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**FINNISH GAME AND FISHERIES RESEARCH INSTITUTE**

**Game and Reindeer Research Unit**

**Helsinki 1999**



**RIISTAN- JA KALANTUTKIMUS**

**FINNISH GAME AND FISHERIES RESEARCH INSTITUTE**  
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# Contents

<b>1. GAME AND REINDEER RESEARCH UNIT</b> .....	1
<b>2. GAME RESEARCH</b> .....	2
2.1. Objective.....	2
2.2. Personnel .....	3
2.3. Funding and costs .....	4
2.4. Research activity .....	4
2.4.1. Main research fields at the GRU .....	5
2.4.2. Scientific evaluation of research activities .....	9
2.5. Publishing activity .....	10
2.6. Expertise .....	10
2.6.1. Statements and reports.....	10
2.6.2. Working groups .....	10
2.6.3. Education and teaching.....	11
<b>3. REINDEER RESEARCH</b> .....	12
3.1. Objective.....	12
3.2. Personnel .....	13
3.3. Funding and costs .....	13
3.4. Research activity .....	13
3.4.1. Main research fields at the RRU .....	14
3.5. Publishing activity .....	16
3.6. Expertise .....	16
3.6.1. Statements and reports.....	16
3.6.2. Working groups .....	16
3.6.3. Education and teaching.....	17

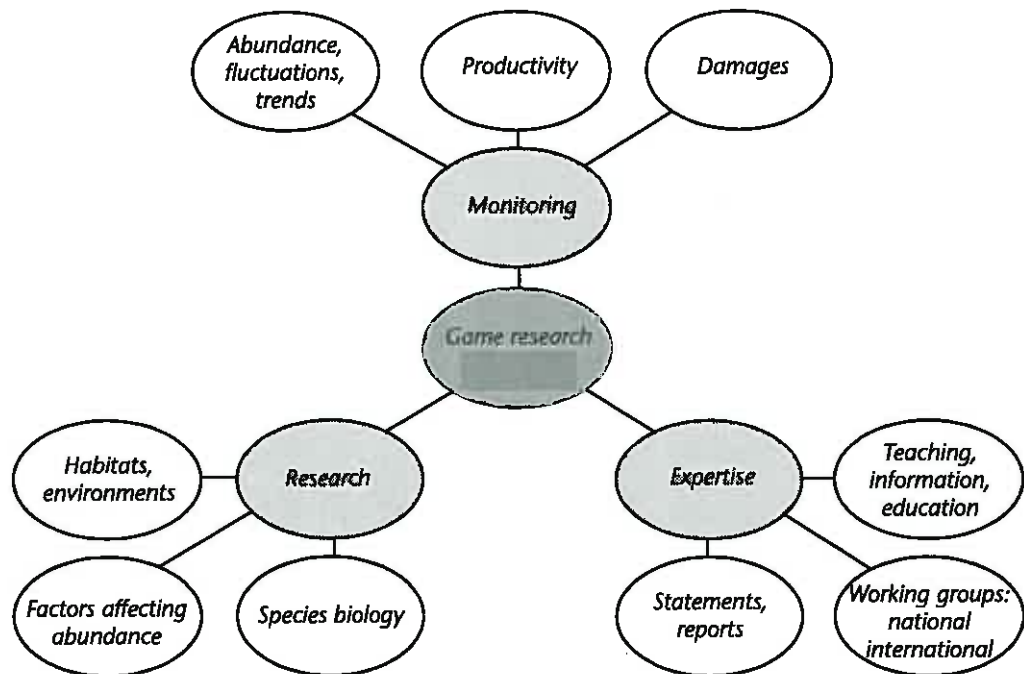
# 1. GAME AND REINDEER RESEARCH UNIT

Game and reindeer research have been organized in the Finnish Game and Fisheries Research Institute (FGFRI) into one administrative entity, the Game and Reindeer Research Profit Centre, whose head is responsible for leading administrative activities and research activities in general. With respect to research activity in more detail, game research and reindeer research are clearly separate. Customers, cooperation partners and methods of working differ to a considerable extent in these subunits, which is why game research and reindeer research are organized into largely separate subunits (cost centres) within the Game and Reindeer Research Unit and are thus presented separately here.

## 2. GAME RESEARCH

### 2.1. Objective

The basic task of the Game Research Unit (GRU) is to increase knowledge about the biology and state of game (★ next page) populations and ecologically associated animal populations, their use of environments and effects on the surrounding community, including human activities. This information, which consists of research results and expertise, is used by other experts in the community to promote the sustainable use and well-being of game populations (see Fig. below).



**FIG. 1. Schematic representation of the main tasks of the Game Research Unit in the FGFRI.**

The main users to benefit from game research are the following:

- 1) The Ministry of Agriculture and Forestry (jurisdiction and management of game species), and the Ministry of the Environment (endangered species); data on abundance and reproductivity of populations; the basis for managing game species populations at the national level.
- 2) The Hunters' Central Organization including its 15 game management districts, about 300 game management associations (roughly corresponding to municipalities), about 3 000 individual hunting associations ('hunting clubs') and finally about 300000 individual hunters, all of which are here referred to as the hunting community; data on abundance and productivity of populations as well as prognoses about harvestable

populations, the basis for managing game animal populations at regional and local levels.

3) Organizations and individual citizens dealing with management of forests, farm lands and bodies of water (e.g. the National Board of Forestry); data on the environmental and habitat demands of game, used as the basis for managing environments.

4) The scientific community; the role played by science in promoting research in the field.

5) The public; data and information on sustainable use and on species of wide public interest.

(★) The game species are listed in the Hunting Law of 1993. It is worth noting that this list includes those species and types that have been utilized by man in the course of time. The list, therefore, includes species which are harvested, but also species that may even be classified as threatened today. This incorporates a wider wildlife and conservational point of view within the activities of the GRU.

## 2.2. Personnel

The permanent staff of the GRU comprised 21 persons in late 1997; in addition, one visiting scientist has been working full-time in the unit for several years. The personnel are located at several sites around the country. In addition to regional duties, the various stations bear national responsibility for their special field of activity, as follows:

	permanent staff
Helsinki, main office	6
<i>Specialty:</i> several subjects	
Evo Game Research Station (Lammi)	3
<i>Specialty:</i> waterfowl (inland), small and medium-sized mammals	
<i>Area:</i> southern and central Finland	
Ilomantsi Game Research Station	5
<i>Specialty:</i> moose and other cervids	
<i>Area:</i> eastern Finland	
Meltaus Game Research Station	4
<i>Specialty:</i> tetraonids; relations between game and forest environment	
<i>Area:</i> northern Finland	
Söderskär Game Research Station	1
<i>Specialty:</i> sea birds	
<i>Area:</i> archipelago off southern Finland	
Taivalkoski Game and Fisheries Research	2
<i>Specialty:</i> large predators	

Of the permanent staff, 6 (29%) have a PhD degree and one an MSc degree. Including one long-term visiting scientist (PhD), 9 persons carry out scientific research

(scientists). The main subjects included in the formal education of these scientists are ecological zoology (6), biology (2) and genetics (1).

Assisting staff carries out almost entirely actual biological research tasks, under the direction of the scientists.

In addition to the permanent staff, the GRU has annually had a number of temporary employees. These have varied, depending on the outside funding available, and have included an average 5 postgraduate students per year.

## 2.3. Funding and costs

Total funding of the GRU has increased in recent years, which has resulted from increases in both official budgetary funding of the FGFRI, and off-budget funding (includes cooperative funding and employment subsidies). The most of cooperative funding has come from the Finnish Academy of Sciences and the Ministry of Agriculture and Forestry.

### Costs in 1995-1997 (1000 FIM)

Type of cost	1995	1996	1997
Direct cost	5103	4822	6821
Share of joint cost	4081	4766	5017
Share of cost of capital	250	299	549
Total	9434	9887	11847

Direct labour costs formed 70% of total direct costs in 1996-1997. The total costs in 1997 were divided percentually as follows:

Monitoring studies	23%
Research projects	62%
Expertise	15%

## 2.4. Research activity

Game research at the GRU is directed toward answering 2 types of question. As a governmental research institute, it must serve authorities in practical matters by producing applicable and usable information about game resources. Secondly, game research at the GRU aids in promoting scientific development in the field. In fulfilling the latter task, cooperation with university scientists and scientists from other research institutes has been largely utilized both at the international (especially with Russia, Sweden and Estonia) and national levels. Cooperation has added remarkably to the research output of the GRU. The GRU has had a coordinating role in the Finnish game research.

The structure of the research activity is determined by (a) special tasks allotted annually by the Ministry of Agriculture and Forestry (negotiated jointly in advance), and (b) goals prioritized by the FGFRI. Views from throughout the surrounding community - including the scientific - affect both of these.



## 2.4.1. Main research fields at the GRU

Game research carried out in the FGFRI during recent years can be divided, on the basis of the needs presented above, into monitoring work and 3 additional research fields, as follows (see Figure 1):

1) **Monitoring studies.** With respect to all species or groups of species, monitoring refers to their abundance. In addition, monitoring of the most important game resources covers population structure (sex, age), reproductive success and for some species damage caused by the animals. The species and groups monitored include the moose, large predators, Baltic seals, beavers, most winter-active mammalian species, tetraonid birds and waterfowl.

2) **Environmental and habitat research.** This field includes habitat requirements and state and effects of changes in the major environments on game abundance (structure of forests, cultivated areas and bodies of water). Research on habitat structure is carried out at both the singular habitat and landscape ecological levels.

3) **Factors affecting game abundance.** (other than habitat structure). This includes population dynamics, reproductive ecology, predation, intra and interspecies competition, migrations, diseases, parasitism, effects of environmental impurities and hunting.

4) **Species biology.** This branch includes separate species-specific topics that do not fall within the above-mentioned categories.

The most important research activities in the above main areas during 1995-1997 are described and listed briefly on a project basis in the following.

### *Monitoring studies*

Results from the monitoring studies are utilized by hunting authorities, hunting community and owners of the hunting right, in determining the level of the sustainable harvest. The data are also widely used by other experts in the society, e.g. by environmental and conservation agencies.

The Finnish system for monitoring game populations is uniquely characterized by the use of extensive field censuses carried out by hunters on a voluntary basis and is considered to belong as a part into hunting pursuit (the only exception is monitoring of seals, which is carried out by research personnel). This extensive input is demonstrated by the estimate that roughly 15000 man-days are devoted annually by hunters to censusing of game stocks. In addition, about 200000 moose observations are reported annually, covering 50000 hunting days. Mass estimates of the abundance, reproductivity and structure of populations are planned, coordinated, processed and published by the GRU. The extensive use of hunters in carrying out field counts demands the large-scale training of observers, which is performed in cooperation with the Hunters' Central Organization. Monitoring results are published regularly after the annual surveys of each game species/group to offer a basis for estimating harvestability of stocks during the following hunting season.

The main monitoring schedules are briefly presented below; a more detailed description can be found in the enclosure International evaluation of the monitoring schemes for game and wildlife in Finland.

*Moose.* The abundance of moose is estimated by 4 main methods: (1) Moose-hunting clubs estimate the number of animals occurring in their hunting area at a certain time of the season (most of Finland's land area is utilized for moose hunting); the total estimate is corrected for double-counting. (2) Some game management districts arrange extensive counts during the snowy period, in which the entire area is surveyed

and a total estimate obtained by excluding double-counting of snowtracks between neighbouring subareas. (3) Some game management districts utilize aerial surveys during the snowy period (midwinter). (4) An abundance index is processed, based on moose observations reported by hunters (see below). Items 2 and 3 are carried out more independently by the game management districts, but the results are partially utilized by the research. The structure and productivity of the moose population are determined, using moose observations. The GRU produces areal estimates on the abundance of wintering populations and harvestable stock in the coming hunting season, as well as recommendations for the harvest (numbers and structure).

*Large predators.* Observations on the brown bear, wolf, lynx and wolverine are collected 3 times per year throughout the country. Observations (mostly snowtracks) are reported to specially trained local observers (of which there are more than 800), whose responsibility is to check the correctness of each observation. Special attention is devoted to dens and females (parents) with cubs. By excluding unreliable observations and possible double-counting, areal estimates are constructed annually at the GRU.

*Winter-active mammals.* The abundance of almost all winter-active mammals is surveyed in winter-counts of the so-called 'wildlife triangle scheme'. In this scheme, the basic unit is a triangle with 4 km sides, 12 km in total. The triangles have a fixed location, independent of any changes occurring in the habitats on and around the triangle. The intention is that changes in the environment should be reflected in the abundance of game counted. More than 1400 triangles are active throughout the country at present, amounting to more than 16000 km of track census line.

The winter census for mammals is carried out during January - March along the sides of the triangle. All mammalian snow-tracks crossing the census line are counted against a known period of accumulation of the tracks, and the exact location of each observation is expressed on a map. The abundances are indicated as relative indices (number of tracks per 10 km per day).

*Seals.* Baltic seal monitoring is carried out by the institutional staff in cooperation with other interest groups (national and international). The ringed seal population is monitored by aerial censuses over the Baltic ice in spring during the moulting season, at intervals of 1-3 years, depending on the weather and ice conditions. Grey seal censuses are carried out aerially over haul-out skerries during spring - early summer, visually and with the aid of photography.

*Beavers.* The beaver census is carried out at 3-5-year intervals, depending on the abundance and rate of change in abundance by province. The census is based on the number of active dens.

*Tetraonids.* Monitoring of the abundance of tetraonids is carried out, using the wildlife triangle scheme (see description 'Winter-active mammals' above). Tetraonid birds are counted in August along the sides of the wildlife triangles by a 3-man team, 20 m apart from each other. The team thus covers a census-strip 60 m in width, resulting in absolute densities (individuals per square kilometre). Each observation on tetraonids is also located exactly on the map. An average of about 12000 birds is observed annually. Observations are separated into chicks and adults and adults further by sex, thus making it possible to also estimate reproduction in the populations.

*Waterfowl.* Monitoring of waterfowl breeding in inland waters includes 2 types of census carried out at fixed sites throughout the country, using a standardized point-count method. The abundance of nesting pairs is estimated with pair counts twice during May - June and production is estimated with brood counts once during June - July. - Sea birds are surveyed annually on fixed routes along the coast and in core

areas of the Finnish archipelago. Monitoring concentrates on changes in the size of breeding populations.

### ***Environmental research***

The aim of this branch is to increase understanding of environmental and habitat needs and preferences of game animals. The ultimate goal is to use information in managing environments properly with regard to the well-being of game animals. It is more and more common practice, e.g. in forestry, cultivated areas and bodies of water, to carry out game-friendly management policies. Research on environmental structure on game populations is demonstrated here through the 3 main environments, namely forests, cultivated areas and bodies of water.

### ***Wildlife-habitat relationships in forest landscapes***

The main focus of the study is on assessing the relationship of forest landscape structure to the abundance and production of game animals. The study utilizes data collected in the forest wildlife monitoring (wildlife triangle scheme; see above). An invaluable property of the monitoring data is that observations in the field are located exactly. Wildlife observation sites can be assessed against land use and forest structure data adopted from the National Forest Inventory (satellite image data) with the aid of geographic information systems (GIS). The study also throws light on the habitat selection of target species also from the landscape-ecological point of view. It has become evident that forest structure affects game populations not only directly but also indirectly via predators.

### ***Comparison of game animal communities in Finland and Russian Karelia***

The basic idea is to compare game populations in Finland and Russian Karelia, which differ markedly with respect to land use and intensity and type of forestry practice. Karelian forests are much less affected by man, they are older in general and less fragmented. The study mostly works at the landscape-ecological level.

### ***Farmland game***

This project aims at determining the habitat needs of game living on farmlands. In Finland, this deals more with field-forest mosaics rather than large, pure field areas alone. The project covers a large variety of species, and also sheds light on the habitat demands of game species. The project also develops methods for monitoring abundance of game populations in habitat mosaics governed by fields.

### ***Reproductive ecology and population dynamics of waterfowl***

Breeding environments of waterfowl consist of patchily distributed lakes differing in size, vegetation luxuriance and isolation. In the present study habitat requirements, reproductive success and population dynamics will also be examined in relation to landscape-level factors, especially landscape physiognomy (e.g. lake isolation) and composition (e.g. relative amounts of different lake types). Density-dependent effects in habitat selection, reproductive success and population dynamics as well as reproductive investment and success, nest site selection and nest predation are also examined.

## ***Factors affecting game abundance and management of game species***

### ***Small- and medium-sized carnivores in game management: significance for small game and grounds for predator control***

The objectives here are to examine the effect of small- and medium-sized carnivores (red fox, raccoon dog, badger, pine marten, American mink and stoat) on the reproductive success and numbers of certain other small game animals (grouse, hare and waterfowl). The aim of the study is also to examine the effect of predator control on predator numbers and, thus, to estimate to what extent predator control is a reasonable tool for game management. The project utilizes the experimental approach by comparing manipulated and control (no-hunting) areas.

### ***Role of large predators in calf mortality of the semidomesticated reindeer***

Calf mortality, the reasons for which are largely unknown in Finland, is one of the important factors affecting the profitability of reindeer-herding. An unknown part of this mortality is caused during the first few weeks of life, from birth to the so-called summer gathering in late June - July, but an additional number of calves, as much as 20-30%, are lost between the summer gathering and autumn slaughterings. This project aims at determining the causes of mortality during this latter period. The study was undertaken in the northern part of central Lapland, where the role of predation, especially by the brown bear, has been hypothesized as an important factor. The research was started during summer 1997 by equipping 300 reindeer calves with mortality transmitters and by locating dead calves and determining the causes of death as soon as possible after the incidence.

### ***Role of chick mortality in fluctuation of eider populations***

The eider is the most important game species of sea duck in Finland. Fluctuations in eider populations are greatly influenced by chick mortality. This study concentrates on the role of various mortality factors off the southern coast of Finland. The study on breeding success begins with the females, the life history and condition of which are known in detail from the first breeding onwards. Clutch size and hatching success are surveyed. The 3 main causes of mortality are examined: predation, parasitism and malnutrition. The role of food resources is the key factor connected to more or less all these factors and is monitored thoroughly.

### ***Scientific basis for management of grouse populations***

This research programme aims at coordinating grouse research in Finland by filling the existing gaps in information and by producing not only scientific reports but also management guidebooks and information packages for the public at large. About 40 Finnish scientists are included in the programme, representing nearly all national institutions working with grouse problematics. The scientifically most important research topics are population dynamics (e.g. modelling of population cyclicality and synchrony, optimal harvesting, risk analysis), environmental problems (landscape ecology, GIS applications, forecasts) and the effects and possibilities of artificial rearing (physiological and anatomical consequences, effects on survival etc.).

### ***Physiological, pathological and ecological effects of environmental toxins in Baltic seals***

Baltic grey and ringed seal populations have been affected by environmentally induced reproductive disorders since the late 1960s. This project aims at examining, how organochlorine toxins interfere with physiological processes, how they lead to pathological changes and what the ecological effects are on the populations. The study is based on individuals drowned in fishing gear, found dead on beaches and

specimens taken specifically for research purposes (the seals are otherwise protected throughout the Baltic Sea).

### ***Species biology***

#### ***Home ranges and movement patterns of moose***

The project deals with the size, location and use of home ranges, dispersal, migrations and seasonal movements of moose in central Finland. The basic information on the above topics is obtained through the use of radiotelemetry. One of the main ideas is comparing the relationship of 'moose-biological' phenomena with parameters of forest structure and land use (satellite-based information). The final aim is to get help in the management of moose populations (movements are the most important singular factor causing difficulty in forecasting size of harvestable populations in the coming season) and in preventing damage caused to forestry (managing of forests, hunting practices).

#### ***Breeding biology of moose***

This study concentrates on the dependence of female reproductive capacity and population reproductivity on population structure, density and other intrapopulation as well as environmental factors. The study is based on the use of so-called moose observation charts during 1973-1996, bag statistics as well as age and genital samples from 1980, 1984, 1985, 1989 and 1997. In addition, genetic monitoring of the moose has been carried out since the mid-1970s.

#### ***Development and developmental disturbances in moose skeletons***

This study aims at solving the problem of abnormal skeletal development in the moose. These symptoms occur occasionally over time and area and are hypothesized as being linked to environmental pressures through forage.

#### ***Ecology of the raccoon dog in Finland***

The raccoon dog originated in the Far East and was introduced into NW Russia during the 1930s, 1940s and 1950s. From there the species rapidly spread westwards to Finland. At present, this omnivorous canid is the most numerous medium-sized carnivore in southern and central Finland and continues to colonize central and Western Europe. The importance of the raccoon dog is emphasized by the fact that the species is an effective vector species for sylvatic rabies. The study has dealt with its colonization in Finland, reproductive capacity and mortality, food composition and hibernation.

## **2.4.2. Scientific evaluation of research activities**

The GRU began a continuous process of scientific evaluation of its main research activities in 1992. The 'smaller' evaluations have been carried out by 2 outstanding Finnish scientists outside the FGFRI, the only 'larger' one so far by 2 Nordic experts. To date, the evaluation has covered 5 topics: Scientific grounds for harvesting cyclic tetraonid populations, in 1992 (report in Finnish), Baltic seal research, in 1995 (in Finnish), Ecological waterfowl research, in 1997 (in Finnish), Game and forest structure, in 1997 (in Finnish), and International evaluation of the monitoring schemes for game and wildlife in Finland, in 1997 (in English, by Nordic evaluators; see enclosure). Reports on the evaluations have been delivered extensively both among the scientific community, administrators and the hunting community. The evaluations have been used as guidelines in developing the scope of research and improving the scientific level of research activities.

## 2.5. Publishing activity

Publishing activity and staff size during 1994-1997 have been as follows:

Year	1994	1995	1996	1997
Articles in SCI and SSCI catalogue-based journals	10	12	9	13
Articles undergoing review the FGFRI	9	8	7	5
Articles in departmental books and journal series	7	8	68	5
Other articles (incl. departmental communication material)	52	61	38	63
<b>Total</b>	<b>78</b>	<b>89</b>	<b>122</b>	<b>86</b>
Size of permanent staff	16	22	21	21
No. scientists	9	9	9	9
No. res. articles per scientist	2.1	2.2	1.8	2.0
No. publications per person (entire staff)	4.9	4.0	5.8	4.1

Research publication activity is largely the result of high competence of the scientists and frequent joint research with other institutions (research institutes, universities), both national and international. Scientists from other organizations coauthored 70% of the research articles published during 1994-1997; however, the publishing activity is also characterized by a high output of popular articles. 'Semiscientific' and popular writing is an essential part of publishing activity, and it is exactly this activity through which the social impact of research is largely achieved. The overall task of producing a popular book on Finnish game resources during 1995-1996 was reflected in a lower number of research papers and higher number of 'other articles' published in 1996.

## 2.6. Expertise

### 2.6.1. Statements and reports

Statements and reports have been prepared on administrative processes dealing with game questions (especially for the Ministry of Agriculture and Forestry and Parliament).

### 2.6.2. Working groups

*National level* - GRU scientists participate in numerous formal and informal working groups, both on behalf of the GRU and as individual scientists. The most important

forums are Ministry of Agriculture and Forestry, Ministry of the Environment, Hunters' Central Organization, Finnish Academy of Sciences and World Wildlife Fund for Nature.

*International level* - GRU scientists participate as experts who are also consulted at the international level. The main forums are the International Union for Game Biologists (IUGB), International Research Bureau for Waterfowl and Wetlands Research (IWRB), Nordic Council for Wildlife Research (NKV) and International Council for the Exploration of the Sea (ICES). In addition, consulting activity is permanently carried out at the Commission for the Protection of the Baltic Marine Environment and the Bonn Convention.

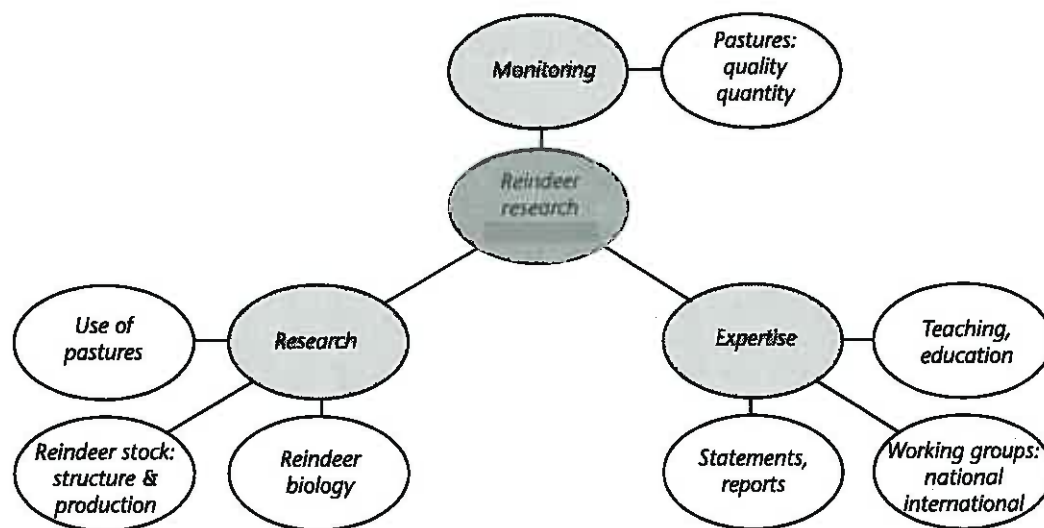
### 2.6.3. Education and teaching

Five GRU scientists occupy positions as high-level teachers (docents) in 3 different universities. The duties include both giving lectures and courses as well as supervising graduate and PhD students. They also give lectures at lower levels of education. In addition, GRU personnel produce material for increasing public call for understanding of game questions and also serve the public in many other ways.

# 3. REINDEER RESEARCH

## 3.1. Objective

The basic task of the Reindeer Research Unit (RRU) is to increase understanding of the biology and state of reindeer stock, state of reindeer pastures and other factors affecting the reindeer population. It also results in information on reindeer owners and reindeer husbandry. This information is utilized by other experts in the society to promote sustainable reindeer husbandry in Finland (see Fig. below).



**Fig. 2. Fig. Schematic representation on the main tasks of the Reindeer Research Unit in the FGFRI.**

The main users to benefit from reindeer research are the following:

- 1) The Ministry of Agriculture and Forestry including its local organizations (jurisdiction and management of reindeer husbandry), Ministry of the Environment, provincial governments, municipalities; data on the state of reindeer stocks and pastures.
- 2) The Reindeer Herders' Association including its local units; data on the state of reindeer stocks and pastures.
- 3) Reindeer owners; data on the state of reindeer stocks and pastures, methods of reindeer herding.
- 4) The scientific community; the role played by science in promoting research in the field.
- 5) The public; data and information on the reindeer and on sustainable use in reindeer husbandry.



## 3.2. Personnel

The permanent staff of the RRU comprised only 4 persons in 1997. The RRU has been located at the new Reindeer Research Station at Inari, in northernmost Lapland, since 1994. Two of the personnel are employed as research scientists, one of whom has a PhD degree and the other a Licentiate degree. The main subjects included in the formal education of these scientists are physiological zoology and ecological zoology.

In addition, resources from the Ministry of Agriculture and Forestry, Ministry of Labour and other funding sources have made it possible to hire additional workers to a considerable extent.

## 3.3. Funding and costs

Reindeer research funds have been increasing in recent years, although fluctuating greatly from year to year. The variation is explained by the special tasks allotted from and funded (off-budgetary funding) by the Ministry of Agriculture and Forestry during 1995-1997.

Costs in 1995-1997 (1000 FIM)

Type of cost	1995	1996	1997
Direct cost	1578	1765	1554
Share of joint cost	1724	1724	1785
Share of cost of capital	167	112	79
Total	3469	3601	3418

Direct labour costs formed 69% of total direct costs in 1996-1997. The total costs in 1997 were divided percentually as follows:

Pasture mapping and monitoring	27%
Other research	63%
Expertise	10%

## 3.4. Research activity

Reindeer research activity is directed toward answering principally 2 types of question. It serves authorities and occupation in practical matters by producing applicable and useful information on reindeer and reindeer husbandry. Secondly, reindeer research at the RRU helps in promoting scientific development in the field. In fulfilling this task, cooperation with university scientists and scientists from other research institutes has been largely utilized both at the international (especially with Russia and Norway) and national levels. Cooperation has been a prerequisite for successful scientific output at the small RRU. The RRU has played a coordinating role in the reindeer research in Finland.

Close contact with reindeer husbandry has been a characteristic of the work carried out by the RRU. Reindeer are easily available for research at annual gatherings, and experimental captive stock owned by the Reindeer Owners' Association are available

under near-natural conditions in the immediate vicinity of the Reindeer Research Station.

The structure of the research activity is determined by (a) tasks allotted by the Ministry of Agriculture and Forestry and (b) goals prioritized by the FGFRI. Opinions from the reindeer occupation, public, other surrounding community and scientific community affect both of these.

### 3.4.1. Main research fields at the RRU

Reindeer research carried out in the FGFRI during recent years can be divided into 4 main fields:

- 1) **Pasture research.** This branch concentrates on studying the amount of forage on reindeer pastures and the state of the pastures.
- 2) **Structure and productivity of the reindeer stock.** This study deals mostly with the effects of age and sex structure of the reindeer stock on calf production and productivity of the herds.
- 3) **Nutrition and condition of the reindeer.** This study deals mostly with various natural and artificial forages and their effects on reindeer condition and productivity.
- 4) **Basic biology of the reindeer.** The RRU carries out basic physiological and ecological research on reindeer biology.

The most important research activities carried out under these main areas during 1995-1997 are listed and described briefly below.

#### *Pasture research*

##### *Survey and monitoring of winter and summer pastures*

The state of pastures has traditionally been closely connected with size and productivity of the reindeer stock. The main focus in pasture research has been on winter pastures (mainly *Cladonia* lichens), which is the most critical source of natural forage during winter, but in recent years the state of summer pastures has also come into focus. The large pasture inventories are based on extensive field work and classification of satellite images. Winter pastures were surveyed during 1995-1997 and summer pastures in 1997(-1998). The state of the pastures will henceforth be monitored at fixed intervals, and the results will form a basis for planning the use of reindeer rangeland and for determining the highest allowable reindeer numbers in different reindeer herding cooperatives. The state of the pastures also shows the need for supplementary feeding. The results are utilized by the authorities governing reindeer husbandry, e.g. determining the maximum numbers of reindeer allowed in the various cooperatives. Reindeer husbandry utilizes the information in planning reindeer herding and especially feeding practices.

##### *Production and usage of reindeer pastures*

This project examines the biological production of forage in different types of winter pasture, especially the growth and recovery of lichen pastures. The deterioration of winter pastures at different grazing pressures is also studied. The effects of pasture resources on reindeer stock productivity is studied with respect to economic results of the husbandry.

## ***Structure and productivity of reindeer stock***

### ***Reproduction and selection of breeding animals***

This project aims at determining the ideal age structure of the male reindeer stock in reindeer herd in biological and economic terms, as well as features important in selecting animals for breeding. It aims at determining the structure of the stock that is most suitable for good productivity and economical results from the husbandry on a sustainable basis. The results will be utilized by reindeer owners in manipulating the structure of their reindeer stocks.

### ***Nutrition and condition of the reindeer***

#### ***Heavy-metal concentrations in reindeer lichens and reindeer meat***

This project examines the chemical composition and heavy-metal concentrations in reindeer lichens and meat in Finnish Lapland and northwestern Russia.

#### ***Effects of additional feeding on the alimentary tract and digestive activity***

Body condition is important for survival and reproductive capacity of reindeer and for favourable economic results from the slaughtered animals. Reindeer live only partly on natural forage thus additional feeding plays an important role in maintaining reindeer stock. Regular, long-term artificial feeding may change the anatomy and functioning of the alimentary tract. This work examines what types of effect are caused by artificial feeding on the nutrition physiology and condition of reindeer. The results are highly important, because most of the reindeer must be fed artificially during winter in the southern and middle parts of their management area; in the north reindeer feeding is essential during exceptionally harsh winters. These results produce useful data for reindeer owners on different methods of feeding.

#### ***Food selection of reindeer***

Palatability of both natural and artificial forage is examined, including chemical composition of forage, reasons for food selection and especially the effects of season and the state of growth on forage palatability.

### ***Basic reindeer biology***

#### ***Basic reindeer physiology***

This part has comprised studies on hormone and water metabolism, thermoregulation, stress, energy needs and occurrence and treatment of parasite infestations.

#### ***Behavioural ecology of reindeer***

This branch has examined mostly the hierarchic relationships in reindeer groups, especially the effects of hierarchical status on reproduction in both sexes and at different ages.

## 3.5. Publishing activity

Publishing activity and size of permanent staff during 1994-1997 have been as follows:

Year	1994	1995	1996	1997
Articles in SCI and SSCI catalogue-based journals	4	3	3	0
Articles undergoing review outside the FGFRI	1	3	0	0
Articles in departmental books and journal series	0	0	0	2
Other articles (incl. departmental communication material)	21	21	16	21
<b>Total</b>	<b>26</b>	<b>27</b>	<b>19</b>	<b>23</b>
Size of permanent staff	4	4	4	4
No. scientists	2	2	2	2
No. res. articles per scientist	2.5	3.0	1.5	0
No publications per person (entire staff)	6.5	6.8	4.8	5.8

High scientific quality and output of research papers have been largely achieved through extensive cooperation; scientists from other organizations coauthored 97% of the articles published during 1994-1996. The RRU published books in 1997 on Finnish reindeer husbandry and in cooperation with the Nordic Council for Reindeer Research on reindeer forage plants and pastures. The lower production of scientific articles during 1996-1997 is explained by the extensive pasture surveys, which occupied the small number of personnel in the RRU almost entirely.

## 3.6. Expertise

### 3.6.1. Statements and reports

Statements and reports have been prepared on administrative processes dealing with reindeer biology, management and husbandry (especially for the Ministry of Agriculture and Forestry, provincial governments and Parliament).

### 3.6.2. Working groups

*National level* - RRU scientists participate in numerous formal and informal working groups. The most important forums are conducted in the Ministry of Agriculture and Forestry, provincial governments and the Reindeer Owners' Association.

*International level* - RRU scientists participate as experts who are also consulted at the international level. The most important forum is the Nordic Council for Reindeer

Research (NOR). Organizational cooperation with Norwegian and Russian colleagues has been especially noteworthy.

### 3.6.3. Education and teaching

One of the RRU scientists occupies a position as a high-level teacher (docent) in 2 universities. His responsibility includes both giving lectures and courses as well as supervising graduate and postgraduate studies. Other teaching occasions are also frequent. The RRU delivers a large amount of written material to public call for understanding of reindeer questions, and it also serves the public in many other ways.