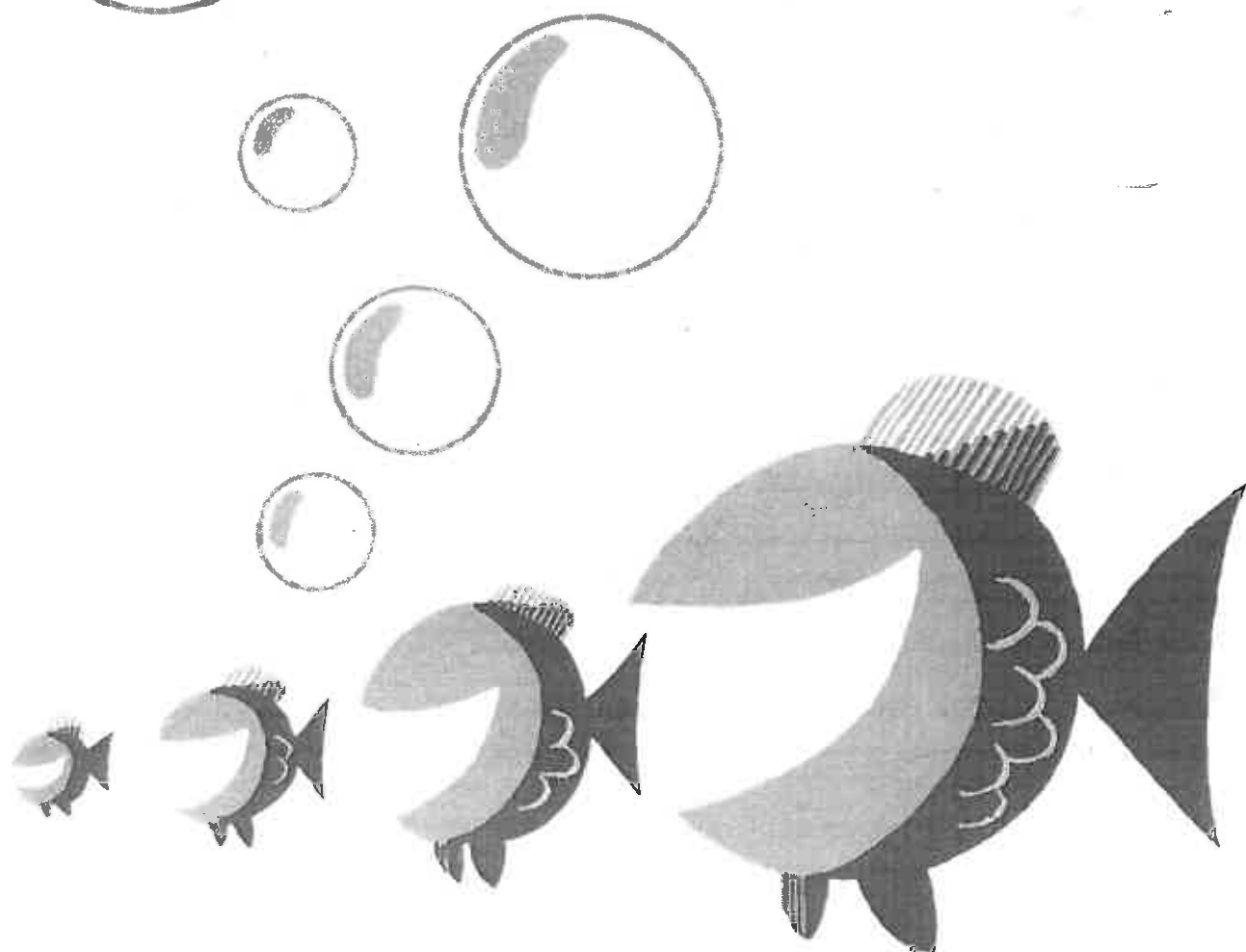


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MONISTETTUA JULKAISUA

Toimittaja: Viljo Nylund. Toimitussihteerit: Juha Jurvelius, Marja-Liisa Koljonen.

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COUNTRY REPORT OF FINLAND FOR THE INTERSESSIONAL PERIOD

1980 - 1982

JUHA JURVELIUS, MARKKU PURSIAINEN, KAI WESTMAN and

PEKKA TUUNAINEN ¹⁾

Introduction

Finland's inland waters cover 31 000 km², which is about 9.4 % of the country's total area. There are over 60 000 lakes, 17 of which have a surface area of more than 200 km² each. The lakes are shallow, the average depth being 7 m; and their total volume is 220 km³. Together they have a total shore length of 130 000 km. From a statistical point of view, nearly one hectare of lake area and about 30 m of shoreline are available per capita of the population (4.8 million in 1981). The total length of the rivers exceeds 20 000 km.

In 1983 a new fishing law, whose main principle is continuous fishing within the limits of the fish production capacity of Finnish waters, comes into force. The law expands fisheries administration to include eleven districts, each headed by a fisheries biologist.

In 1980 some 656 000 people were engaged in fishing in inland waters. About 2 700 were engaged in commercial fishing, and the rest fished for recreation and their own use.

According to calculations made by the Finnish Game and Fisheries Research Institute, the catch from inland waters was about 29 700 tons in 1980 (9). This was about 21 % of the total catch for the country. The combined catch of six species, perch (*Perca fluviatilis*, 8 200 tons), vendace (*Coregonus albula*, 5 900 tons), pike (*Esox lucius*, 5 300 tons), bream (*Abramis brama*, 2 000 tons), burbot (*Lota lota*, 1 300 tons) and whitefish (*Coregonus lavaretus*, 1 300 tons) was about 24 000 tons;

The number in brackets () refers to the number in the bibliography.

¹⁾ Finnish Game and Fisheries Research Institute, Fisheries Division
P.O. Box 193, SF-00131 Helsinki 13, Finland

corresponding to about 81 % of the total catch from inland waters. About 18 % (5 300 tonns) of the total catch from inland waters was taken by professional and semi-professional fishermen.

The value of the total catch from inland waters was about 155 million FIM (about 36 million USD).

The annual catch of the native crayfish (*Astacus astacus*) was estimated to have been about 2-4 million specimens, which corresponds to a value of about 3-6 million FIM (0.8 - 1.5 million USD).

The Eifac National Committee for Finland has been active since 1980. The committee, composed of representatives from fisheries research, fish culture, fisheries administration and advisory boards, has handled questions concerning EIFAC-activities.

1. Crayfish

Owing to her large number of water bodies and their long shoreline, Finland has exceptionally high potential for crayfish production. The disastrous crayfish plague (*Aphanomyces astaci*) and the various river construction operations (draining, dredging, water regulation, etc.) have been and still are the greatest threat to crayfish stocks and production (132).

Several institutes have ongoing research programmes in crayfish fisheries in Finland. Particular attention has been paid by the Finnish Game and Fisheries Research Institute to comparative studies of the only native crayfish species (*Astacus astacus*) and the plague-resistant North American crayfish (*Pacifastacus leniusculus*). Of particular interest has been the competition between the two species. Studies have also been made concerning crayfish sampling methods, the management of crayfish stocks, their cultivation, and catching and fishing gear. Some of the results will be presented at the 5th Symposium on Freshwater crayfish, to be held in Davis, California in August 1982.

Research programmes based on the comparative physiology of *Astacus* and *Pacifastacus*, and on the effects of pollution and diseases on the physiology of crayfish, have been carried out.

In connection with the programme of the EIFAC Working Party on Crayfish, statistics on the status of crayfish stocks and fisheries in Finland, and that of institutes, research workers and research programmes concerning crayfish, have been collected. In addition, a bibliography of Finnish literature on crayfish, compiled in 1978, will be updated.

2. Development of eel fishery resources

Finland's eel fisheries are almost totally dependent on stockings with introduced elvers or young yellow eels. Due to rather large introductions of elvers in 1966 - 1968 the eel catch in inland waters has grown from 9 tons in 1976 to 63 tons in 1980. The stocking rate has been rather low in recent years due to the risk of spreading communicable fish diseases along with the stocking material. The effects of stockings are controlled by a yearly analysis of the eel catch from selected rivers and lakes. Special attention here has been given to the activities described by the EIFAC Working Group on Eels. Catching methods and, in co-operation with Sweden, age determination procedures have been developed. In the near future stockings with reared eel fingerlings will begin. This clearly shows the importance Finland attaches to eels.

3. Economic aspects of sport and commercial fisheries

Statistics for different fish species and fishing methods on catch, yield, expenses, investments and working time, are annually collected by the Finnish Game and Fisheries Research Institute from some 70 fishing households and fishing enterprises in inland waters to study the profitability of commercial fisheries.

As the most popular leisure-time activity in Finland, recreational fishing is of great economic and social importance. Anyone who wants to fish other than by angling with natural bait must purchase a general fishing licence (18 FIM from 1.1.1982). According to the calculations made by the Finnish Game and Fisheries Research Institute about 656 000 people were so-called subsistence and recreational fishermen in 1980. Perch and pike were the most important species in their catch. Statistics on subsistence and recreational fishing in 1981 will be investigated during 1982 (89).

Several Finnish lakes have been studied for many years, especially to gather information on fish stocks, production biology, and fishing and management methods. Research programmes with special reference to natural vendace (Coregonus albula) and whitefish, as well as stocked whitefish have also been continued. A few extensive studies of the fisheries on several watercourses have been carried out to aid in the development and planning of fisheries. The planning program has been expanded to comprise many different areas in Finland.

In northern Lapland, about one-third of the people are primarily dependent on natural resources for their livelihood. Along with the growth in tourism, this is one of the main reasons why fisheries research has been expanded in the most northern parts of Finland.

4. Survey and appraisal of inland waters

According to recommendation 78/3 of the 10th Session of the EIFAC (Hamburg), the intercalibration experiment carried out in Finland in 1976 should be extended to pelagic species, a field study of fish sampling methods in lakes has been made in Lake Konnevesi by the EIFAC Working Group on International Intercalibration, in co-operation with the FAO. The results will be presented during the 12th Session of EIFAC. The echocounting method developed within EIFAC has been used in eight lakes in Finland during the summers of 1980 and 1981.

Fish stock assessment of many fresh-water fish species in some larger lakes in the coastal area of the Baltic Sea has been continued. Results concerning the biology and stock assessment of Coregonids on the Baltic coast of Finland, and fish stock assessment in Lake Konnevesi, have been published (53,111). Studies on the numbers and mortality of eggs and young stages continue.

5. Management of inland waters

River damming for hydroelectric power, and river construction including reservoirs, have seriously damages the stocks of many river spawning fish species and crayfish. Highly regulated lakes and reservoirs also create difficulties in fisheries. Some rivers or parts of rivers have been restored in order to increase the natural salmonid smolt and river spawning whitefish fingerling production. On the basis of the investigations carried out, these operations have clearly been successful. A new research program concerning natural production of both fish and crayfish in restored waters is in the initial phase.

Investigations on natural smolt production in several rivers have been continued.

Extensive fish stocking programs from the main part of the management of economically important fish stocks. The following numbers of fish (in thousands) were stocked in natural waters in 1979 and 1980, according to the statistich collected by the Finnish Game

and Fisheries Research Institute:

<u>Species</u>		<u>1979</u>	<u>1980</u>
		1000 of ind.	1000 of ind.
Baltic salmon	fry - 1-year old	704	295
	2-summers old and older	278	507
Landlocked salmon	fry - 1-year old	94	184
	2-summers old and older	49	138
Sea trout	fry - 1-year old	1,272	693
	2-summers old and older	778	758
Brown trout	fry - 1-year old	1,670	1,280
	2-summers old and older	960	1,260
Other salmonids	fry - 1-year old	2,799	1,460
	2-summers old and older	102	150
Grayling	fry	1,375	650
	1-summer old and older	551	661
Whitefish	fry	107,247	172,876
	1-summer old and older	26,079	28,422
Vendace	fry	4,160	1,220
	adult (transfer stock.)	224	13,340
Pike	fry	40,717	27,190
	fingerling	2,184	1,722
Pike-perch	fry	-	260
	1+ summer old	52	76
	adult (transfer stock.)	7	4
Bream	fry	-	150
	1-summer old	50	30
	adult (transfer stock.)	29	14
Carp	1-summer old and older	31	12
Tench	1-summer old and older	2	4
Perch	adult (transfer stock.)	2	2
Eel		75	-
Crayfish	1-summer old	-	1
	adult /transfer stock.)	27	19

Baltic salmon, sea trout, and migratory whitefish stockings have mainly been made in rivers or estuaries.

The number of stocked fish is increasing rapidly to the point that stocking begins to compensate for losses caused by the damming of the Kemijoki and Iijoki Rivers. These compensations will amount to 925,000 salmon and 118,000 sea trout smolts, and 4.3 mill. 1-summer old migratory whitefish for the Gulf of Bothnia; together with 80,000 brown trout and 2.9 mill. whitefish and grayling for both of the above rivers. In addition, about 160,000 lampreys annually will be transferred from the river mouth over the dams to the rivers.

To evaluate the stocking results, some 25,400 salmon and 28,800 other salmonid smolts were tagged with Carlin tags in 1980: in 1981 the corresponding numbers tagged were 29,200 and 21,400. In addition, about 11,000 other freshwater fish were tagged in 1980 and 6,500 in 1981 either for stocking evaluation or research purposes. To add to this, some 400,000 whitefish fingerlings has been marked by the Finnish Game and Fisheries Research Institute with "nose-tags" for research purposes.

The utilization of coarse fish stocks (roach, small perch, dwarfed whitefish, etc.) in fur farming and for feed has increased. This is especially important in eutrophicated waters as well as in the great eastern and northern lakes and reservoirs with abundant populations of these species (30,37,83).

6. Other subjects

Many cooperative research programs, especially for salmonid fish, have arisen from the Finnish-Norwegian Fishing convention. The densities of salmon parr and adult salmon are reported yearly. Reports on two fish markings will be made in 1982.

The "Finnish-Soviet Boundary Water Commission" has continued its work on questions of mutual interests, including fisheries in the border region. Field work for bilateral research on Lake Karjalan Pyhäjärvi was completed in Summer 1981. Further co-operation is planned especially as concerns salmonids, rivers, and river restoration.

The "Finnish-Swedish Boundary River Commission" has organized the monitoring of the fish stocks and fisheries of the Tornionjoki River. The purpose is to stock the rapids of the river yearly with 300,000 1-year old salmon. Because of high fishing pressure in the Baltic Sea, the spawning stock, and thus also the number of young, decreased drastically on the 1970s.

The fixed-term Committee for the Conservation of Rivers has taken an inventory on those rivers and rapids which should be preserved. The Committee is now searching for ways of preservation.

II FISH CULTURE AND DISEASES

1. Fish culture

The production of rainbow trout (Salmo gairdneri), the only fish farmed for Consumption in Finland, has continually increased. According to the statistics collected by the Finnish Game and Fisheries Research Institute, production was about 4,670 tons in 1980, of which 1.960 tons was produced in brackish water in net cages. The number of private fish farms, which produced all fish for consumption, was almost 200 (148).

The State's fish farms together with private fish farms produce the stocking material: this production has also increased during the intersessional period. The production of 2-summer old and older salmon, trout and charr for stocking purposes amounted to 2.8 million specimens in 1980. Both 1-summer old whitefish and pike and pike-perch fingerlings for stocking natural waters are produced in large ponds with natural food supplies. In 1980 the number of such ponds was c. 100, with a total area of 5,000 hectares, producing over 30 million fingerlings.

The Finnish Game and Fisheries Research Institute, which is responsible for the State's fish farming, has 12 fish farms with two more under construction and a fifteenth in the planning phase. The main aims of the State's fish cultivation are to produce eggs and fry for the rearing of stocking material, to preserve threatened valuable fish species and stocks, to control stocking material throughout the country, and to carry out research on fish rearing and management methods.

While research on fish cultivation by the State's fish farming has dealt mainly with salmon and trout, whitefish, pike, pike-perch and crayfish have also been studied. Special attention has been given to the quality of stocking material by testing the physiological condition of fish during the rearing period, especially smoltification.

Finland has participated in the COST 46/4 project from its inception. The aim of the project is to discover the most suitable place and time for salmon stockings. The Finnish working group is studying factors affecting post-smolt mortality.

Fish genetics has proved to be of great importance in the management of fisheries based on stockings. Some new research programs on this subject have been initiated. Projects concerning the selective

breeding of rainbow trout have been carried out.

2. Utilization of heated effluents and recirculation systems

In accordance with recommendations 80/11 and 80/13 of the 11th Session of EIFAC, fish farming experiments in heated effluents have been continued and expanded. Special attention has been paid to the cultivation of 1-year-old salmon smolts. Comparative rearing experiments with different salmon strains, investigating their smoltification and physiological condition, are in progress. Some results have been published in the proceedings of the Stavanger symposium. Some experiments have been run jointly by Finland and Scotland.

Recirculation and heat circulation systems have been designed in some fish farms.

3. Fish diseases (COPRAQ)

At present 60 fish farms are registered for official health control by the National Veterinary Medical Institute. A veterinarian visits each fish farm once a year to estimate the health situation of the farm. Control samples are investigated on request at the National Veterinary Medical Institute. Most of the recommendations proposed in 1974 in Aviomore in the draft for the Control of the Spread of Major Communicable Fish Diseases are in force in Finland (188).

In 1980 and 1981 a disease with histological and macroscopical symptoms very similar to those of UDN (Ulcerative Dermal Necrosis) was detected in salmon at the mouth of the Kemijoki River. Sarcomatosis (lymphomatosis) is a common disease in pike (Esox lucius) in brackish water on the southwestern coast of Finland. The disease causes losses to fishermen in that area. Vibriosis, a bacterial disease caused by Vibrio anguillarum, is common in farmed rainbow trout in brackish water in southern and southwestern Finland.

The infectious viral diseases IPN (Infections Pancreatic Necrosis) and VHS (Viral Haemorrhagic Septicameia) have never been found in Finland.

4. Fish nutrition research

In Finland, aquaculture uses primarily domestic dry feeds: the amount produced in 1981 was about 13,000 tons. Only a small percentage of feeds is imported (special feeds, medicinal feeds). The raw material for dry feeds is, however, mostly imported fishmeal and fish oil, soy beans, and wheat. Dry feeds are available both for rainbow trout and for other salmonids produced for stocking. The quality of feeds is improving, especially through use of better, high-energy raw material. In order to reduce the eutrophication effects of effluents from intensive aquaculture, the phosphorus level in dry feeds has been reduced.

The utilization of low value fish (roach, smelt, etc.) and Baltic herring as fish feed has been calculated to amount to about 5,000 tons annually.

5. Mass rearing of fry and fingerlings

In accordance with recommendation 80/17 of the 11th Session of EIFAC, the Finnish Game and Fisheries Research Institute has in co-operation with the University of Helsinki run large-scale physiological investigations in order to develop quality-control methods for assessing the quality of salmon and trout, both as fry and as fingerlings, for aquacultural and stocking purposes.

6. Economic evaluation of aquaculture

The Finnish Game and Fisheries Research Institute annually draws up the statistics on aquaculture in Finland for all fish farms. Using producer prices, the total value of all aquaculture products was calculated at 119.2 million FIM (about 28 mill. USD) in 1980. The value of fish production for human consumption (rainbow trout) was 95.7 mill. FIM (22 mill. USD) and that of stocking material 23.5 mill. FIM (6 mill. USD).

7. Introduction of exotic species

No introductions of new fish species have been made during the intersessional period. Stocking with fingerlings of the Siberian peled whitefish (Coregonus peled), and with 2 - 3 year old North American lake trout (Salvelinus namaycush), both produced in fish farms in Finland, has continued. Self-reproducing stocks of these

species have not yet been found, but stockings have been economically profitable.

The North American plague-resistant crayfish (Pacifastacus leniusculus) has developed self-reproducing stocks in some lakes. Stocking with Finnish crayfish has continued on a small scale, and additionally some crayfish imports from Sweden have been made for research purposes.

8. Crayfish diseases

Several new cases of crayfish plague (Aphanomyces astaci) have been observed during the intersessional period. Due to the economic significance of this disease, research on its spread and on means of plague control of the plague has been continued. There is also a program concerning the plague spots in signal crayfish (Pacifastacus leniusculus). The migrosporidian crayfish-parasite, Thelohania contjeani (white tail disease), has been recorded in 36 localities in different parts of the country. In all cases, the number of infected individuals constituted less than 2 % of the crayfish investigated, which is far lower than the frequencies reported in other parts of Europe (74,75).

The parasite Psorospermium haeckeli was observed in 1975. The disease has been recorded in three localities in the south of Finland. The frequency of infection is from 80 to 100 % in different localities, but no observations of mass mortality have been recorded. Psorospermium (almost certainly a fungal disease) has a pathogenic effect on crayfish, especially during moulting periods. The fungal disease, Ramularia astaci (burn spot disease), first observed in 1977, is under study. (76).

9. Controlled reproduction of cultivated fish

Methodological development in the use of pituitary hormones in the breeding of pike-perch has continued.

The programme on advance determination of the sex of rainbow trout has also been continued. The aim of this study is to obtain more females than males for farming purposes. The first fish in these tests will reach maturity in the Spring of 1982. However, small scale sampling already indicates that the results are promising.

III FISH AND POLLUTED WATER

1. General

About 700 km² of the lake area in Finland, i.e. 2%, is badly polluted. The most extensively polluted areas are near pulp and paper mills and close to towns. Some 10-15 % of the lake area in Finland is polluted to some extent. About 2 200 km of the rivers have been polluted by industry, public sewage, or agriculture.

Water pollution control has followed the basic principles presented in the special national program for activities up to 1985. The recommendations made in the plans presented by the nineteen, integrated, water management planning regions; and the results of the situation survey made in 1979.

The revision of the Water Act was completed in 1981. The Decree on the preliminary measures for the prevention of water pollution was amended in 1980. In the same year, the National Board of Waters issued an administrative directive on the use of toxicity tests and physiological studies in water pollution control.

2. Water quality criteria

In accordance with recommendations 76/13, 76/14 and 76/15 of the 9th Session of the EIFAC (Helsinki), studies on the water quality requirements of freshwater fish have been continued. Studies on the effects of pollution on fish stocks and fisheries have also been carried out; and the accumulation of heavy metals and other pollutants in fish has been studied.

3. Fish farm effluents

Fish farm effluents and the stringent attitude of water protection authorities to pollution caused by fish farms are today the most important factors limiting the expansion of aquaculture in Finland. Actual pollution caused by fish farms and possibilities for eliminating pollution are being studied by several authorities. One representative from Finland has been appointed to participate in Working Group on Fish Farm Effluents (FAO/EIFAC).

4. Biological monitoring

Special attention has been directed towards the effects of effluents from pulp and paper mills on fish stocks, fishing, and the physiology of fish. A 5-6 year project, which applies toxicological and physiological methods to the study and evaluation of damage to fish and fish stocks caused by pulp and paper mill effluents, will be continued as a cooperative project of the Finnish Game and Fisheries Research Institute and the University of Helsinki. Most of the work in this project has concentrated on studies of the effects on these effluents on reproduction and on other effects of long term effluent exposures, lasting from several weeks to several months. A study clarifying the sensitivity of different developmental stages and different species of fish to effluents is also going on. Effluent toxicity has been followed using acute toxicity tests. International cooperation relating to the activities of the Baltic Marine Environment Protection Commission. ICES's Marine Environmental Quality Committee, the OECD, and Nordforsk, has been implemented.

5. Fish toxicity testing procedures

A three-year project entitled "Ecotoxicological methods in aquatic environment" coordinated by Nordforsk, was completed in 1981. Scientists and administrators from Denmark, Finland, Norway and Sweden took part in this project, which evaluated methods for the determination of bioaccumulation in fish and invertebrates. Test procedures for the chemical and biological analyses of effluents from the pulp and paper, metallurgical, and chemical industries, were also developed.

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