, the river lamprey landings began to gradually increase in Latvia and from 1990 in the river Daugava as well. Since the late 1980s, the annual landing in Latvia has fluctuated between 72 – 170 t, whereas in the river Daugava it has gradually increased from 6 to 30 t. Currently, the annual river Daugava landing has tended to increase, whereas the overall river lamprey landing in Latvia, after a peak in 1989, has tended to decrease. In recent years the lamprey landings in the river Daugava has come close to the relatively large landings of the 1960s and early 1970s.

The first HPS on the river Daugava, 70 km from its mouth (Ķeguma HPS), was built in 1939. The Ķeguma HPS had a fishpass built into it, and some river lamprey were able to get through it. At this time, the river lamprey migration reached Pļaviņas and the river Aiviekste in the middle reaches of the river Daugava [2, 3]. It was established that the river lamprey landing in the Daugava after the construction of the Ķeguma HPS decreased, and the construction and operation of the HPS has been mentioned as one of the reasons [2, 3, 14]. There have also been observed seasonal changes in the lamprey landing. Compared to the period before the construction of the Ķeguma HPS, the larger part of annual landing was obtained in spring - in April and May [10].

The effect of the construction of the Pļaviņu HPS dam in 1965, 107 km from the mouth of the Daugava, was less, but it completely stopped the lamprey spawning migration in the Daugava's middle and upper reaches.

However, the completion of the Riga HPS, 30 km from the mouth in 1974, completely blocked the access of the river lamprey to its most significant spawning areas in the basin of the river Daugava. Individual places for spawning in the Daugava were preserved only close to Dole Island near the Riga HPS, as well as in some of the Daugava's tributaries – the Lielā Jugla, Mazā Jugla and the Ķekava [10]. The construction and operation of the Daugava HPS cascade is considered to be the most important factor which negatively influenced river lamprey resources in this river [3, 7, 10]. The creation of artificial barriers in other Baltic Sea countries is considered to be one of the most significant negative factors as well [17, 18]. Besides blocking of spawning migration routes, the cyclic operation of the HPS also causes radical changes in water levels and speed of flow under the Rīga HPS. This aggravates the spawning conditions of river lamprey at the remaining spawning places in the river Daugava [3, 7, 10].

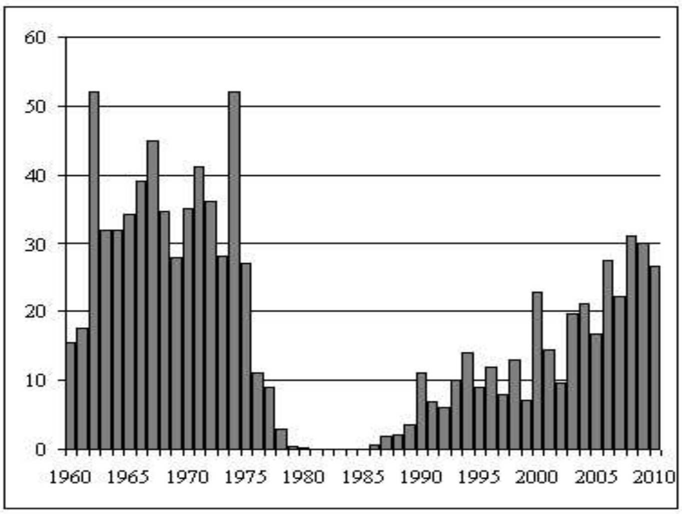

Fig. 2. The annual river lamprey landings in the river Daugava (tonnes) from 1960 to 2010.

The construction of the Daugava HPS cascade has also changed lamprey fishing in the Daugava. The traditional river lamprey fishing places near Dole Island were lost, and for a time (from 1981 to 1984), lamprey fishing was also closed. Currently, lamprey fishing is conducted in an approximately 25 km long

DOI: 10.2478/v10145-011-0025-z
2011
Volume 7

section of the river from the outlet of the Audupe to the Riga HES dam. Traditional fishing gear – lamprey weirs have been replaced by lines of fyke-nets, with which fishing in the deeper parts of the Daugava is possible.

In the period from 1960 to 2010, the annual river lamprey landing in the river Daugava was between zero and 50 tonnes and significant annual fluctuations are characteristic from year to year. Sharp yearly landing fluctuations are typical of other Latvian rivers and total landings as well (Figure 3). These fluctuations can be explained mainly by the biological peculiarities and fishing features. The river lamprey is a monocyclic species and breeds only once in its life. Its spawning stock structure is created by no more than three age groups and individuals of one age dominate in spawning stock [11, 12, 13]. Due to this, the size of the spawning stock and the annual river lamprey landing is dependent on the strength of one separate generation, which is influenced by a range of factors. Factors mentioned in the literature is the level of the river and water temperature and the number of spawners in spawning season [13], wintering conditions in the first year of life, wintering conditions in the period of metamorphosis, availability of food in the sea, etc. [10]. Lamprey landings in rivers are also affected by the intensity of lamprey migration and the opportunities for fishing determined by water temperature and water levels in rivers and the sea, the phase of the moon, water levels (flow) in rivers in various seasons, sludge and development of a stable layer of ice on rivers. Natural 6 – 8 year long landing cycle fluctuations are also mentioned in literature [17]. However, in Latvia, in an analysis of the dynamics of four to eight year long landing cycles, a significant connection between the landings of spawning stock and their potential offspring was not established [14].

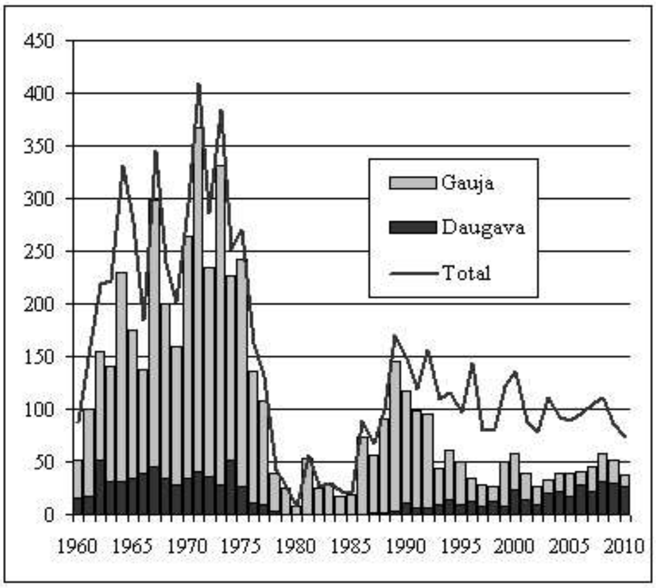

Fig 3. Dynamics of the total river lamprey landing (in tonnes) and landings in the rivers Gauja and Daugava.

The facts mentioned lead one to consider that the yearly river lamprey landing fluctuations in the river Daugava can be explained by a combination of complex natural and anthropogenic factors, and that is why the analysis of separate anthropogenic factors is very difficult.

The fishing mortality of river lamprey spawning stock in the river Daugava has not been researched. In other rivers, the fishing mortality has been estimated up to 80% from the spawning stock [12, 19].

However, it can be considered that commercial fishing of river lamprey in the river Daugava does not have a determinative effect on lamprey resources in this river. Since 1940, river lamprey stocks in the Daugava have developed in conditions of reduced spawning area [10], but the size of the annual river lamprey landing in recent years has been relatively stable and has tended to increase.

Alongside yearly fluctuations, long term trends in the dynamics of river lamprey landing in the Daugava can also be observed (Figure 3).

Since 1960, the annual river lamprey landing in the Daugava and in Latvia as a whole was stable and high. The increase in the landings in these years had been explained by an improvement in river lamprey spawning conditions and successful fish protection measures [1]. In literature, it is also pointed out that the lamprey population in the river Daugava had adapted to the partial loss of spawning sites in the Daugava's middle and upper reaches after the construction of the Ķeguma HES [10].

The decline in the annual river lamprey landings in the river Daugava began in 1975, which on the whole corresponded with predictions expressed [3, 7] on the expected reduction in the landing after the completion of the Daugava HPS cascade in 1974. Over a few years the river lamprey landing in the Daugava fell to 0.2 t in 1980. However, the drop in the landing cannot be explained only by the negative impact of the construction of the Riga HPS. This is shown by the fact that in 1976 the drop in the landing began practically in all rivers where river lamprey were fished in Latvia, which is also reflected in a significant reduction in the lamprey landing in Latvia's rivers as a whole.

The drop in the river lamprey landing and deterioration in stocks in Latvia in the 1980s was partly explained by changes in the Gulf of the Riga ecosystem [10]. Due to the productive cod generations in 1976 and 1977, cod stocks in the Baltic Sea increased significantly. Cod is the most important predatory species of fish in the Baltic Sea, and with an increase in the cod stock in the Gulf of Riga, the stocks of main river lamprey food objects – herring, sprat and smelt – rapidly decreased. The dependence of herring stocks on cod stocks has also been shown in other research [8].

The significant reduction in the river lamprey landings in the largest river lamprey spawning and fishing rivers in the Gulf of Riga basin (in the Daugava, Gauja and Salaca) and the low landing periods in these rivers coincide with an increase in the cod landing in the Gulf of Riga.

Over this time the cod landing in the Gulf of Riga varied from 1 000 to 11 000 tonnes a year, which historically was the largest landing of this species here. In turn, the landing of herring in the Gulf of Riga in this period dropped significantly and only just exceeded 14 000 tonnes in some years, which was the lowest landings of this species in the period from 1960 in the Gulf of Riga (Figure 4).

Scientific Journal of Riga Technical University
Environmental and Climate Technologies
DOI: 10.2478/v10145-011-0025-z 2011
Volume 7

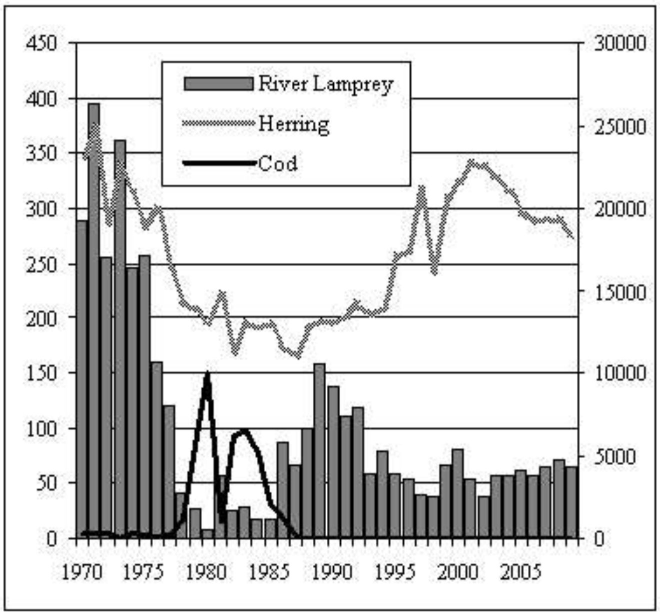

Fig 4. Cod and herring landing in the Gulf of Riga (in tonnes) and the total river; Lamprey landing (in tonnes) in the Gauja, Daugava and Salaca.

Still, the changes in stocks of cod and potential food resources of the river lamprey do not explain the river lamprey landing dynamics over the whole period in review. From 1988 the landing and stocks of cod in the Gulf of Riga were negligible, whereas the size of herring landings has returned to the level of the 1970s, which corresponds to a good stock level. Despite this, the total river lamprey landing in the Daugava, Gauja and Salaca is 2-3 times smaller than the high landings in the period from 1960 – 1975. In the same way, changes in food sources of the river lamprey cannot explain the overall reduction in the Latvian landing in contrast to the increase of the landing from the Daugava.

As mentioned previously, the reduction in lamprey stock in the river Daugava were already predicted in the 1970s. That was a reason why artificial incubation and the stocking of river lamprey larvae in rivers started in Latvia. The artificial restocking was recommended as a measure to reduce the negative influence of the HPS [2, 3, 7, 16]. The stocking of the artificially bred larvae was commenced in the mid 1980s [16], with the release of about two million river lamprey larvae per year. In recent years from 1.3 to 18 million (on average 7.4 million) artificially bred ammocoetes were stocked annually into the lower part of the river Daugava and its tributaries Lielā Jugla and Mazā Jugla.

It has to be conceded that the effectiveness of the stocking of lamprey larvae has not been proved. A number of facts indicate that the growth in river lamprey landings in the river Daugava may be due to other factors than the stocking of ammocoetes.

Firstly, the increase in the annual landings after the low landing period was observed in the majority of rivers, including those in which the stocking of river lamprey was not undertaken as well. Secondly, the number of mature lamprey used in artificial breeding and larvae restocked can be viewed as insignificant. In accordance with data in the literature [16], the recapture rate of river lamprey in commercial fishing is 0.3 – 0.7% of the released number of larvae. In this way, of the 7.4 million larvae available, it should be possible to get 51.8 thousand lamprey individuals. For many years the average weight of river lamprey in the Daugava did not exceed 68 grams [10], therefore the number of artificially bred larvae annually can ensure no more than a landing of 3.5 t.

The dynamics of river lamprey landing from the Daugava also cannot be fully explained by the potentially most significant factors indicated in the research papers – the construction and operation of the Daugava HPS cascade, changes in cod stock and the commencement of artificial breeding and restocking of ammocoetes. Similarly, information which we currently have at our disposal makes one think that the overall size of natural spawning and artificial breeding is not sufficient to provide the size of landings in the river Daugava at the current level (25 – 30 tonnes per year).

River lamprey and other anadromous fish species, in heading into rivers for spawning, are led mainly by smell which allows them to recognize their river of birth. The importance of smell in migratory orientation is also emphasized in research on river lamprey in Latvia [2, 12]. Evidence has also been obtained on the fact that river lamprey spawning migratory orientation, like with sea lamprey *(Petromyzon marinus)*, are also influenced by pheromones released by their larvae [5]. Simultaneously, researching river lamprey homing, it has been established that it is not strongly marked. The research done in Finland [18, 19] indicates that homing could be less strong for river lamprey than for other anadromous species of fish. Research done in Latvia also [12] confirms that individual fish caught in the river Gauja and marked, after release in the Gulf of Riga, were caught in the river Daugava. Cases were also mentioned in this research when lamprey marked in the river Daugava were then caught in the river Gauja.

In lamprey spawning migration research in Latvia, it has been established that the entry of river lamprey into rivers is dependent on a number of factors (phases of the moon, water levels, speed of the current, river discharge, time of day or night, etc.). The total river discharge into the Gulf of Riga at a particular time is mentioned in most of the research, as one of the most significant factors influencing migration [4, 9, 10, 12, 15]. Lamprey marked in one river being captured in another river is also explained by the volume of water emptied [12, 18, 19].

The facts mentioned allow a hypothesis to be put forward that the anthropogenic influence on the dynamics of river lamprey landings in the river Daugava could be connected, not only to the construction of the Daugava HPS cascade, but also with its operation. The regular storage of water and its processing is connected with the periodic increased freshwater discharge into the Gulf of Riga, and the dynamics of such a discharge differ from a natural one. An increased fresh water discharge could attract river lamprey migrating to other rivers (most likely – the Gauja) to the Daugava, which is not the river of their birth. It is possible that the work being done in the river Daugava on deepening the Port of Riga's waterway, which has affected the flow in the Daugava, has had a noteworthy effect.

The partial redistribution of the river lamprey spawning stock from the river Gauja to the river Daugava could also explain the changes in the size of the landings in both rivers and proportionately the overall Latvian landing. In most of the period observed, the river Gauja was Latvia's dominating river in river lamprey fisheries. In the period from 1964 to 1992, more than 50% of the total volume of lamprey caught in Latvia was caught

DOI: 10.2478/v10145-011-0025-z
2011
Volume 7

in the Gauja.

Since 1993, the annual size of river lamprey landings in the Gauja, and its proportion of the landing in the total capture, has tended to decrease. At the very same time, an uninterrupted increase in the annual landing from the Daugava has taken place and its proportion of the overall Latvian landing. In recent years the Daugava has been Latvia's most important river in the river lamprey fisheries (Figure 5).

The data currently at our disposal shows [Abersons, oral contribution] that the natural restocking of river lamprey larvae in the Gauja has not deteriorated (the average number of larvae in suitable biotopes in recent years fluctuated from 19.5 to 35 specimens per square metre) and the heading of a part of the river Gauja lamprey stock to spawn in a different river (in the Daugava) can to a certain degree explain the drop of the landings in the river Gauja and increase in the river Daugava.

Other indirect facts also provide evidence of the possible redistribution of lamprey stock between the river Gauja and the river Daugava. According to the data in the literature [2], annual landings in various river basins in Latvia have fluctuated in a similar manner. However, the river Daugava is obviously an exception. In individual years, with an increase in the river lamprey landings from the river Daugava, they have decreased in the adjacent river Gauja. And conversely, with a decrease in the river lamprey landing from the river Daugava, there has been an increase in the river Gauja. Thus, in 1998 the river lamprey landing from the Daugava was 12.9 t, in 1999 it decreased to 7.2 t, whereas in 2000 it increased to 22.7 t. In those same years the landings changed in the opposite direction for the Gauja respectively, from 13.9 t, increasing to 43.1 t and after that dropping to 34.9 t. A similar correlation has been found in other years as well, but it is not characteristic of the whole period observed.

To obtain the convincing evidence of possible changes in the behaviour of the river lamprey spawning stock, it is necessary to undertake a range of additional research. At the moment, we do not have sufficient information about the strength of river lamprey homing and the choice of spawning migration routes in Latvian rivers.

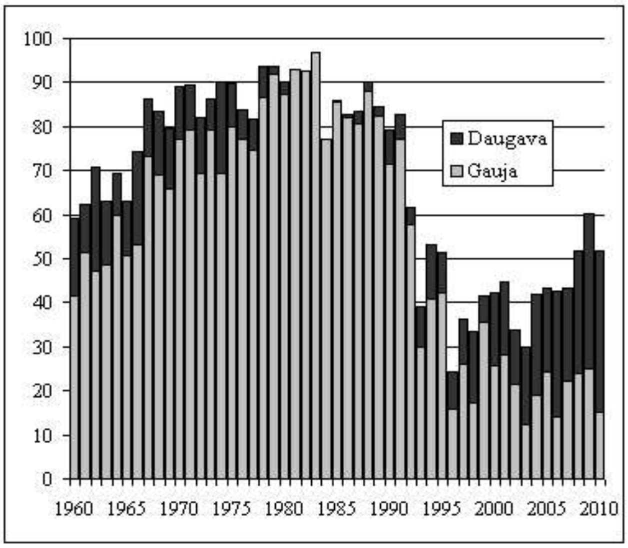

Fig 5. The proportion of the annual landings in the Daugava and Gauja in the overall Latvian landings in the period from 1960 to 2010.

In the last 20 years, the decrease in the annual river lamprey landings shows that a smaller number of lampreys enter the river Gauja to spawn. However, a similar number of lampreys, as before the construction of the Riga HES, migrate to spawn in the river Daugava, but the river lamprey spawning and larvae development area has been significantly reduced in this river. In this way the hydro construction and changes associated with it in the river Daugava could also threaten the survival of Latvia's historically largest river lamprey population in the river Gauja in the future.

Even though artificial lamprey breeding measures were regularly undertaken in Latvia since the mid-1980s, the evidence of their effectiveness has not been obtained. As mentioned previously, the extent of artificial breeding may not be sufficient. Since artificial breeding of river lamprey began, research has not been conducted on the survival of artificially bred ammocoetes and on the overall effect of artificial breeding on the dynamics of lamprey fisheries.

To reduce the negative effect of the Riga HPS on anadromous fish resources, the construction of fish transferring equipment in the dam – a lift, was planned in the 1970s. However, this project did not eventuate. The methods for attraction of spawners were not biologically substantiated. In addition, the fact that the river lamprey spawning and larvae development biotopes above the Riga HPS had been flooded and were no longer suited for the ecological requirements of this species, was not taken into account. In turn, Daugava's tributaries were blocked by watermill dams, which have been transformed into small HPS since the 1990s.

If future research confirms the hypothesis put forward about the influence of the Daugava HPS cascade on the spawning migration of the river lamprey and the redistribution of the spawning stock between the river Gauja and the river Daugava, it may be necessary to make changes in river lamprey fisheries management in the future. It is possible that it may be expedient to reduce the fishing effort in the river Gauja, for the improvement of river lamprey stocks, or to transfer a quantity of the river lamprey caught in the river Daugava to the river Gauja and its tributaries. From the data currently at our disposal, the fact that there is a far greater biotopes area suitable for river lamprey spawning and larval development in the river Gauja and its basin, than in the river Daugava and its basin, provides support for these recommendations. The length of river accessible to migratory fish in the river Gauja exceeds 200 km. The majority of the river Gauja's tributaries are also suited for the spawning of river lamprey. Current data shows that ensuring the river Gauja lamprey populations' natural reproduction at the optimum level can be considered the main factor for the maintenance of river lamprey fishing stocks in the river Daugava as well.

REFERENCES

1. **Eglite, R**. Increase of River Lamprey *Lampetra fluviatilis* (L.) Catches in the Rivers of the Latvian SSR. Zooloģijas muzeja raksti, 1975, No.12, p. 99-104. (in Latvian)
2. **Eglite, R**. Migration and Spawning of River Lamprey *Lampetra fluviatilis* L. in the Rivers of the Latvian SSR. In: P. Stučkas Latvijas Valsts universitātes Zinātniskie raksti, 1961, No. 39, p. 9-24. (in Latvian)
3. **Eglite, R**. Migration and Spawning of River Lamprey *Lampetra fluviatilis* L. in the River Daugava. In: Hydrology, hydrobiology and

DOI: 10.2478/v10145-011-0025-z

fish fauna o the Ķeguma HPS reservoir. Zinātne, Riga, 1969, p. 159-162 (in Russian)

4. **Evtjuhova, B., Ryapolova N**., Impact of Hydrometeorological Factors on the Dynamics of Spawning Migration of Atlantic Salmon and River Lamprey. In: Fisheries Research in the Basin of the Baltic Sea. Zvaigzne, Riga, 1967, vol.2, p. 53-65. (in Russian)
5. **Gaudron, S. M., Lucas, M. C**. First Evidence of Attraction of Adult River Lamprey in the Migratory Phase to Larval Odour. Journal of Fish Biology, 2006, vol. 68, issue 2, p. 640-644.
6. **Maitland, P. S.** Review of the Ecology of Lampreys in Northern Europe. Canadian Journal of Fisheries and Aquatic Sciences, 1980, vol. 37, No. 11, p. 1944-1952.
7. **Malikova, E**. The Question of Protection of the Stock and Fisheries of Valuable Fish Species in Connection with Hydroconstruction in the River Daugava. In: Fisheries Research in the Basin of the Baltic Sea. Zvaigzne, Riga, 1966, vol. 1, p. 61-75. (in Russian)
8. **Ojaveer, E., Gaumiga, R**. Cyclostomes, Fishes and Fisheries. In: Ecosystem of the Gulf of Riga between 1920 and 1990. Estonian Academy Publishers, Tallinn, 1995, p. 225.
9. **Ryapolova, N**. About the Consequences of Spawning Migration of River Lamprey *Lampetra fluviatilis* L. in the Rivers of the Latvian SSR. In: Papers of young scientists. Pischevaja promislennostj, Moscow, 1964, p. 66-69. (in Russian)
10. **Ryapolova, N**. Impact of Hydroconstruction on River Lamprey Stock in the River Daugava. In: Environmental condition of river Daugava. Daugavpils, 1984, p. 51-55. (in Russian)
11. **Ryapolova, N**. Possibilities of Forecasting the Dynamics of Stock and Landings of River Lamprey in Latvia,. In: Fisheries Research in the Basin of the Baltic Sea. Zvaigzne, Riga, 1968, vol. 4, p. 199-215. (in Russian)
12. **Ryapolova, N**. Results of Tagging of River Lamprey (*Lampetra fluviatilis* L.) in the River Gauja. In: Papers of Baltic Fisheries Research Institute (BaltNIIRH). Zvaigzne, Riga, 1970, vol. 4, p. 379-389. (in Russian)
13. **Ryapolova, N**. River Lamprey in the Eastern Baltics. Riga : Zinatne, 1972. 43 p. (in Russian)
14. **Ryapolova, N**. Some Data on the Condition of Stock of River Lamprey *Lampetra fluviatilis* (Linnè) in the Rivers of the Latvian SSR. In: Papers of conference of young specialists. Latvian SSR Academy of Sciences, Riga, 1962, p. 73-81. (in Russian)
15. **Ryapolova, N**. Some Regularities of Migration of River Lamprey (Lampetra fluviatilis) into the Latvian Rivers. In: International Council for the Exploration of the Sea. Baltic-Belt Seas Committee, No. 1188, C.M. 1962.
16. **Ryapolova, N.**, Mitans, A. Biological Background and Biotechnical Principles of River Lamprey (Lampetra fluviatilis) hatchery reproduction. In: Aquaculture at the Baltics. Avots, Riga, 1991, p. 84-99. (in Russian)
17. **Sjöberg, K**. Ecology of the European River Lamprey (*Lampetra fluviatilis*) in Northern Sweden. Canadian Journal of Fisheries and Aquatic Sciences, 1980, vol. 37, No. 11, p. 1974-1980.
18. **Tuunainen, P., Ikonen, E., Auvinen, H**. Lampreys and Lamprey Fisheries in Finland. Canadian Journal of Fisheries and Aquatic Sciences, 1980, vol. 37, No. 11, p. 1953-1959.
19. **Valtonen, T**. European River Lamprey (*Lampetra fluviatilis*) Fishing and Lamprey Populations in some Rivers Running into Bothnian Bay, Finland. Canadian Journal of Fisheries and Aquatic Sciences, 1980, vol. 37, No. 11, p. 1967-1973.

Janis Birzaks, head of Inland waters laboratory, Fish Resources Research Department, Institute of Food safety, animal health and environment "BIOR" since 2010. Janis Birzaks has been staff of institutes and agencies of Fisheries research (BaltNIIRH (1986- 1990), LATFRI (1991- 2004) and LATFRA (2005- 2009)). The main research is river fishes ecology with special interest of migratory species. He has involved in International Council for the Exploration of the Sea (ICES) since 1995 as member of working groups of Baltic salmon (WGBAST) and eel (WGEEL), as well as member of ICES Advisory committee (ACOM). Janis Birzaks is author of about 30 publications.
He has a biologist diploma (1987).
Address: Lejupes 3, LV- 1076, Riga, Latvia
Phone: +371 67612536
E-mail: janis.birzaks@bior.gov.lv

Kaspars Abersons, M.Sc. in Biology (2002), researcher in the Inland waters laboratory, Fish Resources Research Department, Institute of Food Safety, Animal Health and Environment "BIOR" since 2010. Kaspars Abersons has been assistant in the Latvian Fisheries research institute (1998 – 2002) and researcher in the Latvian Fish resources agency (2006 - 2009). The main research object is River lamprey. He is also involved as an expert in the evaluation of the human activities on fish resources.
Kaspars Abersons contributed in the ICES Annual Science Conference 2011 with the poster "Long term dynamics of river lamprey fishery in Latvia" (as a second author). He is also author of five articles published in the Latvian Fisheries yearbooks.
Address: Lejupes 3, LV- 1076, Riga, Latvia
Phone: +371 67612536
E-mail: kaspars.abersons@bior.gov.lv

Jānis Birzaks, Kaspars Abersons. Antropogēnā ietekme uz upes nēģa *Lampetra fluviatilis* nozvejas dinamiku Daugavas baseinā
Upes nēģis ir viens no nozīmīgākajiem Latvijas iekšējo ūdeņu zvejas objektiem. Daugavā upes nēģa nozvejas īpatsvars pēdējos gados ir 30-50% no kopējā šeit nozvejoto zivju daudzuma.
Līdz 1974. gadam tika pabeigta Daugavas HES kaskādes būve, pēc kā Daugavas baseins faktiski zaudēja vērā ņemamu nozīmi upes nēģa un citu ceļotājzivju resursu dabiskajā atražošanā.
Upes nēģa nozvejas dinamikā Daugavā var izdalīt trīs atšķirīgus periodus. Laikā līdz 1975. gadam reģistrētas augstas nozvejas, kas caurmērā pārsniedza 30 t gadā un augstāko līmeni sasniedza 1962. un 1972. gadā (52 t). Tam sekoja straujš nozveju kritums un ļoti zemu nozveju (no nepilnas tonnas līdz dažām tonnām) periods līdz 1989. gadam. Turpmākajos gados upes nēģu gada nozvejas Daugavā pieauga, un kopš 2006. gada nozvejas svārstās starp 22 t un 31 t.
Upes nēģu nozveju kritums sakrīt ar Rīgas HES ekspluatācijas uzsākšanu. Taču šajā laikā novērojama nēģa nozvejas samazināšanās arī citās Rīgas jūras līcī ietekošajās upēs. Lielākā daļa pētnieku nozveju kritumu šajos gados saista ar gan ar Daugavas HES kaskādes izveidošanu, gan izmaiņām Rīgas jūras līča ekosistēmā, ko izraisīja masveidīga mencu ienākšana līcī.
Turpmākā nēģu nozvejas palielināšanās sakrīt ar nēģu mākslīgās pavairošanas uzsākšanu Latvijā. Taču tās efektivitāte ir visai apšaubāma. Netālu esošajā Gaujā, kuru hidrotehnisko būvju celtniecība ir ietekmējusi minimāli, nēģu nozvejas pēdējos gados turpina samazināties un pašlaik gada nozvejas ir 20 t līmenī. Neskatoties uz regulāru mākslīgi pavairotu nēģu kāpuru izlaišanu, tā nozveja Gaujā ir aptuveni desmit reizes mazāk nekā 1960-tajos un 1970-tajos gados.
Savukārt Daugavā tajā pašā laikā nēģu nozvejas ir palielinājušās un pietuvojušās 1970-to gadu līmenim. Nozveju svārstības Daugavā un Gaujā liecina, ka iespējamais to iemesls ir nēģa nārsta bara pārdalīšanās starp šīm upēm, ko izraisījusi Daugavas pārveidošana. Nēģu resursu saglabāšanai nākotnē var būt nepieciešamas izmaiņas nēģu zvejas un mākslīgās atražošanas organizēšanā šajās upēs.

Янис Бирзакс, Каспарс Аберсонс. Антропогенное влияние на динамику вылова речной миноги *Lampetra fluviatilis* в бассейне реки Даугава
Речная минога является одним из важнейших объектов промыслового рыболовства во внутренних водах Латвии. Вылов миноги в реке Даугава в последние годы составляет 30-50% от общего вылова миноги в стране в целом.
До 1974 года было завершено строительство каскада Даугавских ГЭС, после чего река почти полностью потеряла значение в воспроизводстве проходных рыб.

DOI: 10.2478/v10145-011-0025-z *2011*
Volume 7

В динамике вылова миноги в реке Даугава можно выделить три периода. До 1975 года, в среднем, вылавливалось 30 т миноги в год, с максимальными уловами 52 т в 1962 и 1972 годах. В следующий период до 1989 года уровень вылова снизился до 1 т и меньше. После чего выловы миноги увеличились, и после 2006 года составляют 22-31 т в год.

Снижение вылова миноги совпадает с введением в эксплуатацию Рижской ГЭС. Однако, в это время снизился уровень вылова миноги по стране в целом. Болъшинство исследователей указывают, что в 1970 годах произошли существенные изменения в биоте Рижского залива, связанные с массовым заходом трески.

Последующее увеличение вылова миноги совпадает с началом исскусственного воспроизводства этого вида. Однако, в соседней, нетронутой гидростроителъством реке Гауя, несмотря на регулярный выпуск заводских личинок, выловы миноги, в целом, продолжают сокращаться, достигнув 20 т, что более чем 10 раз меньше, чем в период 1960-1970 годов.

В реке Даугава в это же время выловы миноги увеличились, достигнув уровня 1970 г. Данные по вылову миноги в реках Гауя и Даугава свидетельствуют о том, что возможная причина этого явления - перераспределение нерестового стада миноги между реками вследствие антропогенных изменений в реке Даугава. С целью сохранения запаса миноги в будущем требуются изменения организации лова и искусственного воспроизводства миноги в обеих реках.