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FINNISH GAME AND FISHERIES RESEARCH INSTITUTE
Report on the FGfRI's operations submitted for international evaluation

Helsinki 1999

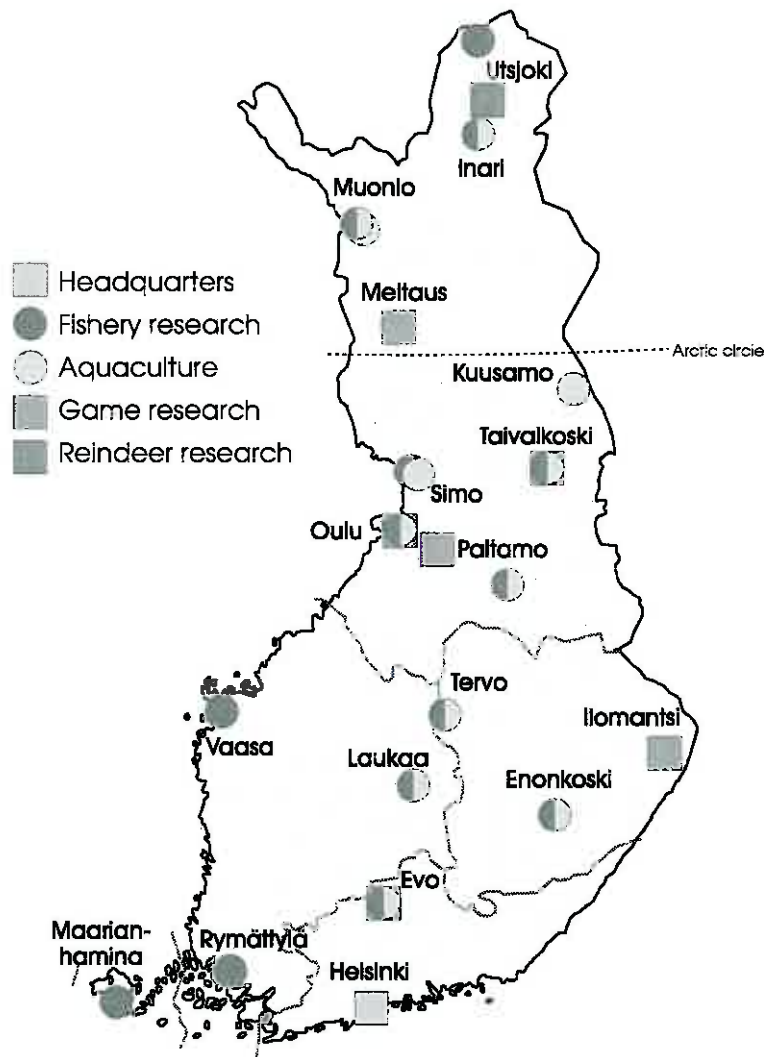


RIISTAN- JA KALANTUTKIMUS

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Report on the FGFRI's operations submitted for international evaluation

January 1999

Stations



Facts on Finland

Finland covers an area of 338 145 km², with inland waters occupying 33 500 km². More than 70% of Finland is forested, the remaining 30% consisting of agricultural land (8%), roads and settlements (7%) and peatland and fells (15%). One quarter of Finland lies north of the Arctic Circle. The coastline measures 1 100 km in length. There are nearly 200 000 lakes, 30 000 of them exceeding four hectares in area. Their average maximal depth is 7-10 metres. The average yearly temperature ranges from +4°C to +5°C in southern Finland and from -2°C to +2°C in Lapland. The temperature range for January is between -5°C and -15°C.

Finland has a population of 5.1 million. The average population density is 16.7 people per square kilometre, ranging from 198 people/km² in southern Finland to 2 people/km² in the north. GDP breakdown is as follows: services 60.2%, industry 35.4% and primary production 4.4%. Finland joined the European Union in 1995.

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THE FINNISH GAME AND FISHERIES RESEARCH INSTITUTE

Introduction

Research institutions operating under the aegis of the Finnish Ministry of Agriculture and Forestry are currently being assessed by a group of international evaluators. Evaluation of the Finnish Game and Fisheries Research Institute (FGFRI) began in autumn 1998.

This report on operations was compiled by FGFRI to serve as background material for the international evaluators.

The main section of the report is divided under four broad chapter headings. 'Our Changing Operating Environment' covers the current status and future outlook of the game and fishery sector, the impact of recent social changes, and the government's role in game and fishery administration. The second chapter provides a general overview of the FGFRI's operations. The third chapter gives a concise summary of the main tasks handled by each unit (Fisheries Biology and Management Research; Socio-economic and Aquaculture Research; Game and Reindeer Research; Aquaculture; Services). The fourth chapter looks at the FGFRI's past and forthcoming strategies and development projects. This report is published in Finnish and English.

Each unit has additionally compiled its own separate report giving a detailed summary of its operations. These reports were all written in English. Those of the Socio-economic and Aquaculture Research Unit, the Aquaculture Unit and the Services Unit are also available in Finnish.

The following documentation is appended to this report: the Decree on the Finnish Game and Fisheries Research Institute; a listing of international agreements applicable to the FGFRI's operations; a report on Finnish science policy; an English version of the fisheries research strategy of December 31, 1996 (published by the Finnish Ministry of Agriculture and Forestry) and the FGFRI's latest statistical material and brochures.

Helsinki, November 25, 1998

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I OUR CHANGING OPERATING ENVIRONMENT

Living close to nature

Finland offers excellent prospects for fishing and hunting. Forests make up more than 70% of its total area, and 10% consists of lakes and rivers. Finland's territorial waters and adjacent fishing zones in the Gulfs of Bothnia and Finland make up one fifth of the Baltic Sea. Finland is a sparsely settled country, with most of the population clustered near the southern coastline. Migration to urban areas and growth centres has intensified in the past few years.

The Finns attach great importance to nature and the wilderness, both as a place of recreation and a source of livelihood. According to a recently published report, more than two million Finns (out of a population of 5.1 million) name recreational fishing among their leisure-time activities. Approximately 300 000 Finns hold a hunting licence. Following a sharp increase in hunting in the 1970s, the present number of licence-holders is largely the same as it was throughout the 1980s. Some 4 200 Finns earn a living from commercial fishing, 3 000 of whom fish in the Baltic Sea and coastal waters. There are 800 full-time reindeer farmers, and 1 500 households for which reindeer farming provides an important source of supplementary income.

There are 60 indigenous fish species and four non-native species which inhabit Finnish waters on a year-round basis. Twenty of these species are fished commercially. The International Baltic Sea Fishery Commission sets annual fishing quotas for salmon, cod, Baltic herring and sprat. The fish species yielding the highest annual catch are Baltic herring, sprat, perch, pike, roach, whitefish and vendace. In commercial value, the species with the highest yield are Baltic herring, salmon, cod, pike perch and crayfish. Rainbow trout is virtually the only fish species cultivated commercially as a food product, though more than 20 fish species, over 70 fish stocks and two crayfish species are cultivated for the purpose of juvenile stocking.

There are 28 mammals and 26 bird species classed as game in Finland. The main game species are cervids, hare, waterfowl and tetraonids. Commercial game farming is confined to a limited scale in Finland.

Finland's cold northern climate means that fish grow slowly and game is less abundant. The cold weather also restricts fish farming. Finland's waters are generally in good condition. Still, the majority of Finland's 188 000 lakes are small and shallow, making them vulnerable to eutrophication, a problem compounded by oxygen depletion during the long winter.

Extended fishing rights

Fishing rights in Finland are controlled by landowners, as the majority of Finland's lakes and coastal waters are privately owned. For a major percentage of Finland's waters, then, fishing rights and water management policy are decided by what are called 'fishery collectives' formed by landowners. A single water area in which fishing and water resource management is centrally administered is called a 'fishing area', of

which there are 223 in all. These fishing areas have recently been granted extended powers to act as an organ of cooperation between land-owners and fishermen.

Fishing rights have recently been extended following the introduction of a new provincial fishing permit in 1997, which confers unrestricted spinning and trolling rights. Angling and ice-fishing is allowed throughout the country without any special permit. Permits for fishing with rod and reel may be purchased from landowners at reasonable cost virtually anywhere in the country. Net-fishing rights are more directly dependent on the landowner.

Now that Finland has joined the European Union, EU citizens have extended fishing rights in Finland. As do all Finns, EU citizens automatically have unrestricted ice-fishing and angling rights all over Finland. EU citizens may also purchase a provincial fishing permit, which confers trolling and spinning rights.

Table 1: Annual catch and food-fish yield in marine and inland waters in 1997, 1000 kg

Fish yield, 1997

	Marine waters		Inland waters			Total
	Commercial fishing	Recreational fishing	Food-fish farming	Commercial fishing 1)	Recreational fishing	
Baltic herring	90334					90334
Sprat	19851					19851
Cod	1536					1536
Flounder	86					86
Pike	264	2769		110	9196	12339
Vendace	73	63		2239	3824	6199
Whitefish	1157	1051	33	501	2632	3
Salmon	1051	286		5	444	1786
Trout	141	458		15	916	25
Rainbow trout	42	165	12965	1	776	3350
Smelt	927			641		1568
Bream	147	794		129	2299	3369
Idé	21					21
Roach	206	1277		567	4714	6764
Burbot	127	261		45	1267	1700
Perch	759	4612		218	11904	17493
Pike perch	748	822		54	1418	3042
Other	149	1116	9	103	1157	41
Total	117619	13674	13007	4628	40547	3419

1) Figure for 1996

Recreational fishing

According to an extensive survey on recreational fishing conducted by the FGFRI in 1998, 2.2 million Finns had fished recreationally that year. The total catch recorded for recreational fishing in 1997 amounted to 54.2 million kilograms, 75% of which was caught in inland waters. The species for which the largest catch was recorded were perch and pike. The bulk of the fish caught by recreational fishermen was used for private consumption.

Commercial fishing, fish farming and fish processing

The commercial catch from Baltic Sea amounted to 118 million kilograms in 1997, 90 million kilograms of which consisted of Baltic herring. Two thirds of the Baltic

herring catch is used as fodder at fur farms. The species with the second highest yield was sprat, the total catch amounting to approximately 20 million kilograms. The combined commercial value of the marine catch was in the order of FIM 160 million. The commercial catch in inland waters totalled 4.6 million kilograms in 1996, amounting to FIM 38 million in commercial value. Half of the inland catch consisted of vendace. Other species with a high inland yield were smelt, roach and whitefish.

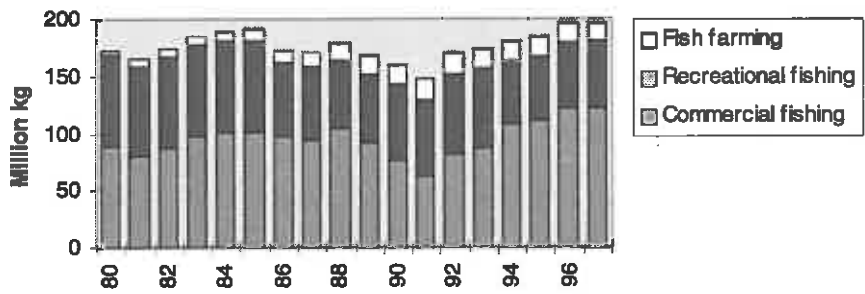
The average annual catch in inland waters is about 15 kg per hectare, and more than 20 kg per hectare in the Baltic Sea and coastal waters.

The total amount of rainbow trout cultivated in 1997 was 17 300 tonnes, a yield equivalent to FIM 218 million in commercial value. Fish farming generates nearly FIM 400 million in annual revenues, and employs a workforce of 2 000. There are 700 fish farms in Finland, 280 of which cultivate food-fish commercially. Most of these fish farms are small family businesses.

Environmental pollution caused by fish farming has been reduced substantially throughout the 1990s thanks to improved fish-feed composition and new feeding methods. Although fish farming accounts for only 3% of the phosphorus load in Finnish waters, in certain areas this is still perceived as a problem. Fish farmers require a special permit from a Water Rights Court. Compliance with the permit's provisions is enforced by the environmental authorities.

Fishing and fish farming together account for 0.2% of Finland's GDP. The job-creating impact of the fishery industry, however, is far greater than its percentage of GDP might suggest; these occupations employ a combined workforce of roughly 10 000. Fish exports make up about 2% of Finland's food exports. Recreational fishing is also becoming an increasingly lucrative tourist attraction.

Diagram 1: Finland's fish yield, 1980-1997



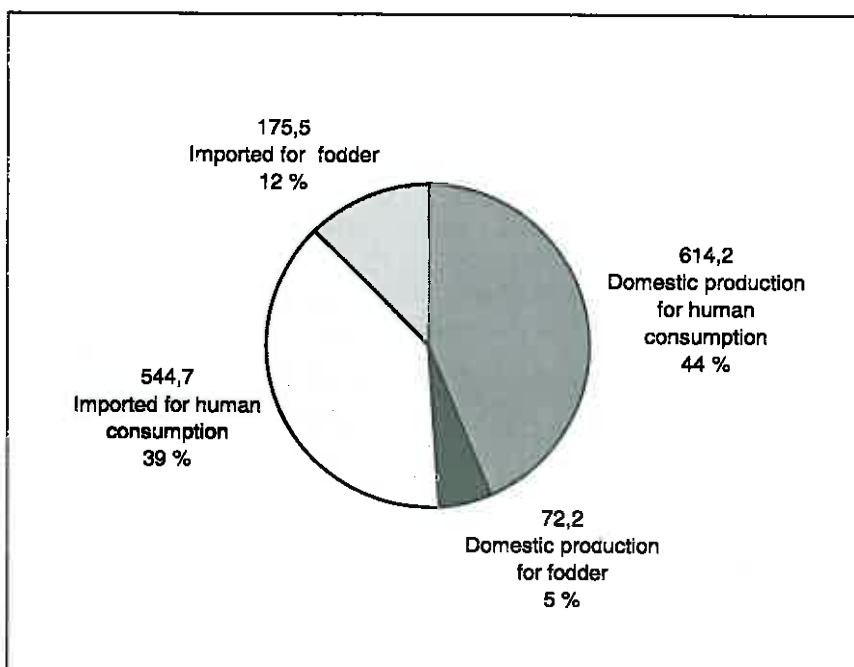
Preservation of endangered fish stocks by State aquaculture

Damming, dredging, pollution and overfishing have caused a decline in migratory fish stocks in the Finnish rivers which discharge into the Baltic Sea. Many of these migratory species have in fact become endangered. Their future survival is being safeguarded through artificial cultivation at the FGFRI's aquaculture stations. Of the 18 Finnish salmon rivers which discharge into the Baltic Sea, only two, the rivers Tornionjoki and Simojoki, are currently able to sustain their wild salmon stocks without artificial stocking. Naturally occurring salmon stocks face an additional threat in the form of 'M74 syndrome', a reproductive disorder which has resulted in an alarmingly high rate of yolk-sac fry mortality (60-90%) in recent years. Stocking of salmon juveniles cultivated at FGFRI aquaculture stations is, thus, a crucial means of

safeguarding the future survival of migratory fish stocks. Juvenile stocking also serves to improve the annual catch.

There are 130 fish farms in Finland which specialize in the cultivation of juveniles for stocking. Twenty fish species, over 70 different fish stocks and two crayfish species are currently being cultivated for stocking purposes. Whitefish and pike perch are the most heavily stocked species. The combined commercial value of fish juveniles cultivated for stocking is roughly FIM 90 million per annum.

Diagram 2: Fish consumption in Finland, 1997 (FIM million)



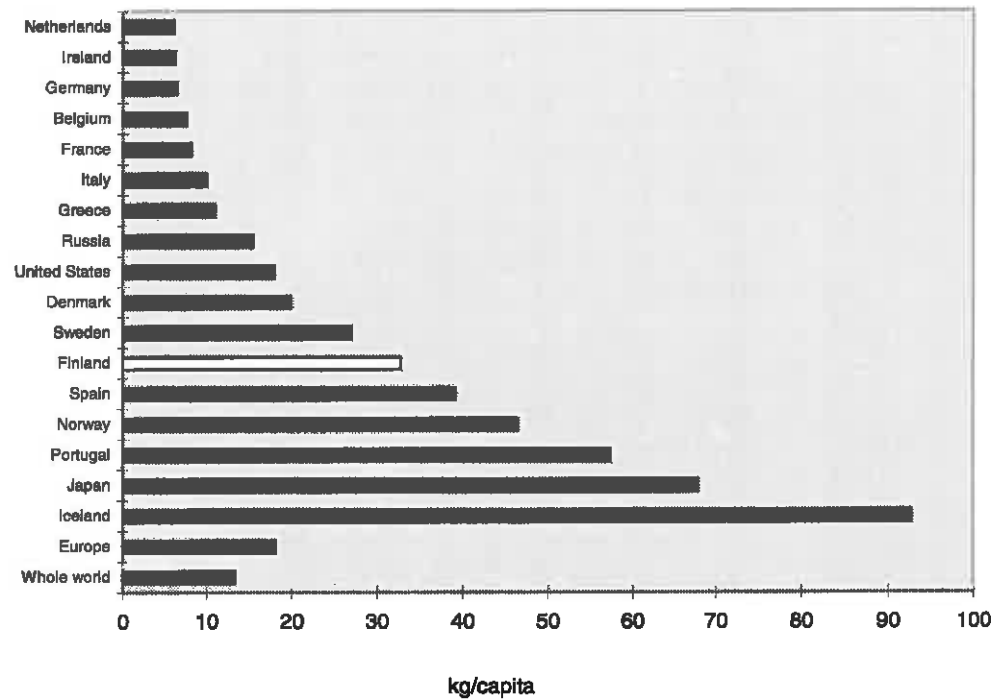
Finns eat 30 kg of fish per year

Over the past few years, commercial fish supply in Finland has averaged 300 million kilograms a year in fresh fish and processed products. Throughout the nineties, the combined producer and import value of fish supply on the Finnish market has averaged FIM 1.5 billion per annum. Domestically produced fish accounts for 60% of this sum.

Roughly 200 million kilograms of the annual fish supply is used as animal fodder. Human consumption accounts for 115 million kilograms, including both fresh fish and processed products. By European standards, fish consumption is comparatively high in Finland; per capita consumption of live-weight fish averages 30 kilograms a year, which is equivalent to 15 kilograms in fish fillets.

The combined value of Finnish fish exports is about FIM 100 million. This sum has risen in 1996-1997. The commercial value of fish imports, meanwhile, is roughly FIM 700 million.

Diagram 3: Per capita fish consumption (live-weight totals); country comparison for 1993 (FAO 1996)



Future diversification in the fishery industry

The future of the Baltic herring industry will depend on trends in Baltic herring stocks, the market outlook and, particularly, forthcoming developments in fur farming and EU fishing policy. While small enterprises form the majority of the industry, some of the larger fishing companies will doubtless continue striving to intensify and improve the quality of their catch. Indeed, there is potential for developing and intensifying fishing of inshore species such as pike perch, perch and pike. Fishing will remain an important source of supplementary income for many households, and diversification of the fishing industry will offer new earning opportunities for young commercial fishing entrepreneurs. In the future, commercial fishing will increasingly be combined with other sources of income such as fish cultivation, fish breeding, 'off-the-boat' sales, tourism and other secondary services.

Finnish consumers will continue purchasing most of their fish from supermarkets and groceries, whether pre-packaged or fresh from the fish counter. The range of fish products available to consumers is steadily diversifying, and their grade of processing is gradually rising. Fish distribution has improved thanks to new types of packaging, enabling a wider range of fish products to be transported together with other foods. Large supermarket chains usually purchase most of their fish from wholesalers, which today provide a broader range of products than ever before. Orders and purchases are increasingly being handled online by computer. Speciality products, however, are still purchased direct from primary producers. The fish supply chain is steadily being integrated: primary producers, fish processors and retailers are cooperating more closely and adopting a common quality assurance system that covers the entire production and supply chain. Still, primary producers and small entrepreneurs will doubtless continue marketing their products direct to consumers at open-air fish markets. Organic products and clean, additive-free foods will become an increasingly important competitive asset in the food industry. In the future, producers will be

expected to prove that their products come from sustainable fish stocks, and that they are ethically and ecologically sound.

Any present disparity in the quality and yield of fish caught in the Finnish wild will level out to a certain extent in the future. The diversification of fish farming will improve the availability of domestic raw materials, and the deregulation of international trade, in turn, will improve the availability of raw material imports. The range of fish imports, too, will expand. An influx of low-priced salmon imports can be expected as a result of worldwide growth in salmon farming, bringing tougher competition to the domestic salmon market. Domestic cultivation of rainbow trout will not expand any further, but a new selection of domestically cultivated fish species will soon become available on the Finnish consumer market. Future expansion is also anticipated in the commercial cultivation and marketing of crayfish.

Recreational fishing will play an increasingly important role as a tourist attraction. Opportunities for recreational fishing are expanding with the emergence of new companies offering package fishing tours. Fishing prospects are also improving thanks to improved control of environmental pollution in agriculture and forestry and intensified management of interesting fish species.

Hunting is a popular recreational activity

Finland's forests cover a combined area of 264 000 km². Cultivated land, by comparison, makes up a total of 25 000 km². A large percentage of Finland's game species are, then, native to forests. Field game species occur in notable numbers only in the southern and southwestern parts of the country. Certain game species have become endangered as a result of e.g. excessive harvesting in the past. Of all the game species encountered in Finland, nine mammal species and one bird species are currently listed as endangered. The populations of large predators and seals have risen over the past few years, however.

Hunting rights in Finland are tied to land owning. The majority of recreational hunters obtain hunting opportunities by joining a hunting club, which either owns or leases the hunting right. In northern Finland, residents are free to hunt on government-owned land within their home municipalities. Residents of southern Finnish municipalities, however, may have limited opportunities to hunt near their home district unless they own land themselves. For many recreational hunters, the main option is to obtain a hunting permit which is valid mainly for government-owned land in northern and eastern Finland, or only for waterfowl in other areas. The hunting of sea birds on outlying islands is unrestricted.

Hunting is a popular form of recreation, particularly in northern and eastern Finland. There is effectively no commercial hunting in Finland. At present, 300 000 Finns hold a hunting licence, 220 000 of whom hunted during 1997. The number of hunting licences is more or less the same as it was throughout the 1980s. The game bag in 1997 totalled five million kilograms in meat yield. The most hunted game species in numbers was the mountain hare, yielding a total bag of 424 000. The top game bird species was the mallard (total bag 245 000). The game species with the highest commercial yield was the moose, accounting for 46% of the combined commercial value of all game hunted in 1997. The moose bag has declined from 70 000 in 1984 to 23 000 in 1997, but is now on the rise again.

Diagram 4: Hunting licences In Finland, 1937-97

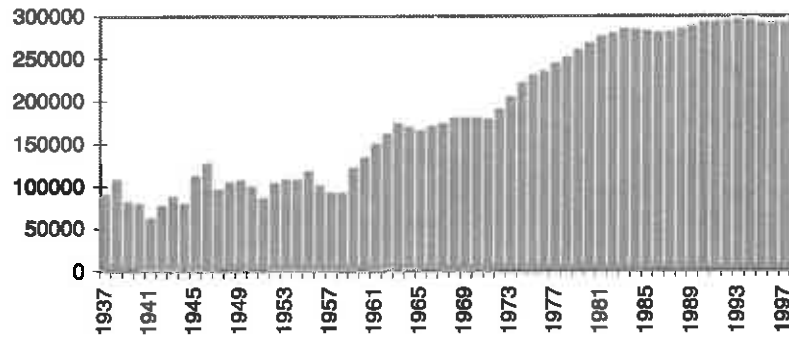


Diagram 5: Commercial value of the annual game bag, 1988-97 (adjusted to the 1996 cost index)

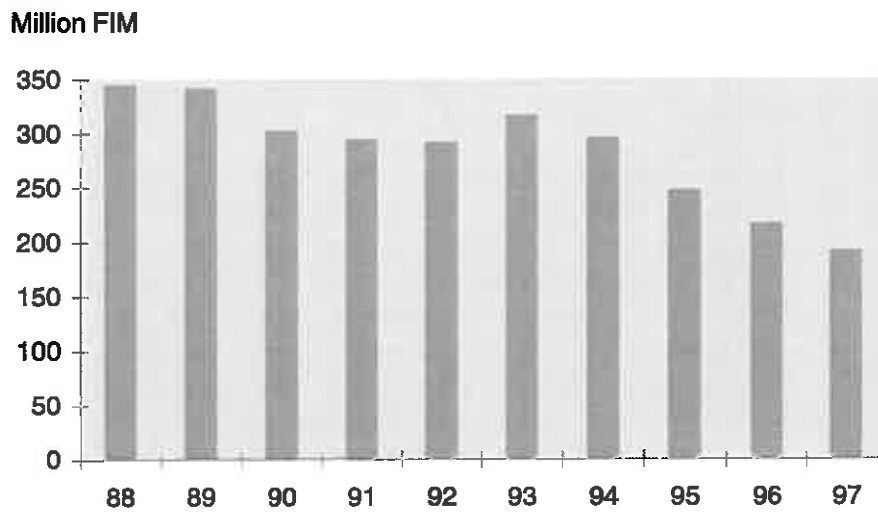


Diagram 6: Breakdown of game species hunted in Finland, 1997

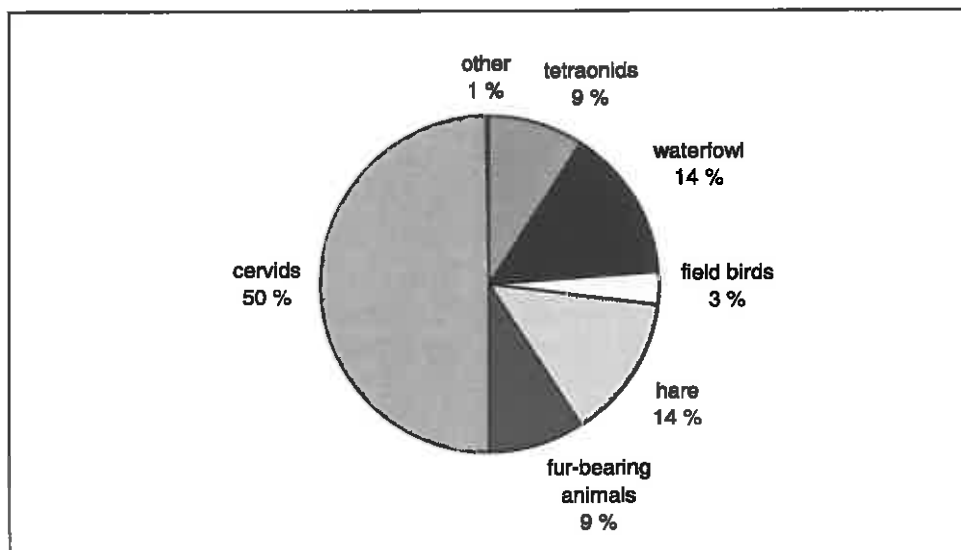


Table 2: Average annual bag, 1991-95.

Mountain hare	320 020	Geese	8 500
Brown hare	59 860	Teals	182 640
Squirrel	3 660	Mallard	357 980
Beavers	1 800	Eider	26 660
Muskrat	56 660	Long-tailed duck	48 760
Fox	50 760	Goldeneye	146 400
Raccoon dog	83 160	Goosander and merganser	22 680
Mink	66 180	Other waterfowl	84 820
Polecat	1 090	Hazel grouse	110 640
Pine marten	16 820	Willow grouse	82 700
Badger	10 440	Black grouse	182 680
Moose	42 448	Capercaillie	53 640
White-tailed deer	6 630	Partridge	1 980
Other artiodactyls	85	Pheasant	16 320
Wolf	9	Woodpigeon	147 140
Bear	44	Woodcock	5 720
Lynx	56		

Good hunting prospects safeguarded

By European standards, Finland offers expansive hunting grounds and a diverse range of thriving game species. Over the past century, a number of new game species have become established in Finland, both through natural occurrence and artificial stocking, further broadening an already abundant range of indigenous game species. Many game stocks have been built up and strengthened through special game management and conservation measures and even through a controlled amount of hunting. Many important game species have suffered on account of habitat changes caused by human land use and intensified exploitation of natural resources. The better we learn to recognize the environmental changes that exert a harmful impact on game species, the better we will be able to prevent any further deterioration of game habitats by devising new and improved methods of resource utilization.

By the same token, some environmental changes have proved beneficial for certain game species. Intensive forest regeneration has favoured cervids and hare, because young forests in their early developmental stages provide an ample nutrient supply for these species. Greater diversity of tree species, too, improves the survival prospects of many game species. Future hunting prospects can be improved by building up the predominantly field-dwelling game populations of southern and western Finland. Extensive measures are currently being taken to control agricultural pollution which, as an added beneficial outcome, has created new habitats for wild plant and animal species, while also enhancing the overall condition and diversity of existing habitats. Waterfowl populations, in turn, have benefited from the eutrophication of inland waters.

The average game bag per hunter has declined. At present, comparatively few foreign tourists come to Finland to hunt, but hunting will foreseeably become a more significant tourist attraction in the future, though this will presumably only have localized impact. Roedeer and white-tailed deer populations are steadily rising, though, which may provide improved hunting prospects in the future. As game management is affected by growing public interest, conservation is also an important aspect in the FGFRI's work.

Reindeer herding: an important indigenous livelihood

The reindeer herding area of northern Finland covers 123 000 km², which makes up 36% of Finland's total area. There are more than 7 000 reindeer owners in Finland, 800 of whom are full-time reindeer farmers. Production of reindeer meat has declined steadily throughout the 1990s, dropping from 4 million to 2 million kilograms per annum. Reindeer herding nevertheless has great importance for the people of Lapland, preserving as it does a valuable aspect of the indigenous Sámi heritage.

The northernmost part of the reindeer herding area is reserved exclusively for reindeer management. No activity constituting a hindrance to reindeer herding is allowed to be undertaken on government-own land within this area. Reindeer herding is not dependent on land ownership, as grazing is largely unrestricted. Reindeer owners must, however, be registered as permanent residents within the official reindeer herding area.

The reindeer is a half-tame species, spending most the year grazing out in the wild. Over the past few years, there has been an increasing need to provide supplementary fodder during the winter. Over-grazing has resulted in localized depletion of lichen resources. The maximum permissible size of reindeer herds is regulated by a government decision taken every ten years.

Predators are the cause of significant losses to reindeer farmers. Financial compensation is paid out of the government budget for damage caused by wolverines, wolves, bears, lynx and eagles. Reindeer hunting is prohibited.

There are various challenges facing reindeer farmers in the future. Extensive grazing grounds are in poor condition on account of overgrazing, and forestry and other forms of resource exploitation are steadily reducing the range of natural grazing grounds. Overgrazing has a simultaneous positive and negative effect on forestry. In the future, herd sizes, pastures, supplementary feeding and grazing rotation will be planned with a greater emphasis on sustainability.

Diagram 7: Annual reindeer herds and maximum permissible herd size

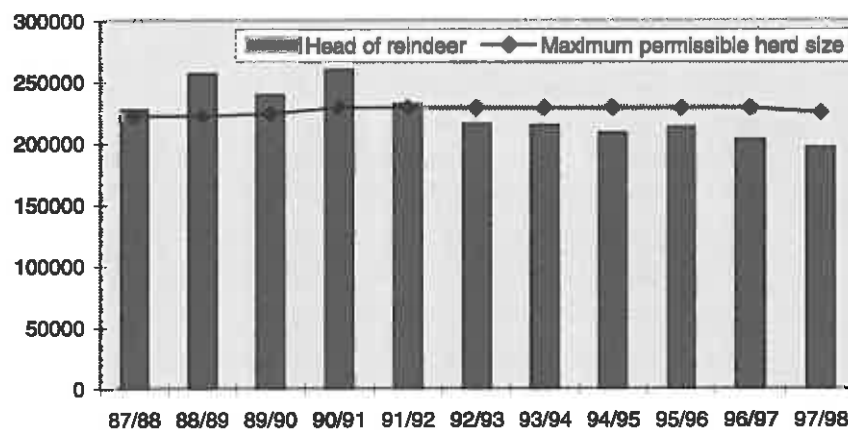


Diagram 8: Production of reindeer meat

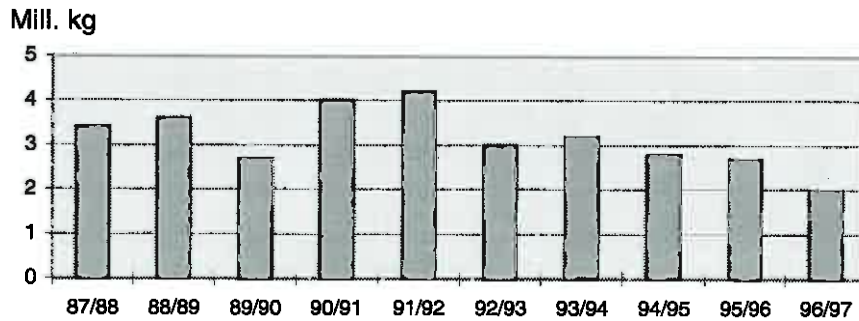
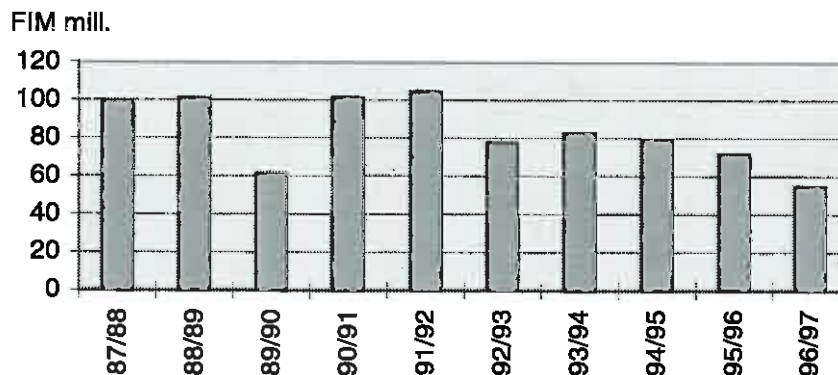


Diagram 9: Annual slaughter yield (in producer prices)



Adverse environmental impact of human activity

The latest scientific reports indicate that the average annual global temperature is steadily rising. The winter is warming more rapidly than the summer; winter rainfall will increase, but summer droughts, on the other hand, may become more common. No drastic changes are foreseeable in the Finnish climate over the next few years, but on the long term, average temperatures are estimated to rise 0.6°C by 2050, and 1.1°C by 2100, which is twice the warming rate recorded for the entire 20th century. The predicted weakening of the Gulf Stream may slow down global warming, however.

Acidic sulphur emissions have been reduced by 20% over the past 15 years. Although a corresponding reduction has yet to be achieved in nitrogen emissions, acidification no longer presents a serious hazard to Finland's lakes.

The eutrophication of the Baltic Sea is at its most acute in the immediate area of St. Petersburg. The Finnish coastal waters hit hardest by eutrophication are the coastal zones of the Gulf of Finland and the Archipelagic Sea. The nutrient load in the Baltic Sea, which was rising sharply for some time, is now on the decline again. Nevertheless, water quality will presumably continue to decline in the Baltic Sea, particularly in the Gulf of Finland. A steadily expanding area is also being affected by oxygen depletion. Rapid economic growth in Russia and the Baltic countries would presumably cause a sharp increase in nutrient oversupply in the pelagic areas of the Baltic Sea. It is difficult to predict the future condition of the Baltic Sea, however, as this partly depends on irregular saline water inflows from the North Sea. In any case,

the above-mentioned environmental changes pose a hazard in important fish reproduction areas along the coastline.

The inland waters formerly affected most acutely by eutrophication are gradually recovering, following measures to reduce point loads from industry and human settlement. At the beginning of the 1990s, 96% of Finland's lakes (in combined area) were in good or excellent condition. Only 3% were in unsatisfactory condition, and the proportion of seriously polluted lakes was as low as 0.3%. The condition of Finland's rivers, however, has not improved. Many previously unpolluted lakes in southern Finland are being affected by scattered loading. Over the coming years, new measures will be taken to improve the condition of the worst polluted lakes. The Environment Programme for Agriculture and the introduction of new, environmentally sound forestry methods have brought about a substantial reduction in nonpoint source pollution, which is improving the overall condition of Finland's surface waters.

Toxicant concentrations in the Baltic Sea have been reduced over the past few years. Finland is working to further reduce mercury emissions, but this will at most only achieve a slight decrease in environmental mercury levels and mercury concentrations found in living organisms. Cadmium emissions, too, are declining, but no substantial decrease is anticipated in existing cadmium levels found in living organisms and the environment. The transition to lead-free petrol has achieved a marked reduction in lead pollution, however.

Levels of DDT, PCB and other notorious organic environmental toxins are continuing to decline in Finland. The future trend for dioxins is unclear at this point, however.

Foreseeable risks in fish and game morbidity

Fish and game morbidity rates in Finland have largely remained stable throughout the 1990s. Compared with many other countries, the current outlook is good. The increasingly widespread use of effective vaccines at fish farms is expected to eliminate two of the most common bacterial diseases currently affecting cultivated fish, thereby reducing the use of medication.

The spread of the *Gyrodactylus salaris* parasite to the River Tenojoki presents a serious morbidity risk. The FGFRI has taken action to preserve Tenojoki salmon genetic resources by establishing a gene bank (milt bank and broodstock). The M74 syndrome remains a serious problem in the Baltic Sea, resulting in alarmingly high mortality in salmonid yolk-sac fry. The government is supporting a project to intensify stocking of salmonid juveniles in salmon rivers in the Bay of Bothnia.

Fish imports have been subject to strict regulation in Finland, and there has been very little importation of fish products since the 1960s. An extensive virus screening programme was carried out at Finnish fish farms in 1995 and 1997, which yielded no trace of the viral diseases listed as most hazardous in Council Directive 93/53/EEC introducing minimum Community measures for the control of certain fish diseases (ISA, VHS, IHN). This means that Finland is allowed to import fish products from other corresponding regions (currently the UK, Sweden and part of Denmark). Screening has been intensified at fish farms to prevent the potential spread of new fish diseases, and transfer of fish from one habitat to another is in some cases prohibited.

Finnish fish and game are vulnerable to certain risk factors. The progressive deregulation of imports will potentially increase the spread of new diseases, and the prevalence of existing diseases is likely to be exacerbated. There is an imminent risk of a further spread in rabies incidence, for example.

Impact of socioeconomic trends on fish and game research

In the future, research funding will increasingly be channelled in line with market requirements. Research funding paid out of the government budget is mainly targeted at projects deemed as having a directly beneficial socio-economic impact. At the same time, research findings are also expected to lend themselves to practical implementation as flexibly as possible, which is changing the respective roles of government authorities and private funding sources. The new trend is for customers to commit themselves to research projects by providing part of their basic funding.

The role of the government authorities is to act as the national coordinator of scientific endeavours. These days, the funding provided by the government is subject to more intense competition than it used to be. Part of Finland's national research spending is now channelled via various EU funds. Research expenditure paid out of the government budget is strategically targeted at projects deemed as beneficial to the development of Finnish commerce and industry. Further cuts are anticipated in the direct budgetary appropriations paid to Finnish research institutions.

Preservation of biodiversity is a key social goal

Environmental protection has become a more urgent priority in the wake of new international agreements (such as the Rio Convention), the provisions of EU directives and the demands voiced by national and international environmental organizations. Animal rights, too, will become a more important issue in the future. The fishery industry is increasingly being drawn into ethical debate on nature conservation, especially concerning issues such as fishing methods and fish farming.

The national, Parliament-coordinated objective of sustainable development will have a positive impact on fish and game resources and biological diversity. New programmes on sustainable development drafted for sectors such as transport and communications, energy, agriculture, forestry and industry will have a beneficial intermediate effect on the conservation of biodiversity. The diversity of fish stocks is being preserved by means of increased *in situ* conservation, through measures such as the rehabilitation of polluted waters and stocking of fish juveniles. Genetic resources will continue to be preserved in the form of living gene banks at fish farms and frozen milt banks.

Public information services

The barriers between different scientific disciplines are breaking down, and an unlimited range of online information is now readily accessible thanks to recent advances in computer technology. This has highlighted the importance of data management methodology, familiarity with the basic sciences and inter-disciplinary approaches to scientific endeavour. Close inter-disciplinary contacts between a wide range of different institutions and organizations will be the key to future success in the sciences.

As the information society expands, the public authorities, too, are linking into increasingly comprehensive data networks. The information resources maintained by individual units of public administration are rapidly becoming a shared public resource; soon, these data will be accessible to all public authorities throughout Finland and, in all probability, throughout Europe. Regional data resources are being

made available through geographic information systems (GIS), which provide a rapid and convenient means of accessing data.

In the future, data will increasingly be packaged in a marketable, processable, digitized form. A clear distinction will be made between the various steps in the data production process: the production of reliable and accurate monitoring data, the scientific processing of these raw data and, finally, the coordination and presentation of this information for customers. A greater emphasis will accordingly be placed on cooperation and networking.

Electronic publishing is another trend of the future; increasingly comprehensive research data are being published in electronic form, giving customers rapid access to a more detailed range of information. The storage and reorganization of information is substantially easier in electronic form.

Greater efficiency through advances in technology

The use of GIS technology and remote sensing in the estimation of game stock abundance and the long-term monitoring of game populations provides a basis for drawing up comprehensive game management plans. These systems could also be used to improve the reindeer yield, for instance, by steering reindeer to higher-yielding grazing grounds.

By combining the latest information technology with new nutritional findings, substantial cost savings can be achieved in aquaculture. In the future, it will be possible to transfer certain desired genetic traits from one species to another, such as a rapid growth rate, disease immunity, desired appearance, palatability and migratory instinct.

New advances are being made in gene technology enabling improved genetic identification of individual strains and species of game and fish (e.g. microsatellite, mitochondrion and DNA identification).

The Government's key role in fishery, game and reindeer management

R&D funding to rise

At the beginning of 1996, the Finnish Science and Technology Policy Council took a policy decision on the structural development of Finnish research. The resultant action programme lays down a list of forthcoming measures, including evaluation of Finnish research institutions, ministerial administration of research-related affairs, any necessary revision of ministerial research policy, measures to monitor the input of EU Structural Funds and its impact on Finnish science, and the intensification of inter-ministerial cooperation.

Over the coming years, the government plans to substantially augment its annual R&D expenditure. The annual sum of government research spending is rising progressively, and will amount to 2.9 per cent of GDP by 1999. The largest proportion of R&D funding comes from private sources, however. Private research funding totalled FIM 11.6 million in 1997, which accounted for 68% of the total sum of R&D spending in Finland that year.

The Ministry of Agriculture and Forestry spent FIM 446 million on research and development in 1998, which represents 6.1% of the total sum of government research expenditure. The Ministry channelled 84% of its funding into research institutions operating under its auspices.

Objectives of the Ministry of Agriculture and Forestry

The main objective of the Ministry of Agriculture and Forestry is to create a basis for the sustainable use of renewable resources and to secure the future commercial and recreational prospects of Finland's rural areas. The Ministry is also responsible for controlling the quality of domestic food produce and the overall condition of Finland's flora and fauna.

The Ministry's strategy for sustainable use of renewable natural resources was ratified in February 1997. One of the prerequisites of sustainable development emphasized in the strategy is the importance of preserving the diversity of game and fish species and their habitats. Related work is also being done to promote small-scale enterprise and tourism in rural areas. New methods are being developed to prevent diseases which pose a hazard to the future survival of Finnish fish stocks. Current game stocks in Finland are abundant enough for controlled hunting to continue. The compilation of reliable and accurate monitoring data and other forms of research are being intensified.

The Ministry of Agriculture and Forestry has six specialized research institutions operating under its auspices. Their work is designed to serve the Ministry's objectives, decision-making and customers.

The Department of Fisheries and Game is in charge of all administrative affairs related to fishing, hunting and reindeer farming in Finland. The FGFRI, in turn, is responsible for carrying out research on fisheries, game and reindeer husbandry, for performing related research and for running state-owned aquaculture stations in compliance with the annual output targets laid down by the Ministry. The FGFRI is also responsible for intensifying domestic and international cooperation and for promoting the practical application of its research findings. The FGFRI maintains high standards of excellence in its research and information services.

FGFRI objectives laid down by the Ministry of Agriculture and Forestry

The FGFRI's mandate is to conduct research on the state of Finnish fish stocks, factors influencing trends in stock abundance and methods of sound fisheries management. Annual prognoses of stock abundance and catch prognoses are produced for important fish species such as salmon, Baltic herring and sprat. Research on water habitats affected by hydro-engineering and eutrophication is to be augmented, and studies on the efficacy of fish stocking will be diversified. Research on recreational fishing will be expanded to incorporate its potentially depletive effects and any pressure this might be exerting on fish stocks. Aquacultural research is designed to build a knowledge base for the future preservation of commercial services related to aquaculture.

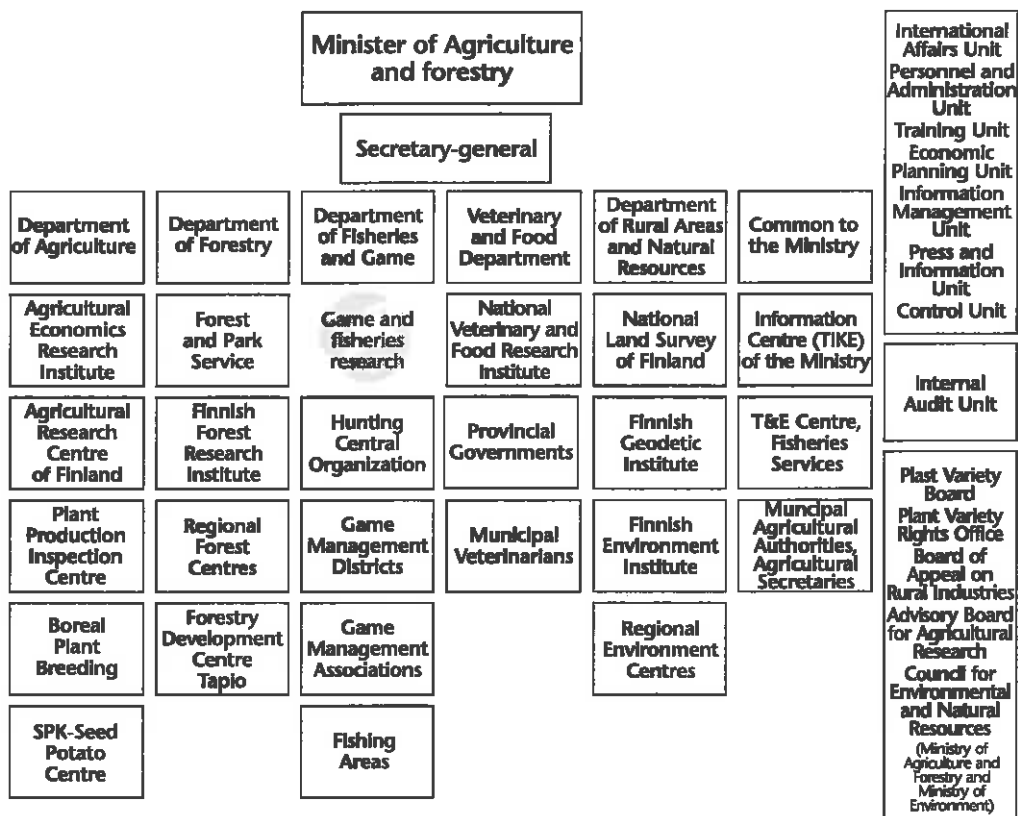
The purpose of game research is to provide accurate, up-to-date information on Finnish game and reindeer stocks to serve as a basis for public decision-making, such as the setting of hunting quotas. More research will be conducted on the incidence and prevention of damage caused by large predators and seals. Habitat studies

investigate the structure of forestry and agriculture and its effects on the abundance of game stocks.

Reindeer research is currently focusing on herd sizes in relation to food resources and the condition of summertime pastures.

The objective of aquaculture is to preserve endangered fish stocks and, through cultivation and juvenile stocking, to revive declining river stocks and the indigenous salmon, trout, grayling, arctic charr, asp and whitefish stocks in major inland waters. Increasing emphasis is being placed on the marketing and profitability of these services, though the FGFRI intends to avoid competition with private service providers.

Diagram 10: Organization chart of the Ministry of Agriculture and Forestry



II THE FINNISH GAME AND FISHERIES RESEARCH INSTITUTE

Main sphere of responsibility

The Finnish Game and Fisheries Research Institute was established on March 1, 1971, following the merger of the Fisheries Research Department of the National Board of Agriculture (founded 1923) and the Game Research Institute (founded 1963). The State's fish cultivation operations and aquaculture stations were transferred from the Ministry of Agriculture and Forestry to the FGFRI in 1971.

The research conducted by the FGFRI is designed to generate information on game and fisheries to serve as a basis for public decision-making. The Aquaculture Unit is responsible for production of eggs and juveniles required for the fulfilment of State stocking obligations, preserving the diversity of Finnish fish stocks by means of aquaculture and safeguarding future fishing opportunities.

The FGFRI's responsibilities are set forth in further detail in the Decree on the Finnish Game and Fisheries Research Institute.

Mission statement

The Finnish Game and Fisheries Research Institute strives to uphold high standards of excellence in its capacity as an internationally significant research centre possessing specialized expertise in northern European game and fisheries. The information and aquacultural services provided by the FGFRI promote the sustainable use of fish and game resources in tune with the demands of biological diversity and the advancement of commercial opportunities in the fish and game sector.

Since 1996, the FGFRI's operating philosophy has comprised the following objectives. The FGFRI aims to:

- generate information and provide expert services;
- promote the sustainable use of naturally occurring game and fish resources in Finland;
- advance commercial operations and recreation in the sector;
- foster awareness of the impact of environmental changes on game and fish stocks, and promote the management of habitats in such a manner as to support their viability;
- produce reliable, up-to-date estimates, statistics and forecasts on game and fish stock abundance;
- preserve endangered fish stocks and the diversity of fish species by means of cultivation;
- promote national and international cooperation in its field of expertise.

This operating philosophy has been fine-tuned throughout autumn 1998 in conjunction with the FGFRI's strategic planning. The present status of this work is described in further detail in the section dealing with the FGFRI's strategy.

Organization of the FGFRI

The highest decision-making body in the FGFRI is the Board, which is in charge of strategic management of the FGFRI's operations. In 1998, the Board consisted of Managing Director Jouni Filppa, Director Per-Edvin Persson (Vice Chairman), Managing Director Kaisa Rossi, Professor Jorma Tahvanainen, M.Sc. Fisheries Biologist Oili Vuorimies (representative of the staff) and the Director General of the FGFRI as Chairman of the Board.

The FGFRI consists of five profit centres, or Units, with the Board acting as their joint coordinator. The Director General of the FGFRI is M.Sc.Econ. Kare Turtiainen. The Fisheries Biology and Management Research Unit is headed by Dr. Petri Suuronen, the Socioeconomic and Aquaculture Research Unit by Dr. Juhani Kettunen, the Game and Reindeer Research Unit by Dr. Eero Helle, the Aquaculture Unit by Lic.Phil. Kai Westman and the Services Unit by M.Sc. Lena Söderholm-Tana. The current organizational model was introduced in 1994.

Each Unit is responsible for one or two of the following areas:

- Fisheries biology and management research: Production of research data on the status of fish stocks, the effects of habitat modification on fish stocks and fisheries management;
- Socioeconomic and aquaculture research: Production of research data necessary for commercial and recreational fishing, aquaculture and other business in the fisheries industry;
- Statistics: Compilation of statistics on fisheries, game management and reindeer husbandry;
- Game research: Production of research data on game populations, hunting and the condition and management of game habitats, and coordination of game monitoring;
- Reindeer research: Production of research data on the biology of the reindeer, reindeer pastures and reindeer herding;
- Aquaculture: Maintenance of gene banks of fish stocks, cultivation of fish and crayfish for revival of endangered stocks, obligatory stocking, research and other purposes, including cultivation contracts;
- Services: Production of support services required by the FGFRI and its customers, i.e. services for which centralization is the most practicable solution.

The FGFRI has 25 research and aquaculture stations across Finland.

The FGFRI's operations are based on the annual State budget and on the operating and financial plan which is ratified early for four years. The result targets for the FGFRI are set by the Ministry of Agriculture and Forestry and specified in the operating plans for each Unit. The State appropriations allocated to each Unit are ratified separately. The FGFRI's annual report and report on operations is made up of the Units' separate reports on their operations. Attainment of the result targets is also described in interim reports submitted to the Ministry each September.

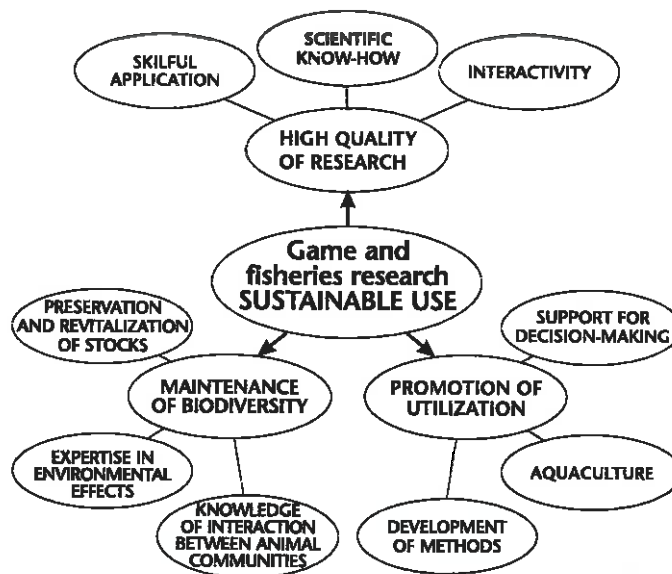
The FGFRI's core competence

The FGFRI's core competence consists of assessment of the status of fish, game and reindeer populations, production of data for their sustainable exploitation, and aquaculture. In addition to research, extensive expert services are an integral part of the FGFRI's activities.

Services and products related to game and fisheries research include scientific publications, estimates and forecasts concerning fish and game populations and annual catches and bags, monitoring the condition of reindeer pastures, statistics for national and international customers (e.g. the EU, FAO, EIFAC, IBSFC, ICES, NASCO, OECD, Nordic Council of Ministers), expert services, a variety of research tools and products (database software, guide books, commissioned research), fish tagging and laboratory services.

FGFRI services and products related to aquaculture include broodstock and fry of fish and crayfish, juveniles from fish farms and natural food ponds, breeding products, milt banks, stocking services, new cultivation methods and expert services.

The Services Unit is in charge of support services including financial administration, human resources, property management, publishing, communications and information services.

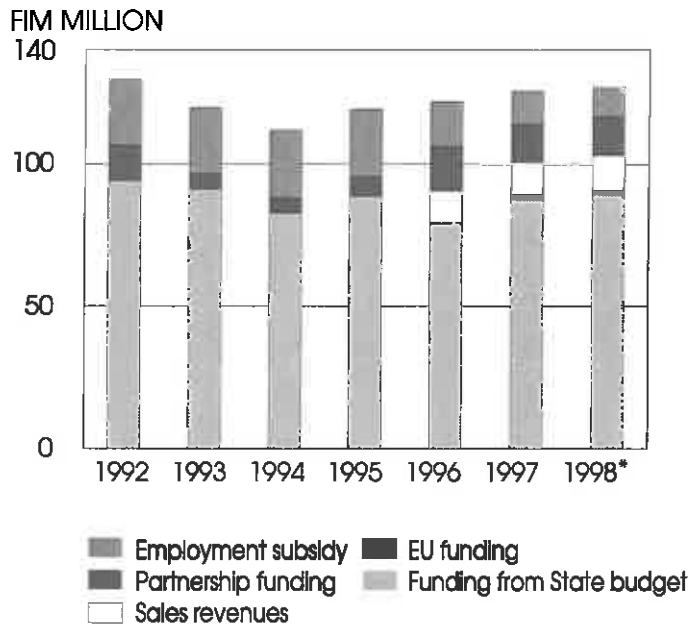


Financing and human resources

Financing of operations

The FGFRI's operations are financed through funding from the State budget, partnerships, employment subsidies, EU funding and sales revenues. As the share of State budget allocations is slowly declining, the FGFRI has striven to increase income from sales. Another welcome source of income is commissioned research projects, which must not, however, conflict with the FGFRI's own strategy.

Figure 11: Funding of operations, 1992-1998



Index for public consumption expenditure in 1997
 * Estimate

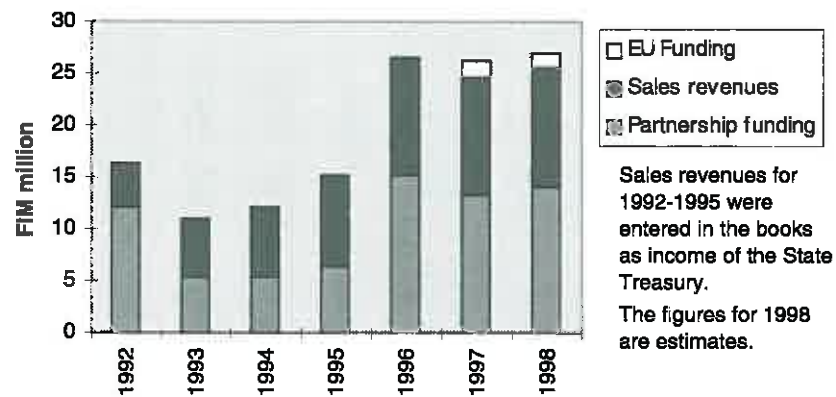
The diagrams presented here have not been adjusted in line with the extensive structural changes made in the budgeting system in the years 1992 - 96. The most significant of these structural changes was the establishment of the State Real Property Authority, which gained ownership of the FGFRI's facilities in 1995. This increased expenditure by about FIM 12 million, while implementation of the net budgeting system had the opposite effect. The real decrease in funding from the State budget in 1992-1998 is sharper than indicated in figure 11.

Furthermore, FIM 9.3 million from the State budget went for new construction in 1997. During the past twenty years, building investments have amounted to FIM 10-25 million annually; in 1998, however, the sum will only be FIM 2 million. Projects launched in recent years have been completed on a smaller scale than originally planned.

In 1997, EU funding and the FGFRI's sales revenues amounted to FIM 13.6 million. Since Finland joined the EU, the amount of EU funding for the FGFRI has increased rapidly. In 1997, the Fisheries Biology and Management Research Unit received FIM 1.5 million from the EU. Other important sources of funding are the business sector (FIM 5.4 million), other governmental agencies (about FIM 3 million) and local authorities (FIM 0.5 million). The Aquaculture Unit had the largest sales income from the sale of eggs, fry and other fish products, while the Game and Reindeer research had practically no sales income at all.

Partnership funding in 1997 amounted to FIM 13.2 million and employment subsidies to FIM 11.8 million. The largest percentage came from the Academy of Finland and the Ministry of Agriculture and Forestry. The amount of funding from the Academy of Finland and the environment authorities varies annually between FIM 500 000 and FIM 1,5 million. Other financing sources are international partners, whose total annual contribution is around FIM 1 million. Partnership funding also includes EU funding received through partnership organizations. The proportion of employment subsidies has declined in recent years.

Figure 12: Partnership funding, EU funding and sales revenues



Labour costs form 58% of expenditure

The FGFRI's expenditure in 1997 was FIM 117.5 million, which was 4% less than in the previous year. The expenditure of the Socioeconomic and Aquaculture Research Unit and the Aquaculture Unit has gone down over the past three years, while that of the Game and Reindeer Research Unit and the Fisheries Biology and Management Research Unit has increased. Fluctuations in costs are largely due to staff redeployments carried out at the beginning of 1997.

Labour costs accounted for the largest share (58%) of the FGFRI's overall expenses, other operating costs for 37% and capital costs for 5%.

Table 3: Key figures in the FGFRI's operations.

The key figures presented here are used as indicators for monitoring the FGFRI's operational performance. Comparable figures have been available since 1994.

	1994	1995	1996	1997
SERVICES, FUNCTIONS AND PRODUCTS				
Expert statements issued	60	53	47	43
Annual estimates of populations ^{*)}	19	20	19	18
Articles in SCI or SSCI catalogue based journals	21	30	40	37
Other articles undergoing preliminary review outside the FGFRI	28	50	21	24
Articles in the FGFRI's own publications	68	106	144	97
Other written publications (including FGFRI brochures)	168	218	163	180
Other published material (lectures, posters, video presentations)	326	373	404	382
Fish eggs (l)	5 513	4 668	4 441	6 982
Juveniles from fish farms (equivalent to a 50-gram unit)	1 796	2 206	1 820	1 622
Juveniles from natural feed ponds (equivalent to a 5-gram unit)	3 354	2 475	2 304	2 463
Person work-years (total)	460	457	452	394
- State budget financing	265	262	260	266
- Partnership funding	24	46	37	24
- Employment subsidies	171	149	155	104
COSTS (FIM 1000)				
Direct costs of commercial operations	7 046	6 215	6 905	7 941
Other Unit-specific direct costs	41 398	58 515	53 549	52 433
Overhead costs	48 130	42 194	47 915	44 734
Capital costs	36 619	4 849	5 332	6 305
Total costs	139 387	121 277	122 386	111 413
- Labour costs	15 335	16 240	15 441	11 605
CULTIVATION CONTRACTS FOR COMMERCIALLY VALUABLE FISH SPECIES (FIM 1000)	6 194	9 504	8 685	6 064
TOTAL COSTS				
Labour costs, total	68 940	70 256	71 572	67 849
- FGFRI's own staff	54 225	51 068	56 846	56 244
- Subsidized employment	14 715	19 188	14 726	11 605
Other costs, total	33 828	46 172	50 364	43 301
- Lease of premises	3 924	15 232	15 878	14 907
- Materials and supplies	15 649	18 106	16 416	14 371
- Travel expenses	3 947	3 580	4 094	3 897
- Outsourced services	8 610	8 422	9 101	8 783
- Other expenses	1 698	832	368	1 747
- Per diem allowances	0	0	-434	-404
Capital costs	36 619	4 849	5 391	6 327
Total costs	139 387	121 277	122 386	117 477
INCOME (FIM 1000)				
Commercial operations	6 679	8 839	11 413	11 504
Other Income	730	293	551	676
EU funding	0	0	72	1 460
PROFITABILITY OF COMMERCIAL OPERATIONS				
Operating surplus (% of income)	-5	+30	+20	+31
Net surplus (% of income)	-36	-15	-31	-14

*) These estimates are also included under the heading 'Articles in the FGFRI's own publications'. Estimates of game populations are published in the FGFRI's game research bulletins and included under the heading 'Articles in the FGFRI's own publications'.

Advances in operating accountancy

Accountancy at the FGFRI has been under intensive development since 1994. In addition to serving the needs of the FGFRI's management, accountancy must comply with the requirements set by the Office of Free Competition, the State Economy Comptrollers' Office, the State Treasury and the Ministry of Agriculture and Forestry. Operating Accountancy is part of the management support system, satisfying the needs of the FGFRI's commercial operations and compiling data on all expenditure and profitability related to the FGFRI's products and functions.

The operating accountancy must also comply with the provisions laid down for State-subsidized public bodies. Cost accounting and other data must accordingly be presented clearly enough to be analysed by third parties, and, indeed, accounting experts and other users of such data have found the FGFRI's present accounting standards to be very high.

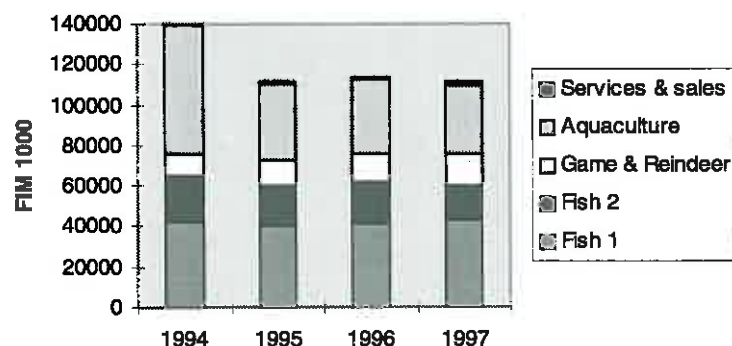
Special demands exist for cost accounting in particular: the FGFRI operates several Units simultaneously across a very large geographical area, producing a large number and great variety of services. The importance of cost accounting is greatest in aquaculture, but its role in research is also increasing.

The basic unit in cost accounting is a project or function, where direct and indirect production inputs are entered in the books or allocated in cost accounting. A project or a function may be an out put measurement (e.g. a research project, a package of services provided by the Aquaculture Unit, internal or external functions) or a support function, such as Unit administration or financial services.

The aim of cost accounting is to establish the true cost effect of out put measurements. Direct costs consist of the required materials, equipment, transport, outsourced services and other expenses. Direct labour costs are determined on the basis of records on paid salaries and completed working hours. In addition to direct costs and labour costs, the final cost of out put measurements are taken to comprise all other administrative costs and other expenses, including the hire of premises. The total costs are entered in the books on the basis of the labour costs incurred from the out put measurement as the combined costs of the Unit and sub-unit plus service costs. Capital costs are allocated in line with planned depreciations.

In figure 13 and table 4, the abbreviation 'Fish 1' refers to the Fisheries Biology and Management Research Unit and 'Fish 2' to the Socioeconomic and Aquaculture Research Unit.

Figure 13: Total costs per Unit



Until 1994, the facilities used by the Units were owned by the FGFRI, which meant a considerable outflow of capital expenditure.

In 1995, ownership of the facilities was transferred to the State Real Property Authority, which leased them back to the FGFRI.

Personnel of the FGFRI

The staff's total input in 1997 was 394 person work-years. Of this, 266 person work-years were financed out of the State budget, 24 person work-years through partnership funding and 104 person work-years through employment subsidies. The mean age of the FGFRI's staff is 44 years, with most employees aged between 40 and 50. Women make up 35 per cent of personnel.

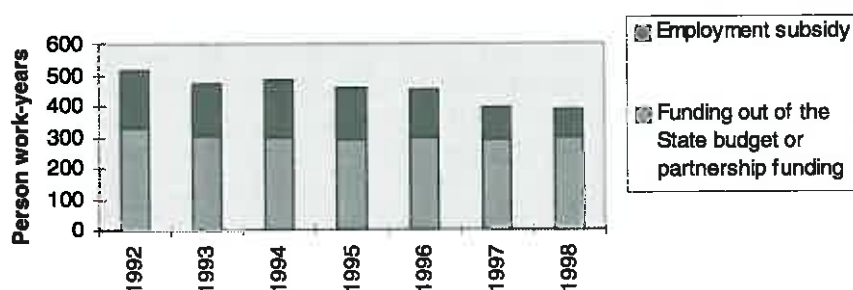
Table 4: Person work-years at each Unit, research station and field station of the FGFRI in 1997

	Units*	Fish 1	Fish 2	Game & Reindeer	Aquaculture	Services	Total
<i>Permanent research and aquaculture stations</i>							
Helsinki, headquarters		41	20	11	3	37	111
Saimaa		20	3		11	5	39
Taivalkoski		3		5	12	11	32
Inari	2	8			18	4	30
Kainuu		10			13	5	28
Laukaa		2	10		10	4	26
Evo	2	7	2	3	3	5	21
Tenojoki		15				2	17
Muonio	2	1			13	3	17
Bothnian bay		12				1	12
Reindeer Research				9		2	10
Rymättylä		4	4			2	10
Ilomantsi				8		1	9
Tervo			1		5	2	8
The Quark		6	1			1	8
Meltaus				4		1	5
Åland		1					1
Oulu, est. 1998							
<i>Field stations</i>							
Reposaari		1	2				3
Lautiosaari					3		3
Valko		1					1
Kalajoki		1					1
		132	43	39	92	87	394

* shared by two Units

104 of the person work-years presented in the table were funded by the Ministry of Labour, mostly in Northern Finland

Figure 14: Person work-years in 1992-1998



Person work-years are calculated on the basis of the working hours reported, or 7 hours per working day for each function.

Human resources development

The average level of education at the FGFRI is high; nearly half (44%) of the employees have completed an academic degree. Those with a doctoral degree are still rather few, but their number is rapidly increasing. Researchers formed 56% of the staff, while 23% worked in aquaculture and 21% in services.

Since 1996, the FGFRI has actively supported employees' pursuit of academic qualifications, particularly doctoral degrees. In the FGFRI's view, research leave and researcher exchange programmes are important for raising the scientific level of the research carried out by the FGFRI.

Table 5: Permanent employees' educational background in 1992-1998

	1992	1993	1994	1995	1996	1997	1998
Ph.D.s	14	16	17	18	19	21	26
Licentiates	4	6	9	10	10	11	13
Master's degrees	77	80	74	71	64	68	66
Other degrees or diplomas	197	165	165	163	167	166	174
Total	292	267	265	262	260	266	279

In addition to its postgraduate programme, the FGFRI has arranged courses in management, methodology, languages and scientific writing. The FGFRI has also encouraged employees to take courses at universities and other institutions.

Material published by FGFRI personnel

A summary of material published by the staff at the FGFRI is prepared each year in connection with the FGFRI's annual report.

The FGFRI promotes the publication of scientific papers in prestigious international scientific journals. One fourth of the scientific papers have been published in SCI catalogue based journals. In 1996, an estimated 10-15% of the research staff were internationally recognized and frequently cited in other papers. The number of these writers is increasing, with active encouragement from the FGFRI. On average, the FGFRI's researchers each produce four papers a year, which is a fairly large number. Most of these are research papers for the scientific community or articles aimed at the general public.

Table 6: Scientific and other publications by FGFRI staff, 1994-1997

	1994	1995	1996	1997
Fisheries Biology and Management Research				
Articles in SCI and SSCI catalogue based journals	6	14	21	15
Other articles undergoing preliminary review outside the FGFRI	16	25	10	13
Articles in the FGFRI's own publications	19	61	37	47
Other publications (including FGFRI brochures)	46	71	65	78
Socioeconomic and Aquaculture Research				
Articles in SCI and SSCI catalogue based journals	2	2	10	10
Other articles undergoing preliminary review outside the FGFRI	2	14	4	6
Articles in the FGFRI's own publications	14	24	26	28
Other publications (including FGFRI brochures)	46	61	36	19
STATISTICS				
Articles in SCI and SSCI catalogue based journals	1			
Other articles undergoing preliminary review outside the FGFRI				
Articles in the FGFRI's own publications	14	19	8	15
Other publications (including FGFRI brochures)	3	6	3	5
Game Research				
Articles in SCI and SSCI catalogue based journals	10	12	9	13
Other articles undergoing preliminary review outside the FGFRI	9	8	7	5
Articles in the FGFRI's own publications	7	8	68	5
Other publications (including FGFRI brochures)	52	61	38	63
REINDEER RESEARCH				
Articles in SCI and SSCI catalogue based journals	4	3	3	
Other articles undergoing preliminary review outside the FGFRI	1	3		
Articles in the FGFRI's own publications				2
Other publications (including FGFRI brochures)	21	21	16	21
Aquaculture				
Articles in SCI and SSCI catalogue based journals			1	
Other articles undergoing preliminary review outside the FGFRI	1	9		1
Articles in the FGFRI's own publications	15	12	16	13
Other publications (including FGFRI brochures)	4	14	7	5

Total*

Number of papers given in parentheses, followed by the total of Units involved in the production of the articles
Some papers were written by staff from several Units and are therefore included under more than one heading

Articles in SCI and SSCI catalogue based journals	(21)23	(30)31	(40)46	(37)38
Other articles undergoing preliminary review outside the FGFRI	(26)29	(50)59	(21)21	(24)25
Articles in the FGFRI's own publications	(66)69	(106)125	(144)155	(97)110
Other publications (including FGFRI brochures)	(168)172	(218)234	(163)166	(180)191

*) Because of their different publication schedules, the figures for scientific articles differ from those given in the list of publications compiled in connection with the FGFRI's annual report. This table gives the figures under the correct dates.

Table 7: Researchers, senior researchers and research professors

	1994	1995	1996	1997
Fisheries biology and management research	43	43	42	42
Socio-economic and aquaculture research	16	17	17	16
Statistics	8	8	8	8
Game research	7	7	7	7
Reindeer research	2	2	2	2

FGFRI publication series

The FGFRI is a co-publisher of *Boreal Environment Research (BER)*, a Finnish scientific publication founded in 1996, replacing the four separate scientific publication series formerly published by the research institutions now involved in BER. The FGFRI has a representative on BER's editorial staff.

The FGFRI's former series entitled Finnish Game Research was discontinued in 1996, along with corresponding wildlife research publications in Sweden and Denmark; the three publications were replaced by a new international publication called *Wildlife Biology. Suomen Riista (Wildlife in Finland)* is an annual publication co-published by the Suomen Riistanhoitosäätiö (Finnish Game Foundation) and the FGFRI, consisting mostly of articles written by game researchers. In addition about ten game research bulletins are put out each year, in which results of game monitoring and game research are made available to a more general public.

Kalatutkimuksia - Fiskundersökningar ('Fish Studies') has been published in its present form since 1990.

In 1996, the FGFRI formed a working group for development of publishing activities. The aim is to disseminate scientific information more efficiently and thereby increase its public influence. This requires wide use of different publication channels and mass communications media.

The quality of the FGFRI's publications has improved. Reports on fisheries research are marketed and sold commercially. The series *Kala- ja riistaraportteja* ('Fish and Game Reports') consists mostly of regional studies, interim and annual reports and other articles targeted at a specific readership, and it is published at frequent intervals and at a low cost.

Statistics on fisheries and hunting are published in the *SVT Ympäristö (Official Statistics/Environment)* in cooperation with Statistics Finland.

In recent years, the FGFRI has placed a special emphasis on publishing books for the general public. Research papers and expert articles are compiled into books, guides and other special publications. In 1996-1998, the FGFRI has had seven titles on the market. Their sales totalled FIM 146 000 in 1997; at the end of October 1998, sales had reached FIM 190 000.

Cooperation and stakeholders

The FGFRI's most important domestic partners - and occasionally its competitors - are other research institutes, such as the National Veterinary and Food Department, the Agricultural Research Centre, the Finnish Marine Research Institute, The Finnish Forest Research Institute, the Finnish Environment Institute, the regional environment

centres, and universities, notably those of Helsinki, Joensuu, Jyväskylä, Kuopio, Lappi, Oulu, Turku and Åbo Akademi. The FGFRI also cooperates with the authorities, organizations and businesses related to fisheries and game management. Statistics are compiled in collaboration with Statistics Finland, the Ministry of Agriculture and Forestry, and employment and economic centres.

The FGFRI has agreements on cooperation with universities, other research institutes, enterprises, environment centres, the Finnish Forest and Park Service and Statistics Finland, among others.

Fish farms are the most important customers for products related to aquaculture, but they are also the FGFRI's competitors. The FGFRI invites competitive tenders from private fish farms for cultivation contracts, under which the FGFRI sells fish eggs to private fish farms and agrees to buy the juveniles back at a specific age, within limits set by the State budget. State-owned and private fish farms cooperate closely in aquacultural product development, breeding, experimental cultivation of new species, and development of cultivation technology.

Universities have an important role in creating know-how and providing academic qualifications for the FGFRI's employees. Some of the FGFRI's researchers teach at universities, twelve of them as docents. By combining fisheries expertise with social sciences, technology and economics, cross-disciplinary joint projects enable new approaches to be employed in fisheries research. This cooperation covers environmental studies, fish biology studies, methodology, studies in population ecology and genetics, pathological studies, aquacultural development projects, teaching and statistics.

The authorities, organizations, fishing areas and fishing collectives have the role of initiators, customers and users of this research, more or less reflecting the needs of citizens at large. Finnish fisheries and the related authorities and information services form a decentralized nationwide network.

Game and reindeer research is coordinated by the FGFRI, which also carries out most of the research, while the actual game management is done by hunting associations.

Although the FGFRI competes for funding with other providers of consultancy services in the fisheries and game management sector, the FGFRI's strength lies in large-scale projects and projects requiring in-depth expertise, where long-term, extensive reference material collected over a long period can be very useful.

Close cooperation with international organizations

The FGFRI has concluded a number of international cooperation agreements with its neighbouring countries and the EU. These agreements concern fishing, water-level regulation, statistical monitoring and environmental protection in the Baltic Sea and the North Atlantic.

There has been a considerable increase in the international activities carried out by the FGFRI, particularly those related to the European Union. Decision-making in the EU requires more and more detailed background information on fish stocks and their exploitation, game and reindeer populations and their habitats. In fishery research, this necessitates cooperation with international organizations and participation in the assessment of resources. In the FGFRI's history, the oldest forum of international cooperation is the International Council for the Exploration of the Sea (ICES). Research on salmon in the rivers Tenojoki and Näätämöjoki is discussed annually at the North Atlantic Salmon Conservation Organization (NASCO). The FGFRI has also been a member of the Working Group on Fisheries Research (NAF) of the Nordic

Council of Ministers since the working group was established in 1989. NAF's primary task is to issue expert opinions on research project applications submitted to the Nordic Council of Ministers. In 1997, the FGFRI participated in five new or ongoing joint Nordic research projects.

Cooperation with Russia focuses on waters between Finnish and Russian territory and assessment of game populations.

The FGFRI has a representative in the EU's Scientific, Technical and Economic Committee for Fisheries (STECF), which reviews the ICES's advice to the EU where intra-Community waters are concerned. Representatives of the FGFRI also provide expert scientific comments on research project applications and on the scientific programme committees. The FGFRI has also actively taken part in Meetings of the Directors of Fishery Research Organizations of the European Union.

The FGFRI is involved in several fishery research projects organized by the EU. In 1997, EU projects were carried out on technical regulation of Baltic fisheries, fluctuations in the Baltic cod stocks, fish catch sampling in the Baltic Sea, tagging methods, and echo-sounding assessment of the salmon stock ascending the Tornionjoki river. The core of the research cooperation within the EU consists of projects funded by DG XIV. In some of projects co-financed by the EU, which generally last for 1-3 years, the FGFRI's role is that of a coordinator. The total sum of funding for these programmes is 2.7 million ecus. Direct EU funding for game and fishery research amounts to about 250 000 ecus in 1997 and 1998 and will increase in the coming years.

Eurostat meetings on fisheries statistics are the most important cooperation forum for statistical work. Other cooperation partners include the Nordic Council of Ministers and the ICES and the national statistical offices of individual countries.

Representatives of the FGFRI have worked as experts at the International Baltic Sea Fisheries Commission (IBSFC) and the North Atlantic Salmon Conservation Organization (NASCO) every year since these were established. In 1997, the FGFRI also took part in drafting the fisheries section of the Baltic Agenda 21 and the implementation of the Salmon Action Plan (SAP) based on a Commission decision.

The FGFRI participates in the FAO's European Inland Fisheries Advisory Commission (EIFAC) by submitting reports requested by the Commission or its working parties and taking part in the activities of the working parties.

The FGFRI has representatives in the Nordic Council for Wildlife Research, the International Union of Game Biologists, the Bonn Convention Scientific Council, the European Bird Census Committee, the Nordic Council for Reindeer Research, the Circumpolar Seabird Working Group and the International Bird Strike Committee. The editor-in-chief and one of the sub-editors of the international journal *Wildlife Biology* are also FGFRI employees.

The FGFRI is involved in joint research projects with foreign universities and research institutes and international scientific societies and organizations.

III ACTIVITIES OF FGFRI UNITS

Fisheries Biology and Management Research

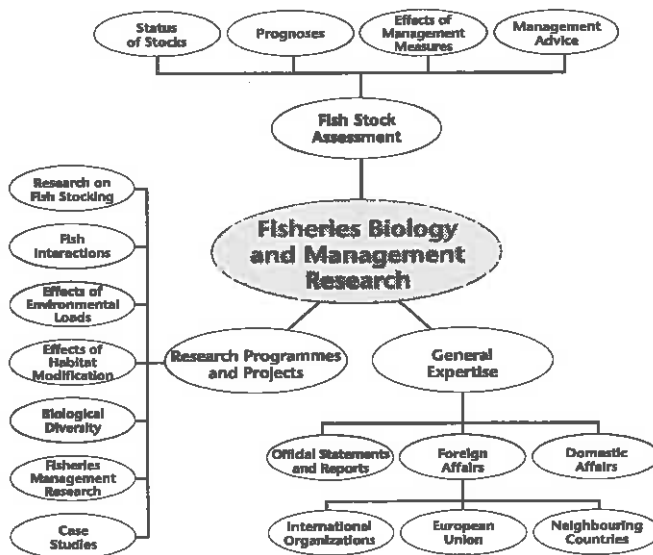
Research in fisheries biology and management is promoting sustainable use of fish and crayfish stocks. By studying the status and exploitation level of stocks, the Unit produces reports and instructions for the Finnish and EU authorities, national and international organizations, water owners, industry, the scientific community and the general public.

Main tasks

The Unit is also responsible for research of impacts on factors affecting on the status of fish and crayfish stocks, and on methods of managing stocks. This task is subdivided into fish stock assessment, research projects and expert services.

Fish stock assessment

One of the Unit's permanent core-tasks is assessment of commercially important fish stocks, which includes scientific consultation in matters related to the management of fishery resources. This activity is based on the principle of sustainable use of natural resources, annual result targets set by the Ministry of Agriculture and Forestry and national and international information needs. The key results of assessment are published annually.



Main tasks of the Fisheries Biology and Management Research Unit

Research projects

Over the next few years, most of the Unit's research projects will be carried out under six programmes, which have been outlined in cooperation with the users of the research results. Selection of the topics of these programmes is largely affected by national legislation, international agreements and conventions and EU-related obligations. Most of the projects within the programmes can be categorized as applied research.

1. Fish stocking research

The purpose of the research programme is to find solutions to reconcile the objectives of stocking, fishing and the protection of fish stocks and to improve the commercial profitability of stocking. The programme consists of research on the effects and economic feasibility of stocking different species and size of fish, assessment of stocking needs in the short or long term and development of systems for monitoring the success of fish stocking.

2. The role of fish interactions in inland fisheries management

The purpose of the research programme is to produce data on the interactions within fish communities to be used as the basis for development of models and fishery-management methods suitable for a variety of environments, fish communities and fishery-related objectives. The programme investigates the impact of fishing and its regulation on fish stocks and the catches.

3. Effects of environmental loads on fish and fisheries

The purpose of the research programme is to produce data which can be used to assess, prevent and reduce damage to fisheries caused by environmental pollution. The programme includes assessment of damage to fish and fisheries caused by environmental loads from catchment areas and air pollution, with special emphasis on reducing the damage to fisheries caused by eutrophication.

4. Habitat modifications in freshwaters: mitigation of effects by rehabilitation and fisheries management

The purpose of the research programme is to provide scientifically valid information on the prevailing processes in human-modified water courses so as to increase the commercial potential of the fishing waters, to develop methods for rehabilitation of fish stocks and fisheries by reorganizing fishing strategies and rehabilitating streams, and to develop models and observation methods.

5. Research on biological diversity

The purpose of research on biological diversity is to provide data to be used as the basis for measures to maintain biological diversity of fish stocks. Projects under this heading focus on development of indicators and methods for monitoring biodiversity, the genetic diversity of fish stocks, maintenance of a fish stock register, and instructions for management of fish stocks complying with the aim of preserving biological diversity.

6. Technical regulations in fisheries management

The purpose of the projects under this heading is to produce data which can be used to maximize the profitability of fisheries and efficient utilization of fish resources. Projects under this heading examine how the structures and mesh sizes of gears, minimum landing sizes and closed seasons and areas affect the regulation of fisheries and seek to ascertain what are the primary targets of future fishing regulation in Finland.

7. Case studies

The Unit is also engaged in individual research projects. The most notable of these are the extensive international Salmon Action Plan (SAP) and studies on the M74 syndrome which causes high mortality in yolk-sac fry of salmon.

Personnel and other resources

The Fisheries Biology and Management Research Unit has 76 permanent employees, 49 of whom hold an academic degree. Of these, 10 have a doctoral degree and 11 are licentiates. Another 10 employees are expected to take a doctoral degree within the next few years. All in all, the Unit actively supports postgraduate education among its employees.

In addition to the permanent staff, the Unit employs researchers, graduate students and field assistants on a fixed-term basis. Their work input amounts to a total of 15 person work-years on average each year.

40% of the staff are based at the FGFRI's main office in Helsinki; the rest work at 14 research and aquaculture stations across Finland.

The annual operating costs of the Unit are about FIM 40 million. In 1997, about 7% of the costs were covered through EU funding and revenues from sales to customers such as hydroelectric power companies.

The Unit's overall costs were distributed as follows:

Fish stock assessment	21%
Research projects	73%
Expert services	6%
Total	100%

Expert services and cooperation with Finnish and foreign organizations

The Unit is responsible for a variety of expert functions based on national or international obligations and the needs of customers and the FGFRI itself (e.g. issue of expert statements).

The Unit is engaged in a number of research projects together with other Units of the FGFRI, universities, research institutes and governmental agencies. Funding for these projects is often also provided by Finnish authorities. Professional fishermen play an important role in fish sampling and in the collection of data for catch statistics. The Ministry of Agriculture and Forestry has a key role in targeting research and funding projects. Hydroelectric power companies, municipalities and commercial fish farms are important customers and financiers.

The Unit cooperates with Finnish universities and research institutes through joint research projects, exchange of research material and by lecturing at universities. Leading partners among governmental agencies include those dealing with regional fisheries and the Finnish Environment Institute.

One of the most important forums for international cooperation is the ICES (International Council for the Exploration of the Sea) and its working groups and scientific committees. Researchers from the Unit of Fisheries Biology and

Management Research have an important role in ICES assessment working groups, and provide expert advice to the International Baltic Sea Fishery Commission (IBSCF), the North Atlantic Salmon Conservation Organization (NASCO) and the European Inland Fisheries Advisory Commission (EIFAC).

The Unit's researchers are also members of and consultants to EU committees, e.g. Scientific, Technical and Economic Committee for Fisheries (STECF), which is an advisory body. The EU also provides funding for many of the international research projects in which the Unit is involved.

Finally, the Unit's partners include a number of research institutes and universities in particular in Finland's neighbouring countries (Sweden, Norway, Estonia and Russia), but also in other European countries and North America.

In recent years, one of the most important international cooperation project has been the Salmon Action Plan (SAP) organized by the IBSFC, which aims at effective revitalization and monitoring of native salmon stocks in the Baltic.

Publications

Results of the Unit's research activities are published in a large variety of forums, e.g. scientific journals, the FGFRI's own publications, international conferences, symposiums, meetings and public events. In recent years, the Unit's researchers have been encouraged to publish in prestigious international series. The most important assessments are published annually in a Yearbook.

Socioeconomic and Aquaculture Research

New socioeconomic approaches to fishery

A major objective of the FGFRI's reorganization in 1994 was to place research on the socioeconomic aspects of the fisheries sector on a par with biological research. For this purpose, a new Unit called the Socioeconomic and Aquaculture Research Unit was established and its research mandate was entirely restructured. The research plans for the new Unit were based on a comprehensive strategic analysis of the expected customers, the demand for research information and the available resources. Most of the research currently carried out by the Unit is of a strategic nature.

Objectives

The Socioeconomic and Aquaculture Research Unit produces research data and expert services for Finnish and EU authorities, the fisheries and aquaculture sector, planning bodies, recreational fishing, the media, the scientific community and the general public. The mid- and long-term problems related to the fisheries sector and recreational fishing receive high priority in the Unit's research.

Activities

The Unit's activities focus on three areas (figure 15): compilation of official statistics on fishery, aquaculture and hunting, research on socioeconomic issues, and aquaculture research. Furthermore, the Unit provides expertise both for Finnish and international customers.

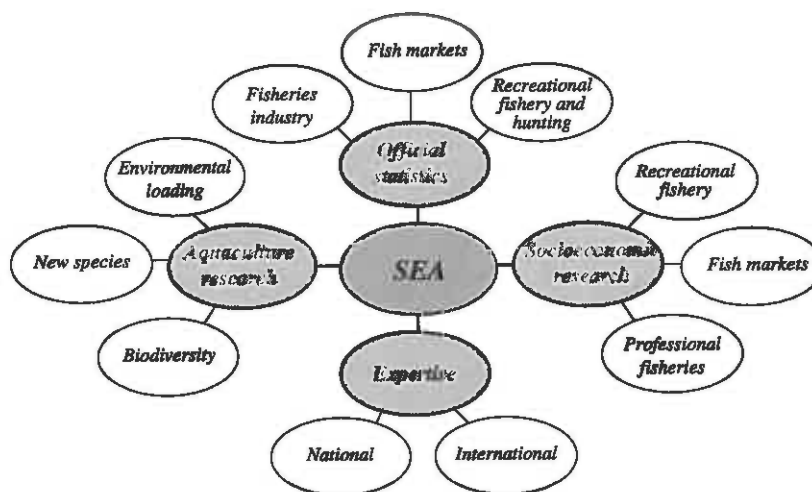


Figure 15. Key activities of the Socioeconomic and Aquaculture Research Unit

Official statistics

The FGFRI compiles official statistics on fishery and hunting to meet national needs and to comply with EU regulations and international agreements and conventions. The statistics are reported to EUROSTAT and other international organizations such as the FAO, OECD and ICES.

Statistics production at FGFRI is organized within a Statistic sub-unit. Statistics are continuously compiled on primary production and processing (statistics on commercial marine and freshwater fishery, aquaculture and the fish-processing industry), fish markets (fish prices, foreign trade and consumption), recreational fishing and hunting.

The statistics are published in Finnish and Swedish in the Official Statistics of Finland/Environment series. Since 1993, the statistics sub-unit has also published four yearbooks. On request, the sub-unit also produces statistical analyses for customers and for research purposes.

Improved overall quality is a priority in the development of statistics compilation, which will soon be supplemented with barometric measurements.

Socioeconomic research

The need for socioeconomic research of the fishery sector has arisen from significant changes in the fisheries sector: a decline in the number of fishermen, intensification of fishing methods, deregulation, changes in subsidization schemes and taxation brought by EU membership, and tougher competition in the food industry. As recreational

fishing in Finland is enormously popular, new trends in the recreational fishery industry (e.g. package fishing tours) and the amendment of the Lure Fishing Act in 1997 have increased the need for research.

Three major projects have recently been conducted in the field of socioeconomic research: *Professional Fisheries in Finland* (1994-1997), *Fish Markets* (1996-1999) and *Recreational Fisheries* (1998-2001).

The *Professional Fisheries in Finland* project is based on a survey of fishermen's attitudes and adaptation to the transitions in the industry, focusing on fishing as a source of livelihood and way of life, fishermen's views on regulation of fishery, and fishermen's adaptability to the changing industry. The project is now in the reporting stage.

The *Fish Markets* project examines the formation of fish prices, consumer behaviour and attitudes (households and catering sector), expectations of the wholesalers, retailers and the processing industry and the structure of the fish market. It is also designed to develop tools for profitability analyses of professional fishing and fish processing. The project is now in the reporting stage.

A sub-project of the *Recreational Fishery* project, called *The impact of new rod licensing system*, is designed to produce regional data on the annual catch by type of fishing gear, for example, which can be used for fishery management and regulation. The Unit is launching *Profile studies of recreational fishermen and waterway owners*. A joint Nordic study on the socioeconomic importance of recreational fishery is also being launched.

Aquaculture research

In practice, Finnish food-fish culture concentrates on one species alone, the rainbow trout. As a result of a 50% drop in the production value of rainbow trout over the past ten years, the industry has declined considerably in the 1990s. Salmon from Norwegian farms have increased its market share rapidly, which has intensified competition in the sector. Meanwhile, the Government's environmental policy requires that nutrient loading caused by fish farms must be reduced by 30 per cent in ten years. Preserving the diversity of fish genotypes is another important social challenge. The genetic diversity of rainbow trout is being put to use in a selective breeding project, aimed at intensifying production.

Aquaculture research is organized into four main areas: Reduction of environmental loading in aquaculture (1997-2000), Diversification of aquaculture production (1997-2001), Biodiversity and Aquaculture (1997-2000) and Selective breeding in farmed rainbow trout (1992-2001).

The *Reduction of environmental loading in aquaculture* project examines the present level of nutrient loading in order to monitor trends in environmental loading, thereby developing fish feeds and feeding practices with low environmental impact. Intensive research is being done to increase the plant protein content in fish feeds, for instance. The Unit is also launching a study on the effect of environmental factors on the growth rate, appetite, nutrition and digestion of rainbow trout.

The aim of the *Diversification of aquaculture production* project is to produce data on alternative species that could be cultivated on a larger scale. The first stage of the project consists of feasibility studies concerning new species which have the greatest cultivation potential. The production-related factors most relevant to the profitability of cultivating the species will be analysed in the second stage using bio-economic models. In the third stage, the main production-related problems will be tackled by

means of experimental studies. The species with greatest cultivation potential are whitefish, perch and crayfish.

The aim of the *Biodiversity and Aquaculture* project is to produce data on ways to preserve the biodiversity of cultivated fish stocks. This research is focusing on the impacts of founding brood stocks and cultivation processes on the genetic diversity of cultivated fish stocks. The project on the *Selective breeding of farmed rainbow trout* is aimed at increasing the profitability of rainbow trout farming by increasing the growth rate of fish, but also at developing selective breeding, the related methods and data collection.

Personnel and finances

The Unit has 46 employees, 7 of whom work in the Statistics sub-unit. The staff are based at 8 research and aquaculture stations, the majority (23 people) in Helsinki. 70% of the staff have an academic degree: 9 have a doctoral degree, 1 a licentiate, 19 a Master's degree and 3 a Bachelor's. Their main academic specializations are as follows: zoology and ecology (12 employees), hydrobiology (6), fishery science (4), limnology (3), economics (3), sociology (1), technology (2), geography (2) and microbiology (1). Their work input in 1997 totalled 44 person work-years. The Unit's total operating costs in 1997 were about FIM 17.3 million, 81% of which came from the State budget, 14% was financed by other public sources and 5% from the sale of research services.

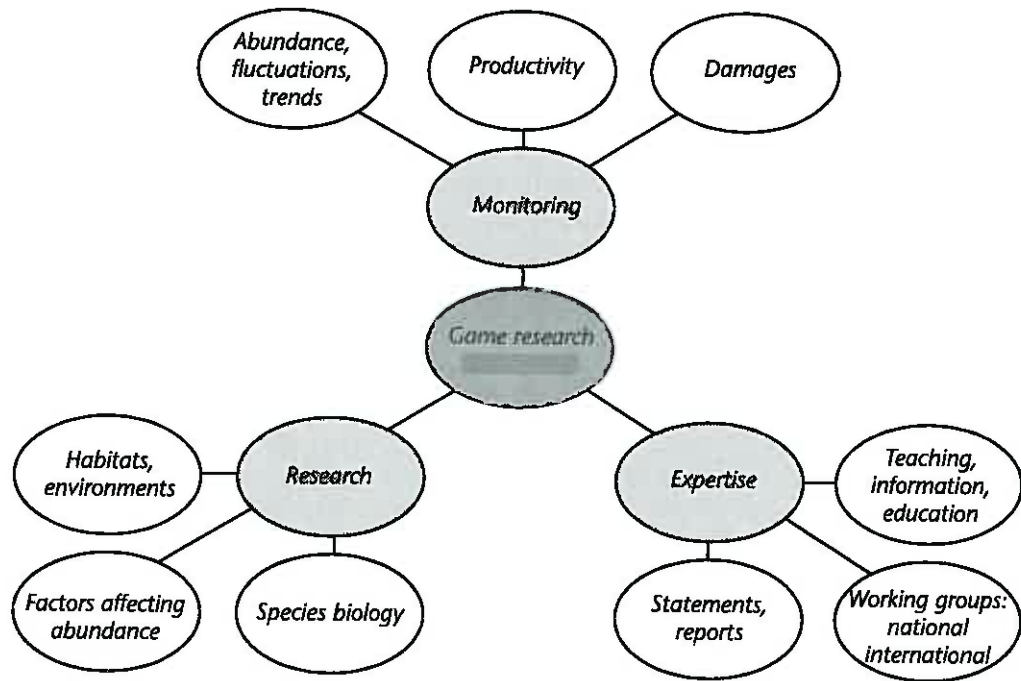
Game and Reindeer Research

The Game and Reindeer Research Unit comprises two sub-units: Game Research Unit, GRU and Reindeer Research unit, RRU.

Game Research

The GRU promotes the wellbeing and sustainable use of game populations and produces data for governmental agencies, organizations, the scientific community and the general public. A substantial amount of the data is used for the planning of hunting and other utilization of natural resources.

One of the GRU's main responsibilities is to produce data on the status of game animal populations and factors affecting it and on game animals in general. This task is divided into three areas: monitoring game populations, conducting research and providing expert services.



Monitoring game populations

Monitoring populations of the most important game species or groups of game species is one of the GRU's ongoing responsibilities. The most important of these are moose, large predators, small mammalian game species, tetraonids and waterfowl. Population abundance is evaluated for all species, and the GRU also monitors annual reproduction trends and damage caused by specific species. Most of the monitoring is based on estimates and observations made extensively by hunters. The monitoring responds to domestic and international needs for information related to the sustainable use of game resources. As a rule, the monitoring results are published annually.

Research activities

Actual research done in the GRU consists of fixed-term projects, the topics of which are determined by the Ministry's procedures on management by result, customers' needs and the strategies chosen by the FGFRI and the GRU. Most projects consist of applied research, which is often based on monitoring results on game populations. Fixed-term projects focus on three areas:

Environmental and habitat research concentrates on the habitat requirements of game species and the effects of habitat modification on game populations. The results of the research provide an extensive knowledge base for planning the utilization of environmental and natural resources, e.g. forests. Forests are the most important major habitat type; the two others are farmland and water courses. The scope of the projects ranges from single habitats to landscapes of ecological importance. Telemetry, geographic information systems and satellite images are among the technologies commonly applied in these projects.

Research on factors affecting game abundance is currently focusing on the food supply, reproductivity of populations, mortality, predation, diseases, parasitism, hunting and environmental contaminants.

Research projects on basic species biology currently include projects on use of home ranges, migration and movements of game animals, reproduction biology, nutritional biology and genetic properties of populations.

Expert services and cooperation

Expert services provided by the GRU to authorities, organizations and the general public include issue of expert statements, participation in working groups and publication of material for general audiences. Members of the research staff also lecture at universities.

Because of the fewness of the researchers and the large scope of the field, much of the GRU's research is based on cooperation with a number of universities and research institutes, which helps to advance the FGFRI's own scientific and methodological expertise.

The GRU is also engaged in international research, particularly with Russian Karelia, which shares a long border with Finland. The FGFRI also has partners in Sweden, Norway and Estonia, and even further afield in projects which require a great deal of special expertise.

The Unit's partners in the administration of game research include the Nordic Council for Wildlife Research (NKV), the International Union of Game Biologists (IUGB), the International Council for Game and Wildlife Conservation (CIC), the International Council for Exploration of the Sea (ICES) and the Baltic Marine Environment Protection Commission (Helcom).

Personnel and publications

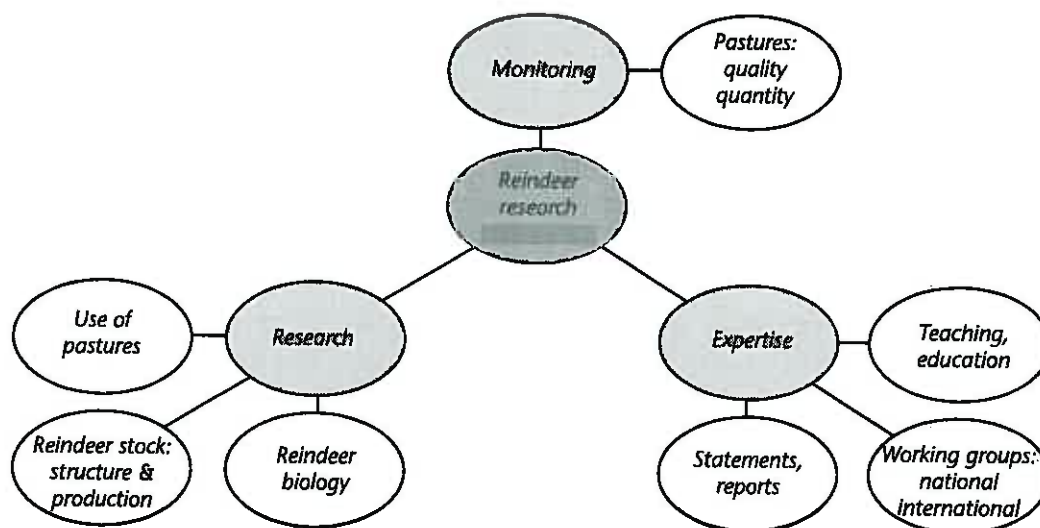
The Unit has 23 permanent employees, 8 of whom are university graduates; 6 of these have a doctoral degree. Their most common fields of expertise are zoology and ecology. In recent years, the GRU has also employed 5-12 postgraduate researchers on a fixed-term basis. Seven members of the staff work at the FGFRI's main office in Helsinki, while the rest (16) work at 4 research stations across Finland.

The Unit's total operating costs in 1997 were about FIM 11.8 million; 20% of this was funded by external sources, with employment subsidies accounting for 5%. The costs were distributed as follows: monitoring game populations 23%, research projects 62% and expert services 15%.

Because the GRU is engaged in applied research within the FGFRI, active publishing for a general audience is a must, but the GRU constantly strives to produce material which also meets high academic standards. Many of the scientific papers published by the GRU have been produced in cooperation with universities and research institutes in Finland and abroad. Important fora for articles targeted at a general audience include the publications of various organizations and the FGFRI itself.

Reindeer research

The RRU conducts research and provides expert services in order to develop reindeer husbandry towards greater ecological and economical sustainability. One of the Unit's important tasks is to monitor the condition of pastures and produce biological data on reindeer for the development of reindeer herding.



Monitoring and research areas

It is the RRU's ongoing responsibility to monitor the quality and quantity of pastures, using comprehensive statistics on winter and summer pastures from 1996-1998 as a standard for comparison. The data thus acquired are highly important when sizes of reindeer herds and grazing rotation are planned.

The research topics are determined on the basis of the result management strategy of the Ministry of Agriculture and Forestry, public demand and the FGFRI's own strategy. Because of its close connections with reindeer husbandry, most of the projects are carried out as applied research. As reindeer are half tame and easy to farm, a large part of the research is experimental. The projects focus on three main areas:

Pasture research is in many aspects based on the results of pasture inventories, pasture condition and use of pastures. The data are used to study the effect of the condition of pastures on reindeer and reindeer population yield, for instance, but also on local ecosystems. The use of artificial fodder is another key research topic in this field.

Projects on the structure and productivity of the reindeer population place a special emphasis on how the gender and age structures affect the production of calves and meat.

Although research on reindeer biology is clearly basic research, it has many connections with the practical aspects of reindeer herding. In recent years, research has focused on thermoregulation and hormone metabolism.

Expert services and cooperation

The RRU provides expert assistance to authorities and organizations and publishes research results for the general public. The Unit's employees teach at universities and other educational institutions.

Because the RRU has a very small staff, a vital condition for its operations is cooperation with universities, research institutes and other relevant organizations in Finland and abroad. A particularly important partner is the Reindeer Herders' Association, which maintains a scientifically prominent experimental reindeer farm. The operational aim of the new Research Station established in the vicinity of the farm is to become a leading centre of international reindeer research.

The GRU cooperates closely with researchers in Russia, Norway and Sweden and participates in the work of the Nordic Council for Reindeer Research.

Personnel and publications

The total work input of the RRU's staff in 1997 was 9 person work-years. Four of the staff are permanent employees; three of these are university graduates, one with a doctoral degree, another with a licentiates' degree. Most of the research is done at the Inari Reindeer Research Station.

The RRU's annual operating costs are about FIM 3.5 million on average (1995-1997); in 1997, the total was FIM 3.47 million. External funding covered about 40% of costs, with employment subsidy forming 20 percentage points of this sum. The costs were divided as follows: pasture inventories and monitoring accounted for 27%, research for 63% and expert services for 10%.

The RRU strives to publish both scientific articles of a high academic standard as well as more popular material related to the practical aspects of reindeer herding. The publications are largely based on extensive research cooperation. In a small Unit, there is liable to be considerable fluctuation in the annual output of published material, but the decline in scientific publication volumes over the past two years is specifically due to the fact that the RRU's resources have been tied up with extensive pasture inventories.

Aquaculture

The Aquaculture Unit maintains indigenous fish stocks and their diversity and produces high-quality fish and crayfish eggs and juveniles for the State and private demand. The Unit's work is developed in cooperation with aquacultural research.

For these purposes, the Aquaculture Unit:

- Maintains endangered and indigenous stocks and their genetic diversity through aquaculture, stocking and milt banks;
- Produces high-quality, disease-free, eggs and juveniles of fish and crayfish of known background to meet the requirements of preservation, research, State stocking obligations and other governmental and private demands;
- Breeds high-quality eggs for rearing at commercial fish farms;
- Carries out the State's cultivation contracts to secure future fishing prospects in Finland and guarantee the preservation of endangered stocks;

- Develops aquacultural products and technology and related quality management systems.

The FGFRI concentrates on producing eggs and fry, while the private sector on juveniles and commercial food-fish production. At the moment, the FGFRI has cultivation contracts with 16 private fish farms.

Products, services and customers

Most of the Unit's functions and services have an important social aspect. Such functions and services include preservation of fish species and stocks at aquaculture stations, stocking juveniles of endangered species, restoration of depleted stocks, maintenance of milt banks, statutory rearing of juveniles, supply of fish for research and provision of expert services.

The Unit's commercial products and services include eggs, juveniles from fish farms and natural food ponds, selectively bred eggs and fry of rainbow trout, and advanced aquacultural methods, technology and equipment.

The Unit's most important customers are fishery authorities, commercial fish farms and other organizations related to fish stocking as well as research institutes, advisor organizations and environmental authorities.

About one half of the Unit's income derives from the sale of eggs. However, the market for the eggs of stocked species is quite small, and as the Unit already has a large market share - 30-80%, depending on the species - it will be very difficult to boost sales by increasing the market share.

Because the State budget precludes competition with the private sector and regulations and costs limit the Unit's scope for competing in price on terms of payment in ordinary juvenile production, the Unit's primary aim is to develop sales of new products and services related to management of fish and crayfish stocks.

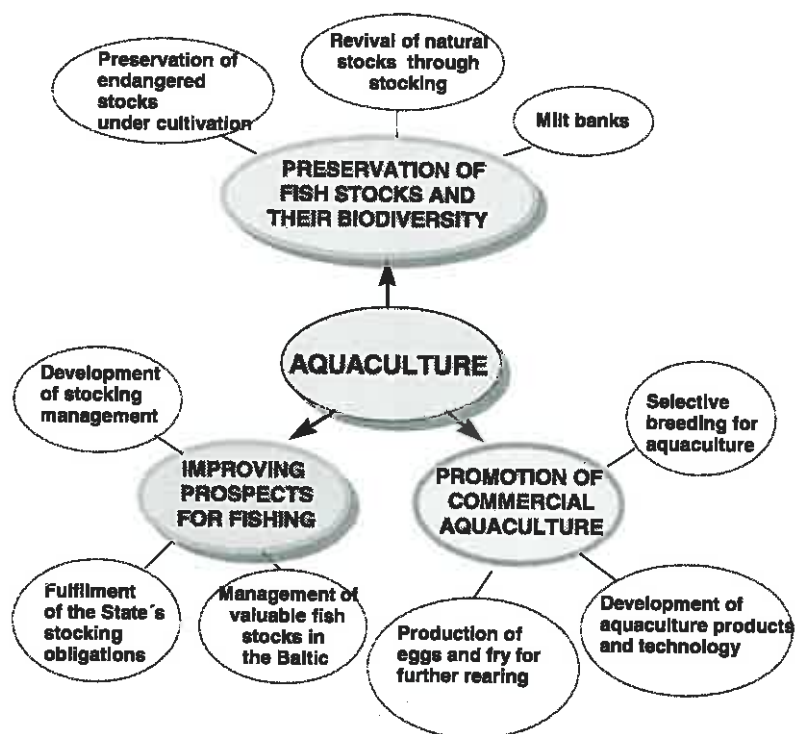


Figure 16. Tasks of the Aquaculture Unit and intended uses of products.

Preservation of fish stocks and their diversity

The Unit's most important national and international obligation is to ensure that the still remaining indigenous and currently endangered Finnish fish species and stocks are maintained and their diversity is preserved as far as possible by aquacultural means.

The Finnish indigenous stocks of the greatest economical value are preserved at the FGFRI's aquaculture stations (living gene banks). This includes the remaining 4 stocks of salmon, 22 stocks of sea trout and brown trout, 15 stocks of whitefish, 10 stocks of grayling, and asp, and the Saimaa landlocked salmon and arctic char. This means that 13 indigenous species and subspecies are preserved in 58 stocks. Crayfish stocks are also preserved at aquaculture stations. Furthermore, several introduced species are likewise cultivated, such as the Neva salmon, which is becoming extinct in its original range.

At the moment, there is no need to extend preservation to other stocks and species. If a stock currently maintained by aquacultural means eventually attains its favourable conservation status as defined in the EC's Habitats Directive, its maintenance by aquaculture may be discontinued.

To revive or restore locally depleted stocks, juveniles of different ages are being stocked in their former spawning grounds, most notably salmon in the rivers Tornionjoki and Simojoki. In 1997, an extensive project designed to revive depleted salmon stocks in a number of former salmon rivers emptying into the Bothnian Bay was initiated under the Salmon Action Plan (SAP).

Without cultivation or juvenile stocking, many of the Finnish indigenous stocks, such as the Saimaa landlocked salmon, arctic char, salmon in the rivers Iijoki and Simojoki and sea trout in the rivers Tornionjoki and Lestijoki would be permanently extinct by now.

Fish genes are also preserved in the form of frozen milt (milt banks). The Unit aims to store the genetic material of all endangered species and stocks in milt banks to ensure their future preservation.

Promotion of commercial aquaculture

The Unit's aim is to promote the Finnish aquaculture industry by producing genetically verified, healthy eggs and fry for further cultivation by developing new products, cultivation methods and technology. The Unit also aims to breed an economically more profitable variety of rainbow trout in collaboration with the Research Units.

The aim of egg production is to ensure that the supply of fish and crayfish eggs and fry meets the current scale of demand. The aim of selective breeding is to improve the profitability of rainbow trout cultivation by means such as accelerating the growth rate of the fish. The aim of developing aquaculture is to make high-quality products available to the private sectors and to develop methods and technologies that are both more economical and environment-friendly.

Improvement of prospects for fishing

The Aquaculture Unit contributes to the preservation of stocks of Baltic salmon, sea trout and anadromous whitefish in the Baltic by stocking juveniles in rivers and

estuaries of the Gulf of Bothnia and the Gulf of Finland. The aim is both to revive endangered stocks and improve salmon-fishing prospects in particular.

The most extensive of the State fish stocking obligations handled by the FGFRI is related to compensating the fish stock depletion caused by the regulation of Lake Inari.

Ethical aspects of production

The wellbeing of fish in aquaculture stations is ensured by regular feeding (largely through the use of automation), systematic monitoring of their health status and high standards of pond hygiene. Fish handling is reduced to a minimum, and any transport, stocking, and stripping of eggs or milt is done in such a way as to cause minimum harm and stress to the fish. The fish are anaesthetized during tagging and egg-stripping operations. Each station is supervised by a veterinarian. The stations are equipped with high-quality vehicles and other technology for transport of fish, which is subject to a transport permit under the Protection of Animals Act.

Personnel and organization

In 1997, the total input of the staff at the Aquaculture Unit was 93 person work-years. The Unit has a staff of 68 permanent employees, 3 of whom work in Helsinki and 65 at stations.

The Unit is organized into five regional sub-units: Southern Finland, Eastern Finland, Northern Finland, Western Lapland and Upper Lapland. Each sub-unit is responsible for 1-5 aquaculture stations and a number of natural food ponds. The boundaries of these regions are mostly determined by those of major water courses and regulations on prevention of fish diseases. The species and stocks cultivated in each sub-unit's area are adapted to local conditions, forming their own genetic strains.

The breakdown of expenditure by main sector of operation is a good reflection of the division of operations between the various sub-fields of the Aquaculture Unit. In 1996 this expenditure (excluding contract juvenile rearing) totalled FIM 36.4 million (roughly USD 7.2 million). Of this, FIM 7 million (19%) was spent on preserving the biodiversity of fish stocks, 11 million (30%) on improving prospects for fisheries and FIM 18.4 million (51%) on promoting commercial aquaculture.

Services

Administrative support services are supplied to the FGFRI and its customers by the Services Unit. This comprises all specialized services for which centralization is the most logical and practicable solution.



Figure 17. Functions and personnel of the Services Unit.

The Services Unit handles the FGFRI's financial and personnel administration, office services, property management, legal services and IT systems. It answers for communications, library and information services, and publishing activities. The Services Unit also provides property maintenance services and commercial library and information services for external clients. The Services Unit is also responsible for departmental planning and drafting corporate documents in cooperation with other Units.

Customers of the Service Unit within the FGFRI comprise the management, other Units and staff. Outside customers include customers of the FGFRI and other stakeholders.

The Unit has a permanent staff of 39 at stations in Helsinki, Evo, Laukaa, Saimaa, Taivalkoski, Kainuu, Inari and Oulu, with a total input of 85 person work-years. In 1997, some of the Unit's functions were also carried out by employees of other Units, particularly at small research stations. Services have also been provided by temporary staff paid out of employment subsidies. In 1997, the combined expenditure of the Services Unit amounted to FIM 24.2 million, 44% being represented by payroll expenses. This total also includes expenditure by upper management. In 1997, the Services Unit's expenditure was divided up as follows: Fisheries Biology and Management Research 42%, Socioeconomic and Aquaculture Research 16%, Game and Reindeer Research 15%, Aquaculture 24% and external services 3%.

The Unit's income has increased in recent years, amounting to FIM 1.9 million in 1997. Most of this income consists of revenues from real estate services. Income from sales of publications has also increased in recent years.

The Services Unit is responsible for coordinating the activities of the FGFRI and its financial planning. It contributes to the drafting of plans, reports and annual reviews with the other Units.

Operating Accountancy

The FGFRI's accounting system yields accurate, real-time financial figures, which serve as the basis for operative planning and management by result. The pricing of scientific and other commercial services is based on accurate, real-time cost calculations made separately for each individual project. Special attention has recently been given to the development of systems for calculating the cost of aquaculture projects.

Recent reforms in public administration and new stipulations related to EU funding pose an increasing number of challenges for the FGFRI's accounting sub-unit. Along with all other government-run organizations in Finland, the FGFRI switched to a commercial bookkeeping system at the beginning of 1998. As the proportion of EU-funded projects is rising, a new routine has recently been developed for monitoring their costs. The FGFRI's growing sales have also underlined the need to further develop the accounting system.

Facilities and IT systems

At each of its locations, the FGFRI works in facilities leased by the State Real Property Authority, where the average standard of equipment is good. In 1997, leasing costs amounted to FIM 15.3 million.

Researchers and most of the other employees have personal computers with Internet access. All offices were linked into the same computer network in 1994. The Windows-based system comprises tools for drafting reports, text processing, spreadsheet computation, cardfiles and databases. Built-in IT tools are also available for statistical calculations. All of the FGFRI's standard forms are built into the network. The upgrading of the system was initiated recently.

Library and information services promote the FGFRI's research endeavours and the circulation of its scientific findings, providing search and data accessing services for research purposes. Some researchers also have self-service access to the library's main literature databases. The Unit also monitors trends in the game and fishery sector by publishing weekly press reviews and a weekly report on decision-making and law-drafting in Finland and the EU.

Data on research papers published by the FGFRI's personnel is available in the domestic article index database and, since 1995, also in the 'Agris' database.

Communications and publications have increased in recent years. The FGFRI will have upgraded WWW pages in Finnish in the beginning of 1999 and new pages in English during 1999.

The quality of administrative services are being improved by productizing the FGFRI's service functions and providing training in customer service.

IV Strategies and development projects of the Finnish Game and Fisheries Research Institute

Strategy work in 1996-97 based on Finland's future options

In 1995, four basic scenarios were drawn up for Finland's future development; the strategic planning of the Finnish Game and Fisheries Research Institute has concentrated on two of these. The 'Grand Design' scenario is contingent on Finland's successful implementation of European economic policy in accordance with shared criteria (EMU), management of major social changes and economic growth in tune with the needs of sustainable development. In the 'Ruthless Progress' scenario, development within the EU will branch off in many different directions, with local and regional solutions gaining importance. Finland will have to adapt to intensive, fluctuating growth and rapid economic change. Local and regional administration will be downsized. Public services and State and local government functions will be privatized. The other two options were not considered likely to materialize over the next ten years. The most probable scenario is something between the 'Grand Design' and the 'Ruthless Progress' scenarios, if closer to the former than the latter. Both scenarios chart a very similar course of development for the reindeer husbandry, game and fisheries sectors over the next few years; differences would only arise in the long term. Environmental trends are estimated to be similar to those outlined in part I of this report.

In the 'Grand Design' scenario, the goal of fisheries management is to maintain ample and diverse fisheries that can be used sustainably, with the exploitation of fish resources primarily based on sustainable use of natural stocks. Commercial, household and recreational fishing observing this principle will flourish, and business in the field will be steered in the desired direction by State subsidies. State aquaculture will concentrate on the preservation of endangered species. Fishing-related tourism will increase steadily. Research will focus on a broad range of issues related to the sustainable use of resources. Game resource management will be extensive and based on natural methods, enabling sustainable recreational hunting to continue. Game habitats will be taken into account in land use planning. Eco-friendly wilderness tourism will expand. Research will focus on producing data that can be utilized in controlling populations and solving habitat-related problems. Reindeer husbandry will be coordinated and scaled according to the capacity of pastures. Predator populations will be controlled in line with their favourable conservation status, and any damage caused by them will be compensated. Research will focus on pastures and the requirements of reindeer husbandry.

The 'Ruthless Progress' scenario is more market-oriented. Fisheries management will concentrate on commercially significant species, and some species will depend wholly on cultivated stock for their survival. The main commercial species will be in danger of depletion due to over-fishing. Fishing, fish processing and related commerce will become concentrated in a few large units, leaving small entrepreneurs to operate in less profitable sectors. State aquaculture will be privatized, confining State-run cultivation to research purposes. Recreational fishing will increase, and

there will be fierce competition in fishing-related tourism: only the strong will survive. Research will focus on fish stock management, being dependent on various interest groups for its funding. State budget funds will be allocated only for the most important long-term research projects. Research institutions will be merged and rationalized. Game resource management will be practised on an amateur or commercial basis, possibly on a quite comprehensive scale in certain localities. Culling will follow trends in game population levels, reinforcing their cyclic fluctuations. Habitat problems affecting game and other natural species will be taken into account only insofar as dictated by market demands. Hunting-based tourism will increase, being partly based on commercial cultivation of game species. State-funded research will focus on population control, pressure on game stocks exerted by the depletive effect of hunting, and habitat-related issues. Reindeer husbandry, focusing on meat production, will become concentrated in large units maintained through supplementary feeding. The condition of reindeer pastures will decline. Reindeer will be steered to new pastures and more supplementary fodder will be provided. Damage caused by predators will be reduced by means of population control. Research will concentrate on pasture problems, optimized commercial exploitation of reindeer, and increasing export potential.

The FGFRI's strategy is principally based on the 'Grand Design' scenario, while incorporating elements of the 'Ruthless Progress' scenario, i.e. in terms of its market-driven aspect and its a clearer division between the public and private sectors.

Major development projects, 1994-1997

The FGFRI's organization structure, management system and operative basis were completely overhauled in 1993-94. The organization is based on the corporate model, giving relative autonomy to five individual profit centres. The FGFRI's profit centres (Units) are divided up according to their duties and managed in line with result targets and fund frameworks. The work of the units is coordinated by the Director General and the Management Group. Support services such as IT, publications and financial systems were also revised.

The Science and Technology Policy Council, chaired by the Prime Minister, published a statement on State biological research stations based on a related study. According to that statement, the number of research stations should be reduced radically. The FGFRI has accordingly shut down six stations and increased cooperation with universities. This policy will be pursued further, pooling resources at a few centralized research locations in order to maximize productivity. There has been great political resistance to the decision to close down stations. Some FGFRI personnel also oppose the policy.

In accordance with the FGFRI's investment policy strategy, construction and other physical investment have been cut, while investment in human resources, expertise and research has been increased. Construction projects already in progress have been completed on reduced budgets, while much has been invested in personnel training such as doctorate programmes; as a result, the number of scientists holding doctorates is increasing rapidly. Investment in aquaculture has been transferred to research.

In 1993, the FGFRI anticipated and prepared itself for the national financial crisis resulting from the recession, and subsequent cuts in public expenditure. In talks with the Minister of Forestry and Agriculture, it was agreed that the FGFRI would cut its costs and that the percentage of external funding would be increased at a moderate rate. Funding provided out of the State Budget fund has declined. The FGFRI's personnel has decreased by about 11% since 1992, although sales revenues have

doubled. Also, funding from the Ministry of Labour has been cut, although this has not had a major impact on the work of the FGFRI. Thanks to sales revenues, the Institute is showing slight growth.

Aquaculture had developed into a function much like a Government agency in terms of procedure and personnel structure, yielding high performance quality, but at high cost and low productivity. Concentrating on core competence was thus chosen as the strategy. Also, the unit's financial competitiveness had to be improved substantially. Personnel at the aquaculture unit has been cut by a third, and its efficiency, measured in unit costs, has improved. The natural food pond area has been cut by 1000 hectares, and two small stations have been closed down. Conventional juvenile production have been outsourced from the private sector, at lower production costs. Savings from the rationalization of aquaculture have been channelled into research and overall development of the FGFRI.

In human resources policy, emphasis was laid on existing personnel, and there has been very little recruitment in past years. Instead, the personnel's professional skills have been improved through an extensive training programme.

The original aim was to organize research into extensive yet fixed-term programmes and major projects. Setting these up has not proceeded according to plan, however. The major problems are a lack of directors for the programmes and the demanding work involved in planning projects on such a large scale. At the moment, however, extensive programmes are in the process of being launched.

The communications and publications sub-units have implemented the reforms specified in the programme. All current publication series are either new or revised. Efforts have been made to increase the number of scientific publications, while also fulfilling the needs of a more general readership. The FGFRI has augmented its output of books, guides, OH series and teaching materials. Relative to Finland's small population, a large number of people use the information services produced by the FGFRI, and the feedback has been positive.

Working conditions, public image and customer satisfaction studied

In 1992, following an initiative from the personnel, working conditions at the FGFRI's Helsinki offices were studied in cooperation with the Finnish Institute of Occupational Health. A questionnaire was circulated to establish employees' status in the working community, their job satisfaction, rapport with colleagues, ability to cope with their work, work organization and guidance, stress, job development and employee turnover. The FGFRI was evaluated as an employer, a 'work community' and a workplace. Sources of employee satisfaction and dissatisfaction were also investigated. A similar study was conducted in 1993 at the FGFRI's other offices. A survey on personnel development and training was conducted in 1993. Professional advancement of personnel was seen as an essential aspect of the transition to management by result. Several work community evaluations and development plans were drawn up in 1996-97 in conjunction with project management and leadership training.

In autumn 1995, Inforviestintä Oy made a study of the FGFRI's public image. All major interest groups were polled, comprising 186 representatives from the State administration, universities, local authorities, the media, related companies, unions, organizations and professionals in the field. The responses were mainly neutral or positive. Many respondents praised the FGFRI's expertise and professionalism, though it was also criticized for being inefficient and inaccessible.

Internal communications and company image as perceived by employees were surveyed at the same time. This survey focused on satisfaction with in-house communications, and major shortcomings in information transfer. Of all employees, 35% were satisfied with in-house communications; about half were dissatisfied. The main perceived shortcoming was that the management was out of touch with the personnel's opinions. The dissatisfaction was slightly greater than average for Finnish organizations. The employees had quite a negative image of the FGFRI. The adjectives most frequently used to describe it were bureaucratic, schismatic and lacking in coordination. Several respondents described it as conservative, poorly organized, unclear in its goals and rigid. Its public image was both praised and criticized. Positive features associated with the FGFRI were its expertise, competent personnel and dependable scientific standards. Many respondents noted that the FGFRI is in a transitional phase and that the first signs of change had been positive.

The public image survey was conducted as a basis for drawing up a communication strategy for the FGFRI. This communication strategy was approved and put into practice late in 1997, raising the profile of both internal and external communications and improving professional skills.

A customer survey was conducted in the Aquaculture Unit in 1996 to study customer satisfaction and responses to aquaculture products, sales point functions, customer service, communications, ancillary services and other forms of collaboration in the FGFRI. The aquaculture products were regarded as being of high quality. The main reason for customers purchasing them was their well-known origin. Customers were also satisfied with the standard of service, although half wanted more information on product availability. Species-specific cultivation advice was identified as the most important ancillary service. In spring 1998, the Scottish ichthyologist prof. J.E. Thorpe was commissioned by the aquaculture unit to assess the cultivation practices of the six most northern aquaculture stations.

In 1992, a scientific assessment of the FGFRI's game research programmes began. Two outside scientists well reputed in the field are conducting the evaluations at the unit's invitation. The research projects assessed so far include those on the hunting of cyclic tetraonid populations, the Baltic Sea seal, waterfowl ecology, forest game habitats and game monitoring. In the last of these, the evaluators came from Scandinavia; in the others, they were Finnish. The assessment results have been used in improving the unit's research.

Laboratory services centralized

The FGFRI has biological laboratories at several of its research locations. Biological laboratory services constitute part of the FGFRI's core competence. The laboratories form a decentralized network, each laboratory being located near the research site. Experimental laboratory services likewise represent the FGFRI's core competence and will be kept up on their present scale. Investment and running costs in experimental work are high, so these functions are concentrated in a few major locations.

The FGFRI has five analytic laboratories: at the Helsinki, Laukaa, Saimaa and Taivalkoski units and at the Reindeer Research Station. The laboratories employ a combined personnel of six. The most commonly performed analyses are water analyses (5,600 in 1997), fish, fodder, sludge and tissue determination (13,000), histological preparates, vitamin analyses, ion chromatography and gas chromatography.

Laboratory services as a whole were assessed in 1993. They were then divided up between the various units, enabling them to organize, produce or buy in laboratory services in the most efficient and feasible way.

Certain basic analytic capacities are indispensable at the FGFRI. There is no prospect for profitable commercialization of laboratory services, and most analyses are available through outsourcing. External collaboration in laboratory services has been expanded and deepened in recent years. Laboratory services will be assessed by an outside expert in early 1999.

IT system development started

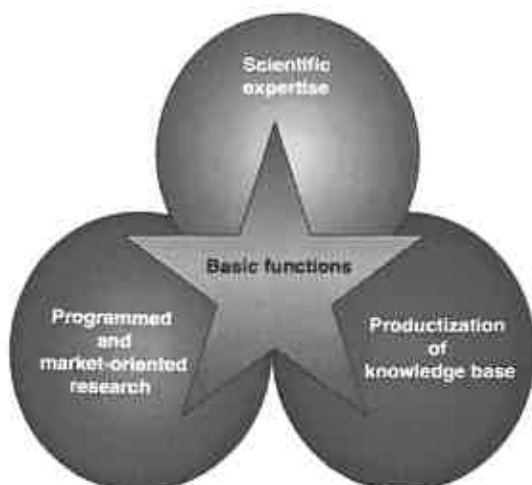
An upgraded IT system was introduced in 1993-94. This was a major overhaul, covering most of the FGFRI's functions. Several local networks were set up with e-mail and other services, and workstations were linked to these. New components included the financial management system and personnel administration system, including payroll calculation. The life span of the upgraded system was estimated to be five years, so another IT overhaul and service update is now imminent. The new system will thus be introduced in 1999.

Strategy 2003 and development prospects

In the 1990s, the work of the FGFRI has been based on selected strategies. The revised strategy proposal has been presented to the Board and widely discussed with personnel. These discussions and personnel feedback will be worked into the strategy proposal. The aim is to complete the strategy by the end of February 1999.

Mission statement and vision specified

The basic functions of the FGFRI are assessment and prediction of fish and game resources, monitoring of reindeer pastures, compilation of statistics and preservation of endangered species. Core competence areas are built upon these basic functions. Scientific expertise is utilized in extensive research programmes, market-driven research and productization of the knowledge base.



The FGFRI's customer-oriented vision and nationally and internationally acknowledged work create challenges and opportunities for each of its researchers and employees.

Vision

The FGFRI aims to be an internationally recognized expert on fisheries, game and reindeer husbandry.

Mission statement

The FGFRI's role is to produce information about fisheries, game and reindeer for the sustainable use of resources and the maintenance of biodiversity.

The mission statement covers the services provided by the FGFRI, from aquaculture to research. Long-term work at the FGFRI is safeguarded through funds from the State budget. Obtaining more external funding for important research areas and aquaculture is a key challenge for the future.

The increased demand for information on game and fisheries enables research to be expanded and deepened. Broader cooperation and interaction are enhancing the FGFRI's existing expertise. Combining the FGFRI's in-depth expertise with that of professional partners enables major problems to be solved. Efficiency and information transfer are being improved through networking and technological progress. The growing demand for research results and products is building up the FGFRI's financial foundations. Customer groups will be clearly defined, and the customer base will be broadened.

The work of the FGFRI is based on expertise, professional skill and dependability. The operating environment is changing rapidly; work is therefore being done to maintain personnel competence and the overall competitiveness of the organization.

The FGFRI's personnel are experienced experts. Their scientific capacity and expertise will be further expanded and broadened. Cooperation between Scandinavian and European experts in the field is already flowing smoothly. International activities will be increased, and more FGFRI experts will participate. Finnish networks of researchers, aquacultural institutes and research station networks are comprehensive. Institute's gene banks, which safeguard the biodiversity of fish stocks, fulfil international standards.

Strategic choices based on customer needs

The FGFRI will continue to compile reliable monitoring data and statistics to support decision-making. The authorities receive dependable expert service, and interest groups can rely on the FGFRI as a quality-conscious partner. The FGFRI's expert services are also a commercial asset for its business customers.

The game, reindeer and fisheries research units advance science in their respective fields and have in-depth expertise on the special properties of northern regions. Practical problems and models for solutions are submitted for discussion in the scientific community. The FGFRI provides organizations in the field with any information they need, thereby promoting the further transfer of new knowledge. Aquacultural services are organized in tune with customer needs.

The FGFRI offers its personnel a challenging workplace with advancement potential and work to match the talents and skills of each employee.

Basic functions strengthened

Fish stock assessment methods will be developed, and reporting, publication and scientific use of monitoring data will be increased. In addition to commercially significant fish species, preparations will be made to monitor other ecologically important species in cooperation with other parties.

The procedures for monitoring the volume and structure of game populations will be developed, particularly for large predators, moose and seal; preparations will also be made to include some new species in the monitoring. The monitoring of reindeer pasture use will be intensified.

The overall quality of the FGFRI's statistics will be improved. Statistics will be published more extensively in electronic form. Barometer-type monitoring will be developed.

In aquaculture, greater focus will be placed on core functions such as the maintenance of fish stock biodiversity, the production of high-quality eggs for further rearing by the private sector, the cultivation of fish for research and State's stocking obligations. Cultivation, the milt banks and revival stocking of depleted stocks will be kept up to ensure that endangered fish species and stocks remain as diverse as possible.

The welfare of animals is at the forefront in production and research. Tagging is being continued on the scale required by research, and new tagging methods are being developed.

Towards a more programme-driven and market-driven approach

Research is being steered in line with Finnish and international research policy programmes.

Major research programmes currently under way in fish stock and fisheries management research concern topics such as the impact of entrophication on fish assemblages and fisheries; management and rehabilitation of human-modified aquatic systems; preserving the biodiversity of fish; determining the need for fish stocking; assessment of fish interactions and development of efficient methods of fisheries management. Re-introduction of fish stocks to their former habitats is supported through research and cultivation. The Salmon Action Plan (SAP) was launched in cooperation between research and aquaculture.

Socioeconomic fisheries research will focus on reducing the environmental load of aquaculture and diversifying its production structure, economic steering of fishing, and the mechanisms of the fish market. Recreational fishing research will focus on analysing different categories of fishermen and the social and economic significance of recreational fishing.

The selection of egg and fish products will be expanded, product marketing will be improved and foreign markets will be sought. Sales will be increased, while avoiding competition with the private sector. Selective breeding of rainbow trout will be productized and its marketing organized. An aquaculture quality system will be introduced, and delivery reliability will be ensured. Profitability will be increased by developing cultivating methods, techniques and equipment, by process control and by improving the professional skills of personnel.

In game research, more attention will be given to research on the population dynamics of large predators, moose and tetraonids. Habitat research on forest, field and water game will also be developed. In reindeer research, the focus will be on establishing

the effect of pastures and other food resources and the structure of the reindeer stock on calving.

Towards high scientific standards and international excellence

The standard of scientific research will be raised by developing networks between research communities and researchers, by increasing the number of visiting scientists and by developing cooperation between international and Finnish organizations and scientists. The volume and quality of scientific publications will be increased.

Productization of information services and fish resources

The information generated by the FGFRI will be produced in a form that is easy to use and readily accessible, capitalizing on the potential of electronic communications, including WWW sites and electronic publishing. Aquaculture and research service productization will continue.

How will we implement the strategy?

Developing the domestic research and aquaculture station network

The FGFRI provides a nationwide service. However, services are being regionally concentrated in order to enhance resource productivity and to improve the quality of research data analyses. Stations that are viable in the long term will be retained. The relative importance of Headquarters will decrease. The network of aquaculture and research stations will be developed along the lines proposed by the Science and Technology Policy Council, with due consideration to the fact that the FGFRI now operates in the capacity of a public corporation. The formation of research communities will be promoted and the proximity of research targets, customers and partners safeguarded, and contact with other research communities will be sought.

In addition to its own units, the FGFRI will also offer universities the opportunity to use its research and aquaculture stations.

Safeguarding funding

Preparations will be made to offset cuts in State budget funds through increased sales revenues, EU funding and funding from partners. Funding acquisition will focus on areas of strategic emphasis. Investment funding will be mainly targeted at increasing the FGFRI's expertise, its research equipment and IT. No extensive new construction investment will be undertaken.

Increasing expertise

Expertise will be expanded in strategically important areas through cooperation and recruitment, so as to enable the development of multi-disciplinary goal-oriented and

problem-oriented research and efficient aquaculture. Expertise in genetics and animal diseases, and methodological and economic expertise will be increased.

Assessment of the FGFRI's work and its results will ensure that it remains competitive. Project-specific evaluation will be organized for major projects and services. Assessment of research quality and effectiveness and indicators measuring profitability, cost-efficiency and performance will be developed.

Keeping the personnel and organization competitive

Proficient handling of the FGFRI's functions steers the development of the volume, structure and professional competence of its personnel. Personnel structure and competence will be developed to correspond to their duties. Considerable resources will continue to be put into professional development. Personnel development is enabled through training, job rotation, subsidization of work at Finnish and foreign research institutions and other organizations, and participation in joint projects with universities. Goal-orientedness, joint efforts, open communication and efficient networking will all be promoted.

The percentage of FGFRI employees with doctorates and that of top experts will increase. Quality will be the strategic focus of development in aquaculture. In recruiting new personnel, priority will be given to highly educated people with development potential and solid methodological expertise. Personnel mobility will be increased while giving staff a broader range of duties.

The basic structure of the organization is the corporate model, consisting of five units and the Management Group. Responsibilities will be clarified, and the work of the Management Group will be developed. A customer-oriented approach will be adopted. The use of sub-contractors will increase in the future. The possibility of internal billing will be explored.

In aquaculture, future changes will mostly affect planning, management, production processes and result information, the trend being towards corporate or production organization methods and models.

The reward system will be developed in accordance with the demands of expert services and production duties. Particular attention will be given to incentives and flexibility.

Occupational safety and working capacity will be maintained. An equal opportunities plan will be drawn up and put into effect.

The IT development project will continue. The internal information network will be developed into an information bank, with links to outside information systems. An information system for research and farming will be produced. User-friendly systems will be created for information management. The Geographical Information System will be introduced according to plan.

The communication faculties of FGFRI's personnel will be increased, and a network of people acting as information officers in addition to their normal duties will be set up. Personnel will be provided with training in communications. Publication of books and guides will continue.