Ann. Zool. Fennici 41: 191–194 ISSN 0003-455X
Helsinki 26 February 2004

The results of the introduction of coregonid fishes into Vashozero, a lake in southern Karelia

Nikolay Ilmast* & Olga Sterligova

*Institute of Biology KRC RAS, Pushkinskaya str., 11, Petrozavodsk 185610, Russia (*e-mail: ilmast@karelia.ru)*

Received 5 Nov. 2002, revised version received 3 July 2003, accepted 29 Aug. 2003

Ilmast, N. & Sterligova, O. 2004: The results of the introduction of coregonid fishes into Vashozero, a lake in southern Karelia. — *Ann. Zool. Fennici* 41: 191–194.

Vashozero is a lake located in the southern part of the Republic of Karelia (62°10´N, 34°27´E) in the Lake Onega basin. The fish community had few species before 1933. In 1933–1935, coregonid fishes (1.29×10^6 larvae of Lake Onega whitefish *Coregonus lavaretus* (L.), 0.94×10^6 larvae of Lake Ladoga ripus — a large form of vendace *C. albula* (L.), and 0.37×10^6 larvae of Lake Onega vendace *C. albula* (L.)) were introduced into the lake. The current study, conducted in 2000–2001, provided positive results for the status of European vendace in Vashozero. The vendace population in Vashozero has reached a level at which the biological indices of the species agree with the abiotic and biotic conditions of the environment. The species has reached equilibrium in the lake and a European vendace population has been formed.

Introduction

Aquatic organisms have been introduced and cultured in countries with warm climates since time immemorial. Nowadays, in some countries, introduced species make up 30%–40% of the ichthyofauna of their inland waters (Welcomme 1991, Cowx 1998, Karpevich 1998).

Although species introductions do not usually make an ecosystem more productive, they however sometimes replace species of low economic value with high-quality commercial fishes. It should be noted, however, that even a thoroughly planned and well-based introduction of a new species is environmentally and economically hazardous because it often results in a radical restructuring of food chains and the entire ecosystem (Reshetnikov 1980, Lever 1998). Therefore, before doing this work, one should estimate possible changes in the ecosystem and probable adverse consequences.

The arrival of new species directly affects the structure and function of communities. Therefore, it is important to study the structural characteristics of hydrobiont communities and to examine patterns in their qualitative and quantitative variation. The purpose of this study was to assess the results of the introduction of coregonid fishes into Vashozero.

The fish population of Vashozero consists of a small number of species. Before 1933, it consisted of perch *Perca fluviatilis* L., ruffe *Gymnocephalus cernuus* (L.), pike *Esox lucius* L., and burbot *Lota lota* (L.). The lake was chosen for the introduction of valuable fishes because it has pristine water and is relatively isolated. Coregonid species were introduced into the lake in 1933–1935 (Novikov 1948). A total of 1 290 000 larvae of Suna whitefish *Coregonus lavaretus* (L.), 370 000 larvae of Lake Onega vendace *C. albula* (L.) and 940 000 larvae of Lake Ladoga ripus *C. albula* (L.) was released. Stocking was done without preliminary catching of predatory fishes and without any special preparation of the lake.

Material and methods

Vashozero is a mesotrophic lake located in southern Russian Karelia (62°10´N, 34°27´E Lake Onega basin). It has a maximum length of 6.2 km and a width of 1.3 km (Table 1). It is shallow with a mean depth of 3 m and has no tributaries. Flowing from the lake into Kondopoga Bay of Lake Onega is Torpruchei Creek. The bulk of nutrients entering the lake are supplied by ground water. Underwater springs are a primary source of nutrients. Amateur fishing is common. The limnological characteristics of Vashozero are shown in Table 1.

Research was conducted in Vashozero in August and September in 2000–2001. Fish samples were collected with three gangs of 30 m long, 1.5 m high gill nets (mesh size 10, 12, 14, 16, 18, 20, 22, 24, 28, 30, 35, 40, 45, 50, and 60 mm). Nets were set overnight (12 h) perpendicular to the shore in the littoral zone and the profundal zone. The total mass and the number of fish per species were recorded for each catch. Material was processed by generally accepted methods (Chugunova 1959, Pravdin 1966, Lakin 1990). The indices estimated were fish body mass (g), body length (cm) as total length (AB), standard length (AD), fork length (AC), sex, and gonad maturation stage (levels of measurement precision were ± 0.5 g for fish body mass and ± 0.1 cm for fish body length). Kiselevich's scale (Pravdin 1966) was used to determine gonad maturation stage. The age of each fish was determined from its scales.

Results

The data obtained in the 1930s, 1940s, and 1950s showed that as a result of introduction, vendace and whitefish populations became established in the lake (Novikov 1959, Belyaeva 1967). In 1937, about 1.5 t of vendace were caught with gill nets and trap nets (Novikov 1959). In post-war years, catches decreased considerably, but later vendace became abundant again and the 1955 catch was as large as 10 t. Upon introduction into Vashozero, the small-sized form of Lake Onega vendace attained some morphological characters typical of a large form of vendace which is common in Karelian water bodies. In Vashozero, whitefish occurred in catches from 1937 to 1955 (in 1955, about 1000–1500 whitefish were caught) and Lake Ladoga ripus was encountered sporadically from 1943 to 1947. However, our studies show that at present neither whitefish nor ripus occurs in the lake, as none were recorded in the survey catch. Our studies show that vendace, ruffe, and perch are now the most abundant fishes in the lake. Predators, such as pike and burbot, are scarce. The spawn-

Table 1. Limnological characteristics of Vashozero.

Characteristics	Value of the parameters	Reference
Altitude (m)	114.5	Grigorjev & Grizevskaya 1959
Surface area (km^2)	5.58	Novikov 1959
Mean depth (m)	3	Novikov 1959
Maximum depth (m)	12	Novikov 1959
Water transparency (m)	5	Novikov 1959
Total mineralization (mg l^{-1})	23.2	Ilmast *et al.* 2002
Total P (mg l^{-1})	0.009	Ilmast *et al.* 2002
Total N (mg l^{-1})	0.88	Ilmast *et al.* 2002
Phytoplankton biomass (g m^{-3})	0.563	Ilmast *et al.* 2002
Zooplankton biomass (g m^{-3})	2	Ilmast *et al.* 2002
Macrozoobenthos biomass (g m^{-2})	1.7	Ilmast *et al.* 2002

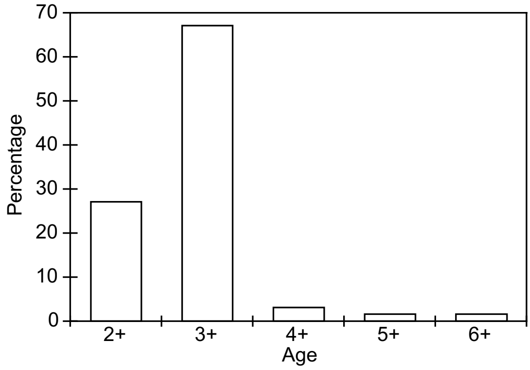

Fig. 1. Age structure of vendace catches in 2000.

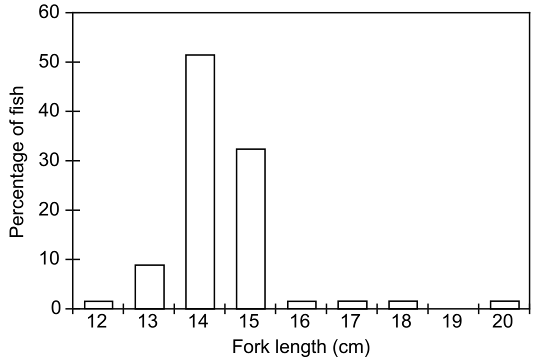

Fig. 2. Size structure of vendace catches in 2000.

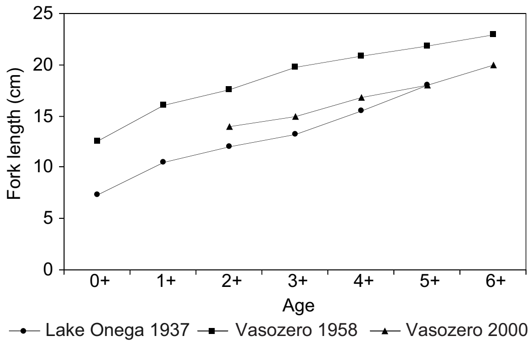

Fig. 3. Growth of vendace.

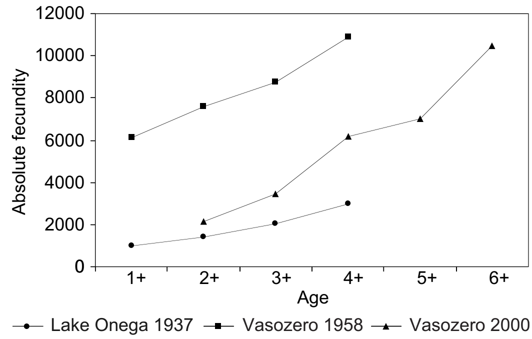

Fig. 4. Fecundity of vendace.

ing vendace stock consisted of fish of five age groups (2+ to 6+) with three- and four-year-old individuals being predominant (over 60%). The fish had a length (AC) of 12.8 to 20 cm (average 14.8 cm), a body mass of 18.8 to 92.3 g (average 31.5 g), an absolute fecundity of 700 to 10 500 eggs (average 3900 eggs), and a relative fecundity of 70 to 140 eggs g^{-1} (average 104 eggs g^{-1}) (Figs. 1 and 2). Initially, the vendace introduced into Vashozero surpassed the original small form of Lake Onega vendace in growth and fecundity. However, these indices are much lower now than those reported in the 1950s (Figs. 3 and 4).

Discussion

Our studies indicate that the introduction of coregonid species to Vashozero has had positive results, with the successful introduction of a well adapted, self-sustaining population of vendace. The adaptation of hydrobionts to a water body and their ability to survive and naturalize are known to depend on their specific characters and external environment. Changes in the growth rate and fecundity of the vendace in Vashozero are probably due to its relative scarcity in the initial stages of adaptation (the 1950s). As a result, in the final stages (the 1990s) the vendace was better supplied with food and its abundance stabilized. At present, the vendace population has adapted itself to the new water body and the biology of the stock reflects the lake's abiotic and biotic environmental conditions. Analysis of catches and the biological parameters of the vendace thus show that this species has naturalized in Vashozero.

The Suna whitefish introduced to Vashozero is a river-spawning form (the number of gill rakers is 29–40). The absence of such habitats is likely to account for the inability of the whitefish to establish a self-sustaining population in Vashozero. The result of our study suggests that although coregonid species are highly plastic, they are not universally adaptable. Also potential interspecific competition between whitefish and other fish species can be connected with the failure of the whitefish to successfully colonize the lake. It is known that perch, ruffe and cyprinids are potential competitors of benthic whitefish in Scandinavian lakes (Svärdson 1976).

Acknowledgements

This research was supported by the Russian Foundation for Basic Research.

References

Belyaeva, K. I. [Беляева, К. И.] 1967: [Variability of the Onega lake vendace acclimatized in L. Vashozero]. — In: [*Proceedings of the state research institute of lake and river economy*] 62: 115–120. [In Russian].

Chugunova, N. I. [Чугунова, Н. И.] 1959: [*Handbook on study of fish age*]. — AS USSR, Moscow. [In Russian].

Cowx, I. G. (ed.) 1998: *Stocking and introduction of fish*. — Fishing News Books , Blackwell Science, Oxford, UK.

Grigorjev, S. V. & Grizevskaya, G. L. [Григорьев, С. В. & Грицевская, Г. Л.] 1959: [*The catalogue of lakes of KASSR*]. — AS USSR, Moscow. [In Russian].

Ilmast, N. V., Sterligova, O. P., Pavlovsky, S. A. & Kuchko, Ya. A. [Ильмаст, Н. В., Стерлигова, О. П., Павловский, С. А. & Кучко, Я. А.] 2002: [Monitoring of mesotrophic lake ecosystem]. — In: [*Ecology of northern territories of Russia. Problems, forecast of a situation, ways of development, decisions*] 1: 580–583. [In Russian].

Karpevich, A. F. [Карпевич, А. Ф.] 1998: [*The elected papers: acclimatization of hydrobionts and scientific bases of aquaculture*, vol. 2]. — Pamyatniki Istoricheskoy Mysli, Moscow. [In Russian].

Lakin, G. F. [Лакин, Г. Ф.] 1990: [*Biometry*]. — Vysshaya Shkola, Moscow. [In Russian].

Lever, C. 1998: Introduced fishes: an overview. In: Cowx, I. G. (ed.), *Stocking and introduction of fish*: 143–152. Fishing News Books , Blackwell Science, Oxford, UK.

Novikov, P. I. [Новиков, П. И.] 1948: [Observation for survival of coregonid fishes in conditions of a shallow lake]. — *Bulletin of fish economy of Karelo-Finnish SSR* 3: 38–43. [In Russian].

Novikov, P. I. [Новиков, П. И.] 1959: [Vashozero]. — In: [*Lakes of Kareliya (nature, fish and fish economy)*]: 312–318. State Publishing House of KASSR, Petrozavodsk. [In Russian].

Pravdin, I. F. [Правдин, И. Ф.] 1966: [*Handbook on fish study*]. — Pischevaya Promyshlennost', Moscow. [In Russian].

Reshetnikov, Y. S. [Решетников, Ю. С.] 1980: [*Ecology and systematics of coregonid fishes*]. — Nauka, Moscow. [In Russian].

Svärdson, G. 1976: Interspecific population dominance in fish communities of Scandinavian lakes. — *Institute of Freshwater Research Drottningholm*, Report 55: 144–171.

Welcomme, R. L. 1991: International introductions of freshwater fish species into Europe. — *Finnish Fisheries Research* 12: 11–18.