PEARL MUSSEL IN THE NAUTSIJOKI RIVER VALLEY, PASVIK – INARI AREA (KOLA PENINSULA, BORDER BETWEEN RUSSIA, NORWAY AND FINLAND)

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Reliable information about the presence of the freshwater pearl mussel in NW Kola Peninsula in the early 21st century is available from the Pasvik-Inari area, on the border between three countries – Russia, Norway and Finland. The study area was the Nautsijoki River – a tributary of the Paz River. The pearl mussel population density varies from the source to the mouth of the river. The highest density was 17 ind./m^2 (1977–1978) and 50 ind./m^2 (2003–2004). No definite conclusions regarding the population dynamics can be drawn. Studies of the population in the Nautsijoki River and other parts of the Paz River watershed, particularly within the Pasvik Reserve, should be continued. The main limiting factor is uncontrolled salmon fishery. Detailed study of the population, recovery of the numbers of salmonids – hosts of pearl mussel larvae, regulation of fisheries, and establishment of a protected area in the Nautsijoki River valley would promote conservation of the species.

Key words: pearl mussel, population, density, distribution, Pasvik-Inari area, the Nautsijoki River, Kola Peninsula, Pasvik Reserve.

INTRODUCTION

The bivalve freshwater pearl mussel (*Margaritifera margaritifera L.)* is an indicator of the water ecosystem status. This species, formerly widespread in freshwaters bodies in the north of European Russia, was barbarically exterminated by so called "Russian pearls" harvesting (Kazanskiy, 1891; Vereshchagin, 1929). By the late 18th – early 19th century already, the harvesting practice had locally declined because of the lack of the mollusks. In the Pasvik-Inari area however (Fig. 1), it continued until World War II, when pearl mussels were fished both by Eastern Sámi and by professional pearl fishers (Oulasvirta et al., 2006).

There existed also other reasons for the decline in one of the world's northernmost populations of the pearl mussel – the Pasvik-Inari area population. After the War, industry in the region was rapidly developing. The mining and smelting enterprise Pechenganickel was built. It generates air-borne pollution and discharges wastewaters in the Paz River watershed. Seven hydropower plants have been operating on the river since the 1950s. The flow is now regulated, and natural development of salmonid populations is hampered. Also, some settlements and frontier posts have been built. Uncontrolled fishing for salmonids by local people and visitors in the Paz River watershed in the second half of the 20th century and at the beginning of the 21st century sharply reduced their numbers. As the result, the freshwater pearl mussel nearly disappeared from most waterbodies where it used to be common.

The pearl mussel is included in the IUCN Red List (IUCN, 1996), Red Data Books of East Fennoscandia (1998), Murmansk Region (2003), and others. It is recognized as a rare vulnerable or endangered species in need of protection and comprehensive study nearly everywhere. The main limiting factors are rapacious harvesting, water pollution and reproductive problems related to the decline in salmonid numbers (Red Data Book..., 2003).

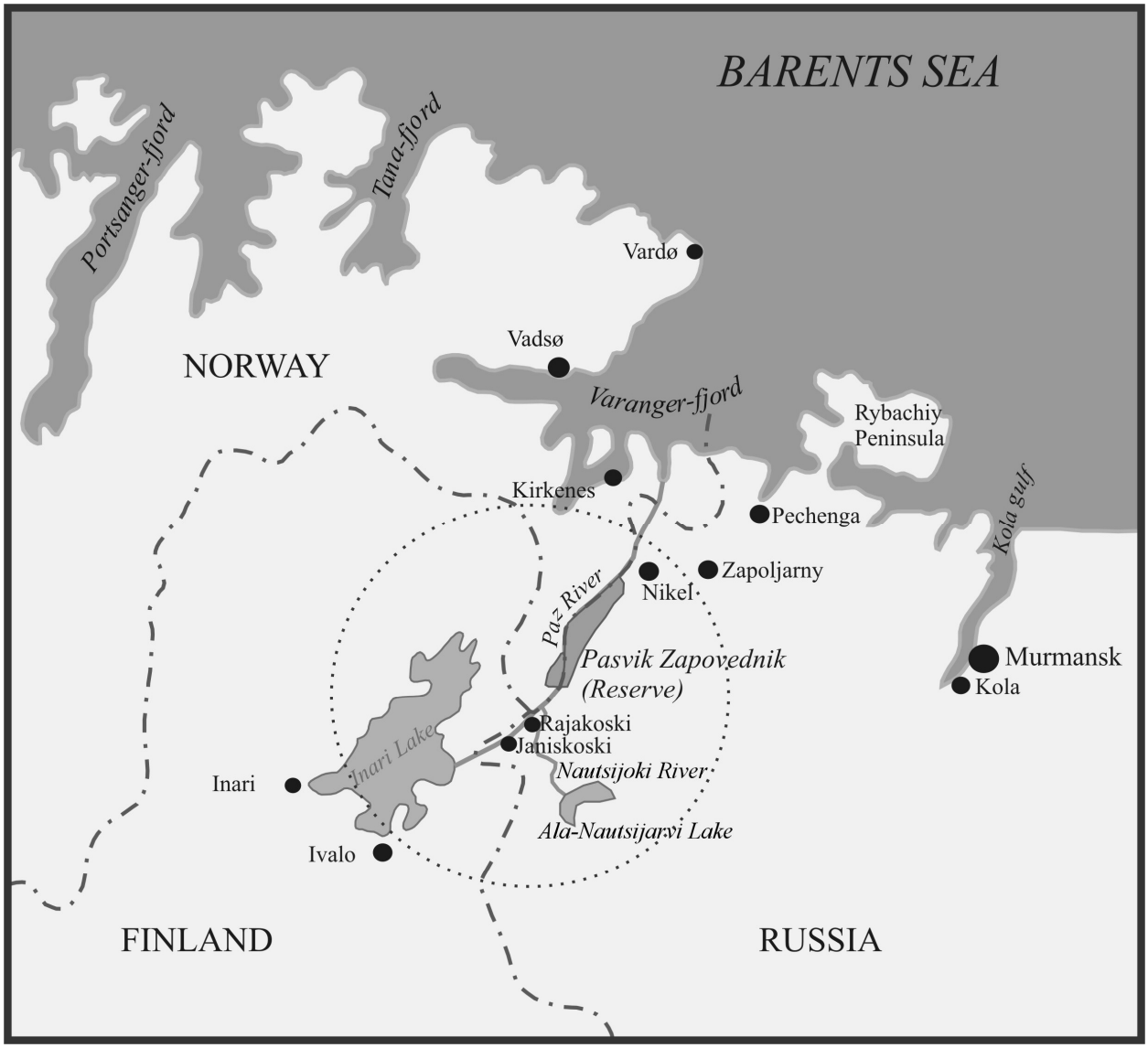

Fig. 1. Map of the Pasvik-Inari area

Pearl mussel studies in the Kola Peninsula began early in the 20th century (Zhadin, 1939; Graevskiy and Baranov, 1949). They became more extensive in the late 1980s and early 1990s, when they mostly covered the watershed of rivers Varzuga and Umba (Zyuganov et al., 1993; Prokhorov, 1995). In the past 20 years, the species has been actively studied in Europe (Larsen et al., 2000; Oulasvirta, 2006) and the European part of Russia (Zyuganov, 2005; Bespalaya et al., 2007). Presence of the freshwater pearl mussel has been confirmed for the Lapland Reserve (Gilyazova, 2000; Red Data Book..., 2003).

The first post-war surveys for pearl mussel populations in NW Kola Peninsula were carried out in rivers Nautsijoki and Pechenga. They were implemented by Primorskaya geological party (directed by B.F. Golubev) under the Ministry of Geology (SeverQuartzSamotsvety Division) in 1977 and 1978 (Golubev, 1978). The materials of the report are published for the first time.

Much later, in 2003–2006, the international project "Presence and status of pearl mussel populations in the north-east of North Calotte" was carried out within the Interreg III A Kolarctic programme. Its aim was to investigate some rivers in the border area of Finland, Russia and Norway with known historical habitats of the pearl mussel (Oulasvirta et al., 2006; Oulasvirta, 2006). In the summer periods of 2003-

2004, the international team surveyed the Russian side of the Pasvik-Inari area, namely the Nautsijoki River in the Paz River watershed.

The Paz River (Paatsjoki in Finnish, Pasvikelva in Norwegian) originates from Lake Inari in Finnish Lapland, and then flows through Russian territory. The middle course of the river is the national border between Russia and Norway. Finally, the river empties into the Barents Sea in Norway. Thus, the Paz River is common for the three countries. The river drains an area of 20 890 km^2. Nearly 70% of the drainage area is in Finland, 25% is in Russia, and 5% is in Norway. The river is 147 km long, its drop is 119.6 m, and its slope is 80 cm/km, wherefore the streamflow is high. In the Paz River mouth, mean annual streamflow is 187 m^3/sec, and mean annual runoff is 11.57 km^3 (National Water Cadastre, 1989). Such high flow rate and the presence of rapids that remain ice-free even in heavy frost had prompted the construction of a series of hydropower plants. Paz has many tributaries, of which the longest and the most full-flowing ones are Nautsijoki, Kornetijoki, Seigijoki and Laukkujoki.

The Nautsijoki River has its source in Lake Ala-Nautsijärvi and discharges into the Paz River in its upper course north of Rajakoski, close to the southern end of the Russian-Norwegian border (Fig. 2). Nautsijoki is 36 km long. It is a meandering river with low swampy banks. Closer to the mouth, the banks may be high, up to 2.5 metres. A few nameless streams join the river. The river is mostly still-flowing with some rapids: in its upper course, 4 km from the source, and 0.5 km downstream of its left-side tributary Kohisevanjoki. The channel is on average 35 metres wide and 2–3 metres deep. The flow rate varies from 0.5 m/sec in still sections to 1.5 m/sec in the rapids. The riverbed is mainly sand and pebbles, with a lot of boulders. The water is yellowish; the visibility is up to 1.5 metres. Most runoff is from snowmelt. Some rapids are ice-free all year round.

The territory surrounding Nautsijoki is mostly covered with lakes and forest, with a high proportion of wetlands. The ridges and chains of hills in the predominantly hilly-ridge terrain (abs. elevations 120–200 m) mainly stretch from north-east to south-west; their height varies from 10-60 m to 180 m. The ridge crests are undulating, and the hilltops are either flat or dome like. The slope gradient of the ridges and hills is up to 10°. Flat swampy lowlands separate the ridges and chains of hills. Strings of lakes cross many of the lowlands. The lakes are connected by channels, forming a line of successive water barriers (Oulasvirta et al., 2006).

Human pressure on the area is moderate. Nautsijoki valley used to be covered in old-growth pine forest, but in the second half of the 20th century the forest was cut down by Verkhnetulomskiy logging company. Some small fragments of the pine forest with lichen in the ground cover have survived, but most of the forest today is mixed birch-pine stands with few spruce trees. There is a road from Nikel to Virtaniemi close to the mouth of the Nautsijoki River. The settlements of Rajakoski and Janiskoski with a population of about 400 people, and three hydropower plants (Kajtakoski, Janiskoski and Rajakoski) are within a distance of 10 km from it. The settlement of Nikel, which comprises the Kolskaya GMK industrial premises, is 100 km NE of it. At present, the main human impact on the Nautsijoki drainage basin is connected with fishing and picking of berries and mushrooms in summer and autumn. These activities result in littering of the river banks and the bottom.

Pasvik Strict Nature Reserve lies to the north of Nautsijoki, in the middle of the Paz River valley, at the border between Russia and Norway. Its area is 147 km^2, of which over 20% is water – the Paz River, other rivers and streams, lakes. Surveys of several sites on the Norwegian side of the Paz River failed to find any pearl mussels there. A number of reasons, first of all border regulations on the Russian side, have made thorough surveys of the Paz channel and its tributaries within the reserve impossible.

MATERIALS AND METHODS

The 1977–1978 expedition explored the Nautsijoki River from the source to the mouth. The tributaries were not surveyed except for the place where Kokhisevanjoki joins Nautsijoki. The bottom was examined from the boat through a «Korean window» (a box with glass). The number of molluscs per square meter was counted, the length of the shells was measured, the substratum was

assessed, and flow velocity was determined. Every other kilometre, divers examined the bottom to more accurately count the mussels in the sample plots. Every sample plot (1 m^2) was numbered and mapped; places with different densities of molluscs were marked (Fig. 2).

In 2003-2004, the international team interviewed local people in Finnish Lapland who remembered or knew something from their ancestors about pearl fishing in Pasvik-Inari area. Locations for the field work were chosen using results of the interviews and analysis of the literature.

The researchers either went snorkelling in wetsuits or used an aquascope to count the number of the pearl mussels along and across the river/stream. Cross-sectional counts were usually done in pairs, one diver moving from the left-side bank, the other one – from the right-side bank. The counts in small rivers and streams were carried out by one diver. Information on the staring point and the end point of the transects was recorded in the survey form. The length and width of the river and the transect were measured, the number of pearl mussel specimens found was indicated, the flow rate was determined, the riverbed topography and the substratum were assessed.

The mussels found were grouped into several classes by size: less than 3 cm, 3-7 cm, 7-10 cm, and bigger than 10 cm. Three samples ten mussels each were taken for the analysis from different parts of the river (sampling points 1, 3, 5; Fig. 3). The sampling was random. The mussels were returned to the river once measured and weighted. Only adult and mature individuals were treated because juveniles stayed in the bottom sediments, and were therefore not used in the assessment of the population status (Oulasvirta et al., 2006; Oulasvirta, 2006).

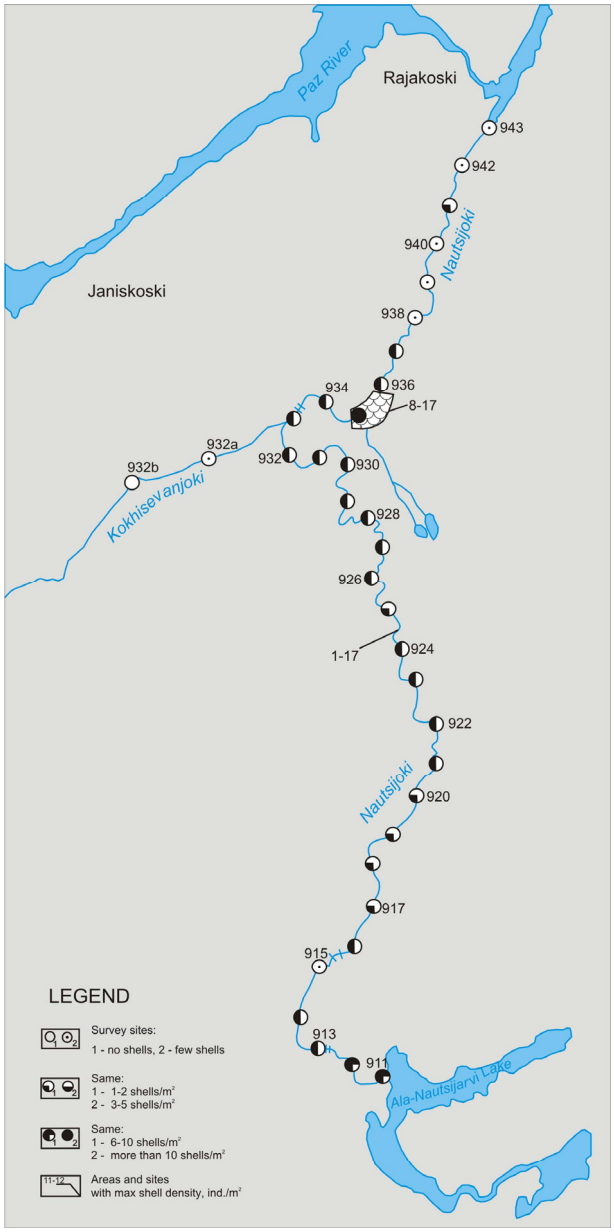

Fig. 2. Distribution of the pearl mussel in the Nautsijoki River watershed in the period from 1977 to 1978 (Golubev, 1978)

RESULTS AND DISCUSSION

Colonies of *Margaritifera margaritifera* were found throughout Nautsijoki when the river was surveyed for the first time in 1977-1978. No pattern could be distinguished in the distribution of the colonies. Mean density of the pearl mussel population in the river was 1-5 ind./m^2. A 50 000 m^2 area (1000 m long, 50 m wide, with a mean depth of 2.5 m) with a maximum density of the micro population – 13 ind./m^2 (data from 18 sample plots), was distinguished 7 km upstream of the river mouth. The density was quite even throughout this area, so that the mussel abundance there was about 650 000 individuals. Also, sites with a higher density – 17 ind./m^2, were found in the lower course of the river (Golubev, 1978). The population status was assessed as good.

The age composition of the population was not evaluated; only adults were counted; average shell length was 100–120 mm.

Surveys carried out in 2003–2004 also revealed the presence of the pearl mussel in the Nautsijoki River; the best population was found in its tributaries.

Population with the highest density – more than 50 ind./m^2, was found in a nameless tributary in the middle of the Nautsijoki River Valley – site 14 (Fig. 3). The number of the molluscs varied from the source to the mouth of the river in the following way: 30 ind. per 500 metres of the river (upper course, site 5), 21 ind. per 100 m (middle section, site 2), 520 ind. per 350 m (lower reaches, site 3). The number of pearl mussels found in the tributaries was the following: 812 ind. per 700 m (site 14), and 429 ind. per 300 meters of Kohisevanjoki – site 3 (Oulasvirta et al., 2006).

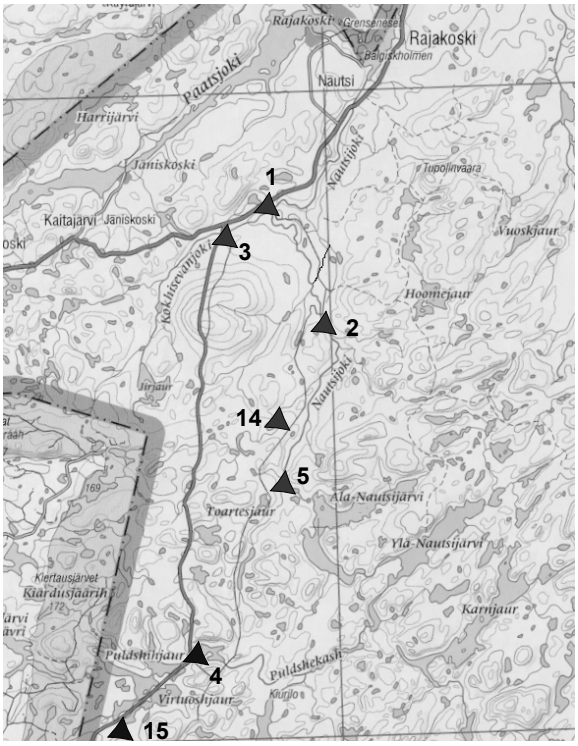

Fig. 3. Nautsijoki watershed coverage by 2003–2004 surveys (Oulasvirta et al., 2006). Sites 1, 2, 3, 5, 14 – pearl mussel found, 4, 15 – not found

According to the information based on three samplings, average shell length was 105 mm (min – max 80-124 mm) in the Nautsijoki River (main stream, site 1), 100 mm (82-110 mm) in Kohisevanjoki (site 3) and 98 mm (65-130 mm) in the nameless tributary of the Nautsijoki River (site 14). Judging by these parameters, the age of the populations in these three rivers may vary from 20 to 150 years or more. The smallest pearl mussel was 1.8 cm (Oulasvirta et al., 2006). This fact evidences ongoing reproduction of the population in the Nautsijoki system.

The main aim of the two expeditions was to get general information about the presence of *Margaritifera margaritifera* in the Nautsijoki River watershed. Therefore, these results alone do not allow for a reliable estimate of the population abundance in the river at large.

No pearl mussels were found in the Paz River. This does not mean however *Margaritifera* is absent also from other parts of its watershed.

CONCLUSIONS

Habitation of the pearl mussel *Margaritifera margaritifera* has been ascertained in the Nautsijoki River basin in the Pasvik-Inari area. The populations there occupy the species' typical High North habitats. The population density varies significantly from the source to the mouth, as indicated by the data received in1977–1978 (17 ind./m^2) and in 2003–2004 (50 ind./m^2). The dynamics of the species numbers could not be traced because the later surveys did not cover the whole river, data on mean density are missing, and so on. Further detailed surveys are needed to get more complete information on the present day status of the pearl mussel population, its abundance and biological characteristics, particularly reproduction. The issue is of international importance and can be dealt with within bilateral or trilateral projects. Human pressure has not yet destroyed the population. One cannot definitely conclude that its numbers have decreased under human impact because this would take specialized research.

It is obvious that the lack of information about the pearl mussel as well as selective surveys of only a few streams where pearl fishing used to be practiced could not provide us with a comprehensive picture. It would be rather difficult to do the job in the future not only for the lack of

money but also for the lack of qualified divers-researchers in Russia. Since this fact hampers the study of this rare species, special courses should be organized for Russian researchers.

It is necessary to proceed with the research, especially given that there now exists a close international cooperation network on this issue in the Pasvik-Inari area, and exchange of experience would create a more comprehensive image of the pearl mussel life in its northernmost habitat. This is first of all important for the watercourses where the pearl mussel has already been found, as well as for the unsurveyed rivers and streams, e.g. in Pasvik nature reserve and for other watercourses in the border area.

An issue to be seriously addressed is the industrial impact on the pearl mussel population in the Pasvik-Inari area (Kolskaya mining and smelting company, hydropower plants). Measures should be taken also to restore the population of salmonids – typical hosts of pearl mussel larvae.

Unregulated fishing and poaching are still a big problem in the region. One should take care to conserve the brown trout population lest it becomes irrecoverable. This would not only benefit nature conservation but also help local people use natural resources sustainably. Awareness raising should therefore go along with active research and conservation measures. A useful step would be to publish a book in English to widely disseminate information among local people, specialists and authorities, and to design a website.

Setting up of a fishery- or integrated protected area in the Nautsijoki River valley would promote recovery of brown trout (host of pearl mussel larvae), further research into the status of the population, as well as enable some other studies, e.g. on post-felling successions.

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