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NASCO Implementation Plan For Salmon Management in Finland

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1. Introduction

In Finland, there are two rivers discharging into the Barents Sea, northern Atlantic Ocean, that support populations of Atlantic salmon, the rivers Teno (Tana in Norwegian) and Näättäjäjoki (Neidenelva in Norwegian). Both of them are border rivers between Finland and Norway. Therefore, the management of the rivers and their salmon stocks is based on bilateral agreements between the governments of the two countries.

Some reference is also made here to the potential salmon production in the River Tuloma system, which has its western headwaters in Finland and drains through north-western Russian Kola Peninsula into the Kola fjord, Barents Sea.

2. Aim

The governments of Finland and Norway, in their common agreement (1989), aim at maintain and enhance the anadromous salmonid stocks in the Teno river system through feasible fishery regulations. The aim of the agreement and the management measures is to conserve and maintain the anadromous salmonid stocks in a way that ensures the conservation of their biodiversity and natural production.

Corresponding aims are reflected in the bilateral agreement about fishery management in the River Näättäjäjoki.

3. The resource

The River Teno system (70°N, 28°E) has a catchment area of 16 386 km² one-third of it being located in Finland. The river runs into the Barents Sea through Tanafjord. The main stem of the River Teno, and one of the three main headwater rivers, the River Inarijoki, form the border between northernmost Finland and Norway (Fig. 1). The maximum distance salmon can migrate from the sea is more than 300 km along three main headwater branches, the Inarijoki, Karasjoki and Iesjoki. More than 1200 km of different stretches of the river system are available for anadromous fish. The River Teno is the most important and one of the largest salmon rivers in Finland and Norway.

Juvenile Atlantic salmon coexists with 16 other fish species in the River Teno system, although the occurrence of other species than salmon in shallow riffle and rapid sections of the rivers Teno, Utsjoki and Inarijoki is low and their densities negligible. New introduced

species, bullhead (*Cottus gobio* L.) in the River Utsjoki has expanded its distribution since late 1970's (Pihlaja *et al.* 1998) and occurs frequently in areas with low salmon density but is seldom found in areas with high salmon density

The River Teno salmon stock complex consists of several sub-stocks in different parts of the large main stem and there are more than 20 tributaries supporting spawning stocks. The stock complex shows high level of heterozygosity allowing a large number of genetically distinct sub-populations. The Teno salmon show also very diverse life history traits including exceptionally large variation in freshwater residence time, age at maturity and the extent of ocean migration. The smolt ages vary between two and eight (mostly 3-5) and spawning run consist of maiden individuals with one to five sea-winters and repeat spawners resulting in an exceptional total of 96 life history combinations of smolt ages, sea ages and previous spawning times. Until today there are no rigorous estimates on the yearly smolt production of the entire Teno system but it has been believed to vary between 1 and 2 million.

The significance of the River Teno system to the entire wild salmon production in the North Atlantic area is substantial. The total salmon production of the River Teno system including both sea and river catches and the spawning escapement is estimated to be up to 600 tonnes out of which 139 tonnes on the average has been caught annually in freshwater (range 70-250 tonnes in 1972-2005). Annual salmon catch in the River Teno system is the highest single river catch within the distribution area of Atlantic salmon, and it has accounted for up to 15% of all riverine Atlantic salmon harvests in Europe (1995–2001) and as much as 22% in 2001.

Näätämöjoki (Neidenelva in Norwegian; 69°N, 29°E, catchment area 2 962 km²), which also empties into the Barents Sea is another transboundary border river between Norway and Finland (Fig. 1). Distribution of salmon in the River Näätämöjoki covers 110 km of different stretches of the river system in the main stem and in two major tributaries. Annual salmon catches in the River Näätämöjoki vary typically between 6 and 12 metric tonnes. Salmon stocks in the rivers Teno and Näätämöjoki are conserved, maintained and enhanced only by fishery regulation as all fish releases are prohibited in these systems.

The large River Tuloma (catchment area 21 140 km²) discharges into the bottom of the Kola fjord, the Barents Sea, close to the city of Murmansk. The large majority, 84%, of the watershed is on the Russian territory; only the headwaters of the two main branches, the Rivers Lotta (Lutto) and Nota (Nuorti) are on the Finnish side. The River Tuloma has been one of the largest and most important Atlantic salmon rivers running to the Barents Sea, larger than any other river system in the Kola Peninsula. In the late 19th century, the annual salmon catch of the Tuloma river has been several dozens of metric tonnes, most likely exceeding 100 t. According to some historical Russian catch estimates, the annual salmon catch in the Finnish territory only may have been at a level of 15 t. After the construction of the Upper Tuloma hydropower dam in 1960's, the majority of the watershed area was left outside Atlantic salmon production. The watershed area above the Upper Tuloma dam (88% of the catchment area) is mostly wilderness with very few roads and negligible human population.

4. Fishery and management

Marine fisheries

After the closure of the Norwegian marine drift net fishery in 1989, salmon of the rivers Teno and Näätämöjoki are still subject to marine exploitation with numerous bag nets and bend nets during its feeding and homing migration along the Northern Norwegian coastline. This is clearly indicated by smolt tagging experiments in the River Teno mainstem in 1970s', when 45 % from recaptures of adult salmon were taken from the sea (10 % from Tanafjord, 35 % mainly in other coastal areas; unpublished data, Finnish Game and Fisheries Research Institute).

There has been a steady decline in effort of the Norwegian coastal fisheries, e.g. the number of gear units in operation on the northernmost coast in Finnmark has declined c. 25% over the last decade. In the Tanafjord, there were 219 bag nets and bend nets operating in the salmon fishery in 2003, whereas the annual average in 1994-1996 was 294 gears. At the same time, however, the coastal salmon catches in Finnmark have roughly doubled (Sturla Brørs, County Governor in Finnmark, Norway).

Smolt tagging in the 1970s' indicated that marine salmon fishing targeted mainly to 2SW salmon (58 %) and to lesser amount to 1SW (23 %), 3SW (17 %) and 4SW (2 %) salmon. After the drift net fishery was prohibited in 1989 the number of 2SW salmon increased in catches of the River Teno system. Smolt tagging experiments indicate that the coastal fishing in Tanafjord exploit more MSW salmon (2SW 35 %, 3SW 20 %) than small salmon (1SW 45 %) compared to the catches in the River Teno, where 1SW, 2SW and 3SW salmon comprise 65 %, 13 % and 22 %, respectively. Moreover, recent information collected in 2003 in the Tanafjord and in the River Teno salmon fisheries indicates that the sea fishing in coastal areas harvest relatively more large salmon than the fishing in the River Teno.

River fisheries

The River Teno salmon stocks are exploited in the river with various fishing methods including weir, gill net, seine, drift net and rod and line. The net fisheries are practiced by local people, mostly native Sámi people, and it is permitted by fishing rights based on land owning or inherited rights. Licences for some 15–20 000 angling days have been sold yearly over the recent years, more than 80% of those typically on the Finnish side.

Within the entire river system with tributaries included, the average proportions of different methods in salmon catches (in weight) in 1980–2002 have been 59% for rods, 20% for weir, 9% for gill net and 12% drift net. In both Finland and Norway the proportion of salmon catch with rod and line fishing has increased since 1980's, whereas in Finland the proportion in gill net fishing and in Norway the proportion in drift net fishing has declined over the past two decades.

Fluctuations in the salmon catches of recreational fishermen, as in all fisheries, are at least partly dependent on the fishing effort. The number of recreational fishermen is unlimited

and no quota or bag limit policies are practiced either in sport fishing or in different net fishing methods used by local fishermen. However, there is typically a positive relationship between the salmon stock abundance and the effort of recreational fishermen, even if their fishing effort shows a general long-term increase.

Effort of the various fishing methods can vary yearly, which can result in varying size-selective exploitation. Extreme flow in summer can prevent the use of weir and gill net. Similarly, late break-up of ice followed by high and late spring flood can prevent effective drift net fishing, which is permitted from May 20 until June 15. Nevertheless, there are significant correlations in the catch between fishing methods indicating that environmental circumstances in general are stable enough allowing undisturbed fishing for all fishing methods throughout the summer, and run size may generally drive the success of all fisheries.

In the River Näätamöjoki, fisheries for salmon mostly comprise rod and gill net fisheries. Gill nets are operated only on the Finnish side whereas a traditional seine net, “kápälä”, is at use on the lowermost part of the river on the Norwegian side.

Fisheries management

Salmon fishing in the River Teno system has been regulated since 1873 by bilateral agreements between Finland and Norway. A general fishery agreement has been concluded between the governments of Finland and Norway, and this agreement primarily regulates the local fisheries and their fishing rights. Tourist angling is regulated by regional authorities in both countries, and these regulations can be amended on a yearly basis. The latest general agreement, concluded in 1989, states that the fishing season commences on 20 May and terminates on 31 August. Net fishing is allowed for three days per week and drift net fishing can take place only from the beginning of the season until 15 June. All fishing is prohibited for one day per week (Sunday night-Monday night).

Fisheries on salmon originating from the rivers Teno and Näätamöjoki have been regulated also in the ocean. The most important management actions include the prohibition of the high seas salmon fishing since 1984 in North Atlantic through NASCO convention. Norway has taken further steps in improving salmon stocks by closing entirely the drift net fishery at sea since 1989 and by limiting coastal net fisheries.

Socioeconomic importance of salmon fisheries

Salmon fisheries in rivers Teno and Näätamöjoki have a great social and cultural importance to the local people, especially to the native Sámi people. Although the net fisheries are mostly not true commercial fisheries anymore, the impact of salmon catches to the household economies should not be underestimated. The importance of the recreational tourist fisheries to the local economy is substantial; an estimated value of a rod-caught salmon is c. 200 euros per kg.

Information on the socio-economic aspects of the recreational salmon fishing in the River Teno has been collected by the Finnish Game and Fisheries Research Institute for several

times over the past two decades: in 1981-82, 1985, 1991, 1996 and 2002. In connection with the yearly, routine postal questionnaires on their salmon catch, the fishermen have been asked about the costs during their salmon fishing trips, both locally in the river valley and during the journey. Information on the motivation, values, opinions and attitudes connected to the salmon fishing has also been collected.

5. Status of the salmon stocks

Monitoring of the salmon stocks in the rivers Teno and Nääämöjoki are based on long-term investigations carried out jointly by Finnish and Norwegian authorities. The long-term monitoring programme includes estimating the juvenile salmon abundances in permanent sampling sites (since 1979 for Teno, since 1990 for Nääämöjoki), catch and fishery statistics, and catch samples (since 1972). These programmes are carried out by Finnish Game and Fisheries Research Institute and the County Government of Finnmark, Norway.

In the absence of true measures of the salmon run sizes, the salmon catch is considered to represent a surrogate of abundance. The lack of catch quotas for any fisheries in these rivers and significant correlations in the Atlantic salmon catches between fishing methods indicate that the estimated numbers of salmon caught may reflect actual variations in the populations. In addition, significant relationships between the estimated numbers of salmon in the catches and the abundance of juveniles in subsequent years indicate that the catch may be realistic surrogate of the stock size (Niemelä et al., 2005).

In contrast to many areas around the North Atlantic Ocean, the salmon stocks of these northern rivers do not show a long-term decline but cyclic oscillation. The salmon catch of the Nääämöjoki show even an increasing trend over the past 30 years (Niemelä et al. 2004). Moreover, estimated abundances of 1SW and 2SW salmon and the previous spawners in the Teno have increased over the past 15 years (Niemelä et al. 2004, 2006). However, the estimated abundance of 3-4 SW salmon in the Teno seem to have somewhat decreased since the 1970s (Niemelä et al. 2004, 2006).

Similarly to the catch estimates, the juvenile indices in both river systems also show a cyclic fluctuation, which is in good accordance with the estimated earlier and subsequent adult salmon abundances (Niemelä et al. 2001, 2005).

A recently established video monitoring site at the outlet of the large tributary, the River Utsjoki, has indicated increasing smolt numbers over the past two years. The adult salmon counts at the monitoring site have been well in accordance with other, independent indices of run sizes (catch statistics, spawner counts).

6. Threats to the salmon stocks

Fisheries

Even if the weekly fishing time and the length of the fishing season have been reduced over the years since the first regulations in 1873, the technical development has improved the net fishing methods. Fishing effort in the River Teno on the Finnish side has increased

particularly in rod fisheries by the increase of recreational fishermen from 200 anglers in 1953 to 10500 anglers in 2002. Fishing days of anglers have increased from c. 600 in 1953 to 37 500 and 2002. Similar development has taken place on the Norwegian side where fishing days of anglers have increased from 1500 in 1980 to 8300 in 2002.

The economical value of salmon in 1970s' and 1980s' and even until early 1990s' for people living in the Teno river valleys was extremely high resulting in great interest in fishing and extensive exploitation. According to tagging experiments, harvest rates in the river fisheries could have reached the levels of 60–70% (Erkinaro et al. 1999; Karppinen et al. 2003). However, there has been an obvious change in salmon harvesting in latest years as many local commercial salmon fishermen have shifted to earn their incomes through recreational fishermen by renting out fishing boats and fishing camps and by offering guiding services. At the same time the price of wild salmon has declined significantly and effort in traditional net fishing methods has decreased accordingly. Drift netting remains the only net fishing method where effort has not declined and even young men seem to be interested in practicing it.

The historical distribution area of adult salmon in the River Teno system (c. 1 270 km) has declined covering today 860 km indicating too high exploitation especially in spawning areas in the uppermost tributaries and headwaters. It is most likely that some stocks adapted to the uppermost distribution areas have become threatened or extinct. MSW salmon has disappeared from some smaller tributaries compared to its historical distribution, and today 1SW salmon form the main component in those populations.

Aquaculture

The development of salmon aquaculture in North Atlantic and in particular on the Northern Norwegian coast has raised concerns about the possible negative impacts of the escaped wild salmon to the wild salmon stocks of the River Teno system. Although the monitoring programme has revealed only very low proportion of escaped fish in the catches during the fishing season (June–August), mostly varying between 0.1–0.5%, occasional sampling after the fishing season (September–October) has indicated much higher proportions of farmed fish, up to almost 50% in some samples. In addition, most of the escaped farmed salmon are found in the river fisheries in August, which also indicates late entry of these fish. This pattern raises concerns about the possibility that the fishery-dependent sampling may fail to detect the actual impact of escapees on the River Teno salmon populations and calls for more focused sampling programmes during the autumn and in the spawning grounds.

All aquaculture activities and transfers of live fish and eggs from other catchments are strictly forbidden in the catchment areas of the rivers Teno and Näätamöjoki.

Gyrodactylus salaris

The lethal parasite *Gyrodactylus salaris* has not been found in the rivers Teno and Näätamöjoki despite intensive monitoring programme, which started in early 1990s. New legislation and guidance for preventing the spread of this parasite have been introduced in both Finland and Norway during recent years. Widespread education programmes have

been started in recent years in order to improve the public awareness of the *Gyrodactylus*, its effects on Atlantic salmon stocks, and the measures required to prevent its spreading. This has included distribution of information in different forms, e.g. roadside signs, video tapes, leaflets handed out in various places, e.g. together with issuing salmon fishing licenses etc.

7. Future management needs

The rivers Teno and Näätämöjoki support basically healthy and self-supporting salmon stocks and the environmental status of the rivers is good with no major human-induced disturbances (e.g. Niemelä et al. 2001; Sivonen 2006). Therefore, there are no plans to start new large-scale action plans but the current management regime will be developed and generally continued along the present lines. Some activities on habitat enhancement have been carried out recently in the Teno system (Erkinaro 2003; Erkinaro & Erkinaro 2006) and continuation of some of those actions, e.g. culvert restoration, will be considered.

In December 2005, a joint Finnish-Norwegian meeting concluded that a working group, with members from both countries, should be established to draft a stock monitoring program, including knowledge requirements and research collaboration, that will meet the future challenges for a sustainable management of the River Teno salmon. The mandate of the working group is to:

- **Review the monitoring programmes and research projects that have been carried out in light of:**
 - The complexity of salmon stocks in the Teno
 - Relationship between production of juveniles and catch of adult salmon in different parts of the river system
 - Harvest of Teno salmon in modern sport fisheries and traditional fisheries
- **Review the reliability of the salmon catch records in Teno with tributaries**
 - Are the salmon catch records comparable among years and between mainstem Teno and tributaries?
 - Do catch records reflect differences in salmon production in different parts of the river system?
- **Identify the needs for future research and monitoring as a basis for sustainable management of the salmon stocks in the Teno**
 - Juvenile production in the main stem and tributaries
 - Smolt production and migrations
 - Return migration of Teno salmon in main stem and tributaries
 - Harvest of Teno salmon in sea and freshwater
 - Spawning of salmon in main stem and tributaries
- **Organization of the future work**
 - Collaboration and coordination between Finland and Norway
 - Compatible methods, both over time and in different parts of the river system

- The need for a mixed stock management according to NASCO's Decision Structure for Management of North Atlantic Salmon Fisheries
- Possible establishment of a permanent advisory committee for management of the Teno salmon

Based on the review of these themes, the working group is requested to suggest a priority list of actions necessary to reach the overall goal of future sustainable management of the salmon in the Teno River system.

There are no river-specific conservation limits for the rivers Teno and Nääämöjoki, although the Working Group of the North Atlantic Salmon of the ICES has estimated the pre-fishery abundances and established a "pseudo stock-recruitment" relationship with an estimate of the conservation limit for the Teno river. This is the only case for the ICES WG where the estimation has been carried out for an individual river. According to this analysis, the river Teno salmon stocks have been below the "conservation limit" over the past few years. Development of environment- and biology-based, more realistic conservation limits for the salmon stocks of the Teno and Nääämöjoki is an important future task.

In the case of the River Tuloma, there is a need for further cooperation between Finland and Russia and for a common fishery agreement. In addition, problems related to overcoming the hydroelectric dam and salmon access to the production areas are to be discussed and solved in the future. There are also questions related to the salmon stock rebuilding, e.g. concerning the possible donor stocks and related veterinary regulations.

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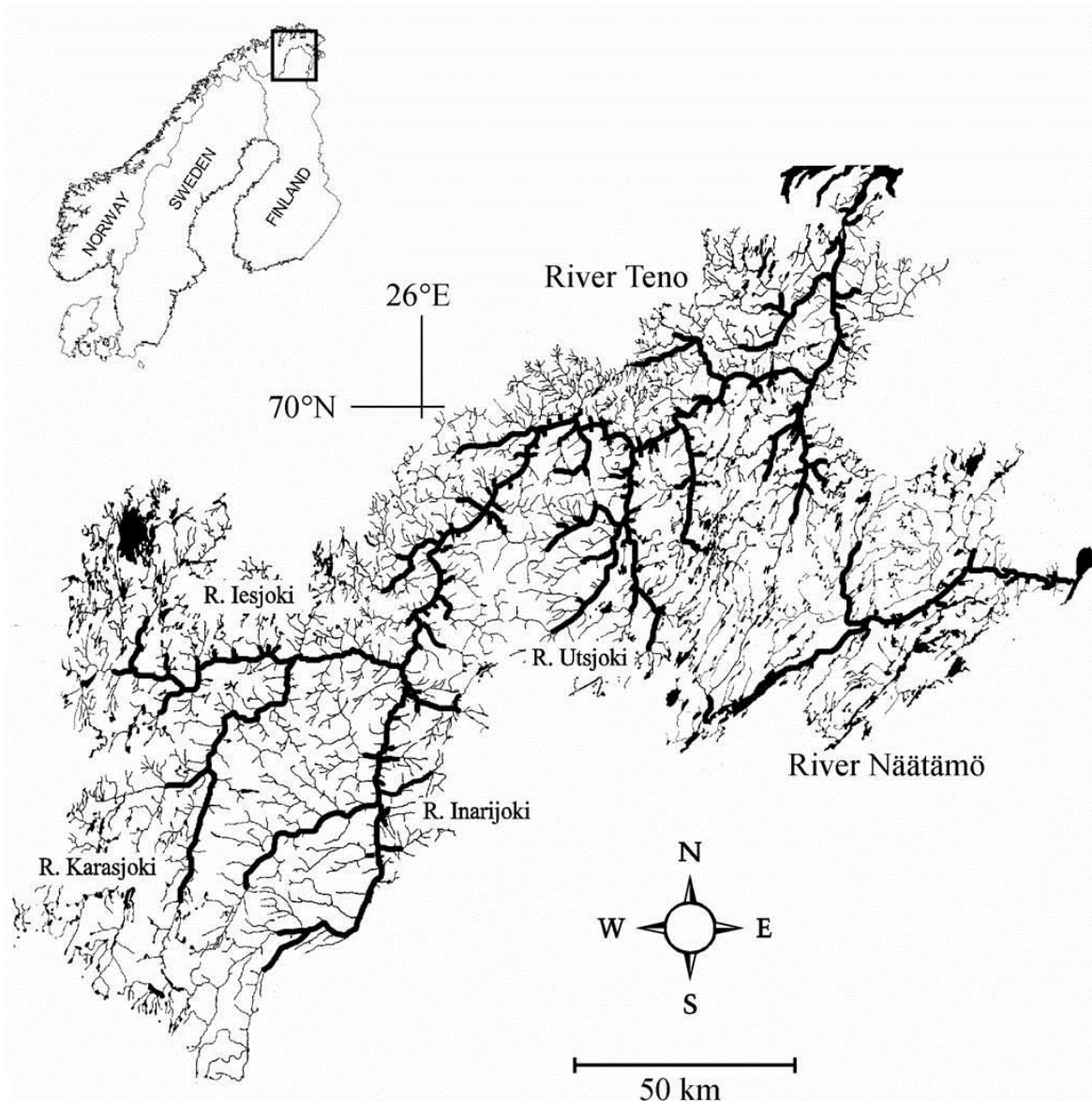


Fig. 1. The rivers Teno and Näätämöjoki in the northernmost Finland and Norway. Distribution area of Atlantic salmon is indicated by thick black lines.