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The commercial coregonid fishery in northernmost Finland — a review

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In northernmost Finland, in lake Inari (1100 km^2) and the reservoirs, Lokka and Porttipahta (total 630 km^2), commercial fishing is significant for its economical and social aspects. Local European whitefish (*Coregonus lavaretus*) is the most important catch species. Two new coregonids were introduced: vendace (*Coregonus albula*) in the Inari area in the 1950s, and peled (*Coregonus peled*) into the reservoirs in the 1970s. Later these species have naturally succeeded in reproduction. In lake Inari, the commercial fishery originated in the 1930s and in the reservoirs in the 1980s. Essential for the development of the commercial fishery was the modern infrastructure, established in the 1980s, when the stocks of vendace and peled became dense. The commercial fishery took up trap netting and trawling, in addition to gillnetting. The number of commercial fishermen increased and the commercial coregonid catches peaked at 350 tonnes in both areas. After the collapse of the vendace and peled stocks, European whitefish has maintained the commercial fishery. Today, in all about 50 commercial fishermen supply the market with high-quality coregonids.

Introduction

The coregonid species are prominent members of the fish stocks in lake Inari and in the man-made reservoirs, Lokka and Porttipahta. In addition to the indigenous and polymorphous European whitefish (*Coregonus lavaretus*), a new species, vendace (*Coregonus albula*), was introduced into the watershed in 1956, 1964–1966 and was first observed in lake Inari in 1973 (Mutenia & Salonen 1992). In the reservoirs a new species, peled (*C. peled*) was introduced in the 1970s (Salonen & Mutenia 1992). The surroundings of lake Inari and the reservoirs are mostly wilderness and sparsely inhabited areas. Commercial fishery is very important in the area, due to the high rate of unemployment and the lack of other employment opportunities. Since the beginning of the1980s, a great majority of the yield of coregonids has been commercially harvested in the reservoirs. In lake Inari, commercial fishermen have harvested the bulk of the coregonid yield in a period of high-level vendace stocks and catches in 1987–1992 (Salonen 1998). Nowadays a large and active group of local household fishermen harvest a considerable part of the fish yield.

This review gives a summary of the previous papers regarding the development of the fishery (Mutenia 1985a, 1985b, Mutenia & Ahonen 1990) and adds the recent data up to 2001. The

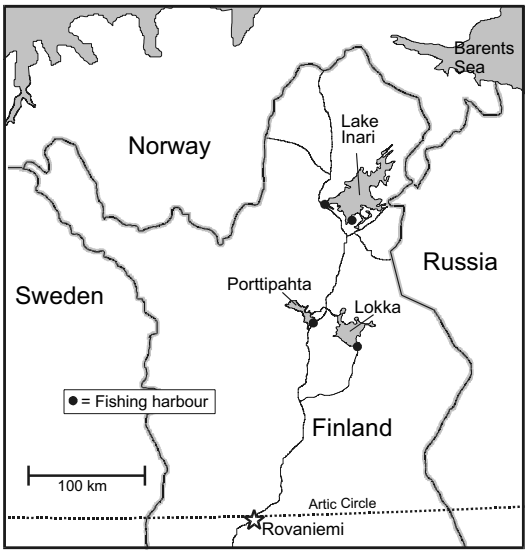

Fig. 1. Location of studied waterbodies and fishing harbours.

commercial fishery in these areas has quite a short, but very intensive history.

Study area and fishery statistics

In northernmost Finland, the largest coregonid waters are lake Inari, situated in the subarctic region of 69°N, 28°E, (surface area 1100 km^2) and the man-made reservoirs, Lokka and Porttipahta, in the boreal region of 68°N, 27°E (Fig. 1). Lokka was filled in 1967 and Porttipahta in 1970 and their combined maximum surface area is 630 km^2. The water level in lake Inari has been regulated since the 1940s. The regulation amplitude is at the maximum 2.36 m, but is usually around 1.5 m (Marttunen *et al*. 1997). In the reservoirs, the regulation level used annually has been around 2 to 3.5 m (Sutela *et al*. 2002). The reservoirs and lake Inari are covered by ice from 6 to even 8 months a year, so fishing under the ice is of great importance there.

In lake Inari, commercial fishery commenced in the 1930s. The most important commercial species were whitefish and from the 1980s also vendace and salmonids, e.g. brown trout (*Salmo trutta m. lacustris*) (Mutenia 1985a). In Lokka and Porttipahta, the commercial fishery first began with pike (*Esox lucius*), burbot (*Lota lota*) and perch (*Perca fluviatilis*), but then in the 1980s also with local whitefish and the peled (Mutenia 1985b). Commercial fishery statistics are based on (1) the obligatory bookkeeping for trawling and trap netting since 1987, (2) annual inquires, and (3) the data of local fish buyers (Mutenia 1995a, 1995b).

The development of the fishery infrastructure

Since the 1930s, there have been fishing camps and cottages at lake Inari. During the 1980s, fishing camps were built around the reservoirs. The regulation of the water level in lake Inari created negative effects for both the fish stocks and fisheries and, until the 1980s, commercial fishery was in depression (Mutenia 1985a). A court decision in 1975 gave way for a large-scale compensatory stocking and monitoring programme, which helped regenerate commercial fishery in the latter half of the 1980s (Salojärvi & Mutenia 1994, Mutenia & Salonen 1994).

Modern technology such as ice-cooling and collection and transportation network systems was introduced in 1982. The wholesale and processing units in Sodankylä began operation in 1986 (Mutenia & Ahonen 1990). In 1989–1990, two fishing harbours were built by lake Inari and one by each reservoir. These harbours are equipped with ice machines, refrigerators and deep-freezers, and scaling and filleting machines. This new technology was introduced following the education of the fishermen. The marketing channels were extended beyond these northern areas to encompass the entire country. The public sector, the state and the municipalities of Inari and Sodankylä granted financing for these large investments. Since 1995, the European Community has also participated in financing the fisheries sector.

Commercial fishermen and catches — huge variations

Subsequent to the construction of infrastructure for the fisheries, the number of commercial fisher-

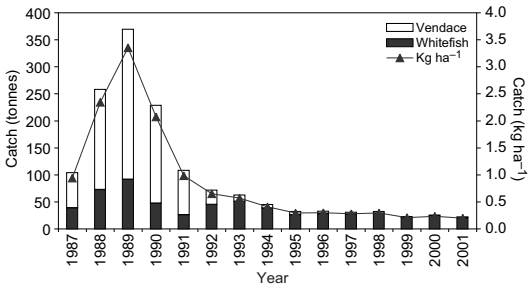

Fig. 2. Commercial catch of whitefish and vendace in lake Inari in 1987–2001.

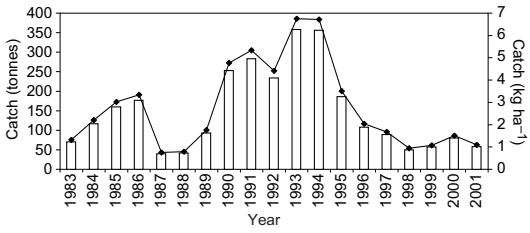

Fig. 3. Combined commercial catch of peled and whitefish in the Lokka and Porttipahta reservoirs in 1983–2001.

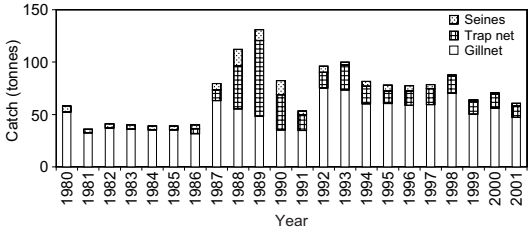

Fig. 4. Total catch of whitefish by gear in lake Inari in 1980–2001.

men began to grow. At lake Inari, their number peaked in 1989 to around 100, which resulted in extensive vendace and whitefish catches. In Lokka and Porttipahta the commercial fishermen numbered about 70–80 during the high yield of peled in 1994 (Mutenia 1995a, 1995b). In recent years, we observed about 20 professional fishermen in both study areas. In lake Inari and the reservoirs, the commercial fisheries have been mostly semi-professional in character. The qualifying criteria of commercial fishermen have changed over the recent decades. Today, fishermen who obtain at least 30% of their yearly income from fishing, are classified as professionals.

In lake Inari, before regulation, the total catch level had been estimated for 250 tonnes, from which 145 tonnes was whitefish (Mutenia 1985a). After regulation, the catch of whitefish dropped to approximately a third from the 1960s to 1986 (Mutenia & Salonen 1994). The vendace and whitefish fisheries with new gear (trawling, trap netting, winter-seining) began and the vendace became a commercial catch species for the first time in 1987. In 1989, the commercial vendace catch jumped to 280 tonnes and the whitefish catch reached nearly 100 tonnes (Fig. 2). Because of the depression of many vendace stocks elsewhere in Finland, the demand for lake Inari vendace was great. At the same time, the total catch of all species in lake Inari peaked at over 560 tonnes (over 5 kg ha^{-1}). In the 1990s, after the collapse of vendace stocks, the commercial vendace catch dropped to only a few tonnes and the whitefish catch has stabilized to a level of 20–30 tonnes in recent years (Salonen *et al*. 2002).

In Lokka and Porttipahta, the commercial coregonid gillnet fisheries began at the beginning of the 1980s and peled became the most important in the catch (Salonen & Mutenia 1992). The combined commercial catch from the reservoirs peaked at about 350 tonnes, about the same level as in lake Inari (Fig. 3). The catch was chiefly peled. The total commercial catch was 420 tonnes per year in 1992–1994 (Mutenia 1995b) and the highest total catch was over 500 tonnes (almost 10 kg ha^{-1}), including all species. In recent years, the combined coregonid catch was from 50 to 80 tonnes consisting mainly of whitefish. Of the above amount, around 80%–90% was caught by the commercial fishermen.

The largest coregonid catches in both lake Inari and the reservoirs were taken mostly with trap netting, trawling and winter seining. With regard to lake Inari's whitefish, gillnetting has proven important during the entire period and trap netting was broadly used in the commercial fisheries at the end of the 1980s (Mutenia & Ahonen 1990) (Fig. 4). The high vendace catches were taken by commercial trawling (Fig. 5). Fishing began with three trawl pairs (two-boat system) in 1987. At its maximum in the years 1989–1990 there were 16 trawl pairs in operation, the annual fishing effort used over 3000 hours with the CPUE of around 50 kg h^{-1} (Fig. 6). Since the middle of the 1990s, commer-

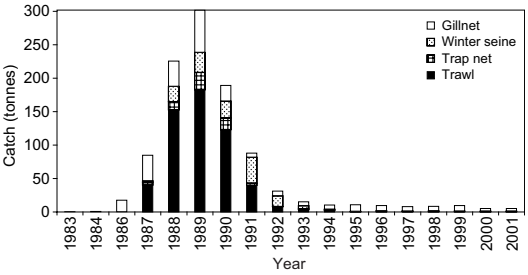

Fig. 5. Total catch of vendace by gear in lake Inari in 1983–2001. Data for 1985 not available.

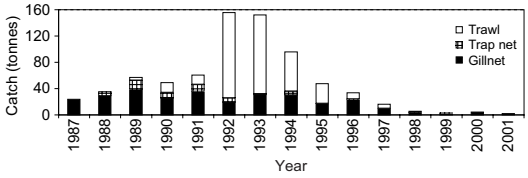

Fig. 7. Total catch of peled by gear in Porttipahta (mean surface area 17 500 ha) in 1987–2001.

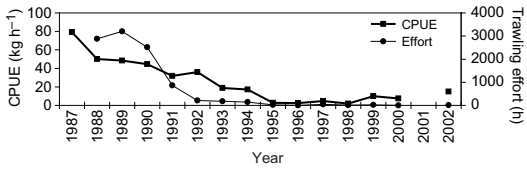

Fig. 6. Catch per unit of effort of vendace and fishing effort by commercial trawling in lake Inari in 1987–2002 (no trawling in 2001).

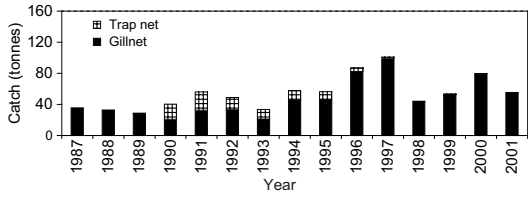

Fig. 8. Total catch of whitefish by gear in Lokka (mean surface area 35 500 ha) in 1987–2001.

cial trawling has practically ceased. In 2002, two trawl gangs dragged only a few trial hauls. The high yield of vendace was based on some very strong earlier underexploited year-classes, both from 1983 and 1984 and then in 1986 and 1989 (Salonen 1998). In the 1990s, only poor vendace year-classes were born, but the year-class 2000 was slightly stronger (Salonen 2004). The cold and harsh environmental conditions (north of the distribution area of vendace) affect the reproduction negatively (Salonen 1998, 2004).

In Porttipahta, the high peled catches were taken by commercial trawling, at a maximum of three trawl pairs (Fig. 7), and in Lokka by gillnetting and trap netting, at a maximum of 46 trap nets (Mutenia 1995b). After the collapse of the peled stock (Mutenia *et al.* 2000), the local whitefish has maintained commercial fisheries (Fig. 8). The high yield of peled was based on some very strong year-classes in 1986 and from 1989 through 1991. This was mainly supported by natural reproduction, which was very rare in Finland (Salonen & Mutenia 1992). The natural reproduction almost ceased due to more intensive water level regulation since 1993 than before (Sutela *et al.* 2002), and after 1991 only weak year-classes have hatched. The year-classes of 2000 and 2001 were notably better in Lokka (Sutela *et al.* 2004). Our assessments show that the use of newly hatched larvae in the stocking since 2000 seems to be profitable in Lokka.

We estimated that the total value of coregonid catches was at a maximum of about 0.7 million EUR in lake Inari in 1989 and 0.6 million EUR in the reservoirs in 1993–1994, with the current price level. In 2001, the estimated total value of the coregonid catch was about 0.3 million EUR in Inari and 0.4 million EUR in the reservoirs. These values were based on local producer prices, calculated from purchasing notifications in those years. Today, the high-quality processing of coregonids further increases the value of the catch, which is not included in the above-mentioned figures.

Conclusions and the future

Lake Inari and the Lokka and Porttipahta reservoirs are the northernmost large lake/reservoirs in the world, where the commercial coregonid fishery is significant. The local coregonids, whitefish in lake Inari and in the reservoirs, reproduce naturally and constantly. In lake Inari, there is also a compensatory whitefish stocking program. The introduced species, vendace and peled (outside their natural area of distribution), have created unexpected and large changes in catches. We estimate that at the same latitudes

in the range of Holarctic coregonid species, it is a unique situation that entrant species have caused so large a commercial fisheries boom as vendace and peled have done. The highest coregonid catches were based on strong, but irregular natural reproduction of vendace and peled (peled also stocked). Today, the vendace and peled populations are increasing in density due to the promising year-classes 2000 and 2001. The development of stocking practises of peled (fingerlings/larvae) makes it possible to increase the level of catches in the reservoirs. However, the instability of vendace and peled stocks is difficult for fisheries management in the long run. Today, in lake Inari there are only a few trawls left and none in the reservoirs. Fishermen face high risks when investing in new equipment due to the instability of the recently introduced coregonid stocks. Local whitefish stocks are more stable and constitute the grounds for commercial fisheries. The future development of fisheries management will be based on real time monitoring and follow-up studies in these areas.

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