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NINA·NIKU

Research collaboration develops unique national park

Bjørn P. Kaltenborn & Graciela Rusch

How do human activities affect large populations of wildlife? How do large numbers of poor people utilise the local wildlife resources? What role does wildlife play in the culture and daily lives of these people, and how do they try to cope with their marginal life conditions?

These are some of the questions addressed by researchers from Tanzania and Norway in and around the Serengeti National Park. The fifty years old park is one of the largest and most famous in the world. It houses large and valuable populations of wildlife, but the management problems are considerable. Illegal harvesting of wildlife is significant, causing a strained relationship between park management and the local people. Poverty is widespread, the park is not benefiting local people adequately, and there is a lack of alternative development opportunities. A sustainable future for the park and its surroundings will require better understanding of human-wildlife interactions, improved ways of resolving conflicts, and improved living conditions for people in the communities.

A unique ecosystem

The goal of the project is to provide new knowledge on the ecology of the park as well as on the human dimensions regarding wildlife use and conflicts over the protected area. Improved ecological, socio-cultural and socio-economic data are required for developing a programme for local sustainable use of game in the Serengeti region.

The Serengeti-Mara ecosystem is located east of Lake Victoria in northern Tanzania and southern Kenya. It constitutes a remnant of the great migratory wildlife systems in Africa and harbours the largest herds of migratory ungulates and the highest concentrations of large predators in the world.

Currently, the condition of the Serengeti ecosystem is considered to be good. However, severe human pressure on wildebeest and resident game species may have a strong impact on biodiversity, and therefore, on the integrity of the ecosystem.

Wildlife has probably been important to the people in this area since the dawn of time. The present harvest levels are estimated to be significant and possibly unsustainable, while the human population is rapidly growing. Around two million people live adjacent to the park, and the habitats used by Serengeti wildebeest during migration are insufficiently protected. Along the western boundary of Serengeti, traditional wildlife harvest is closely associated with migratory herds. Thus, hunting pressure is more intensive in the dry season, when the herds pass through the area.

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Research collaboration

The interdisciplinary research project dealing with ecological and human systems has been initiated as a collaboration between Tanzania Wildlife Research Institute (TAWIRI) and NINA. The University of Dar es Salaam and the Norwegian University of Science and Technology (NTNU) are also partners. While understanding more of the human effects on the ecosystem, we also want to identify opportunities and means for community participation in the management of migratory wildlife resources.

Monitoring of ungulate populations: the wild reindeer

John Linnell & Olav Strand

NINA has been involved in monitoring of ungulates in Norway since 1967. The monitoring programmes have through the decades been adjusted to cater for the needs of the various users. Presently the monitoring is adapted to the decentralised system of management for these important resources.

Ten years have passed since NINA's role in the national monitoring programme for wild ungulates was formalised. Previously the activity was spread across several projects. The longest time series concerns the Vefsn (Nordland county) moose population with data since 1967. The present organisation of the monitoring programmes reflects the importance of the results for local institutions in the management structure.

Local management

For example, landowners have a great deal of responsibility for managing their local reindeer populations, and they are closely involved in the collection of monitoring data. The basic institution in the decentralised management structure for wild reindeer is the *wild reindeer committee*. The committees are composed of representitives for private and public landowners. The *wild reindeer boards* consist of politically elected representitives from the local municipalities. They have greater authority than the committees in that they process any complaints on the committees' decisions. The boards also have a defined responsibility to ensure that national goals for wild reindeer management are achieved, and they receive instructions from both county and national level wildlife management agencies. Results from the monitoring programme are used by all levels in this management hierarchy, both in terms of setting local hunting quotas and in setting national goals.

Most of the data collection for all ungulate species is conducted by hunters and landowners, with slight modifications for each species. These modifications reflect the ecological and social differences between the species, their habitats, and the manner in which they are harvested. The various study areas included in the monitoring programmes reflect the diverse ecological regions of Norway.

Monitoring and research

The long term series also form the main platform for NINA's research activity on wild reindeer, moose and red deer. The original intention was to obtain data on population development (population size and condition) and demographic parameters (reproduction and survival) to help develop harvest strategies. For example, in the early years of the monitoring program on wild reindeer, the focus was on understanding the relation between food, population density and productivity. This research resulted in many classic publications that are still central in our understanding of the mechanisms of population regulation in wild reindeer. In addition, this research was central in developing an understanding of the way wild reindeer population dynamics and behaviour are adaptations to the alpine ecosystem.

These time-series have also proven to be invaluable to answer new questions that have appeared in recent times, for instance to address increased concerns about the possible negative effects of selective harvest.

Habitat fragmentation

The present distribution and status of wild reindeer populations in Norway is largely a result of the serious human influence on their habitat. The development of transport, energy and recreational infrastructure has fragmented the national wild reindeer population into 26 more or less isolated units. This has lead to a greater focus on how human activities affect reindeer populations. We have been able to use the spatial data from the monitoring programme (previously considered less important) to directly address these issues. These data have shown that technical installations and human disturbance have a significant effect on wild reindeer movements, and have in fact excluded them from large areas of potential habitat. As wildlife managers implement plans to reduce some of this disturbance, our data series will allow us to evaluate the attempts at habitat restoration.

The present organisation of the monitoring programmes reflects the importance of the results for local institutions in the management structure.

Agricultural landscape diversity
– a key feature for biodiversity, cultural heritage remains and human experience

Erik Framstad

How does agricultural policy and management influence landscape structure and associated values? A monitoring programme is set to trace changes in landscapes over time in order to elucidate how various landscape parameters may relate to biodiversity, cultural heritage remains and human experience of the landscape.

Three percent agricultural land
Although agricultural land in active use constitutes only 3% of the Norwegian land area, the agricultural landscape represents a characteristic feature of the Norwegian countryside. The spatial distribution of various types of fields, meadows, woodlands, buildings, field margins, roads and other landscape elements represent the structure of the landscape. Studies indicate that biodiversity, cultural heritage, human experience of the landscape and other amenity values may often be related to landscape structure. By managing the landscape and its elements, we may hence directly or indirectly manage the various values associated with the landscape.

Landscape diversity turns out to be a common framework for explaining the landscape's richness of biodiversity and cultural heritage remains.

Rapid transformation
Over the last decades the agricultural landscape in Norway, as in all western countries, has undergone a rapid transformation due to profound changes in agricultural policy, public attitudes, and economic and technological drivers. It is essential for policy makers and management authorities to understand how agricultural policy and management actions influence landscape structure and associated values. The Norwegian Ministries of Agriculture and Environment have therefore started a monitoring programme for the agricultural landscape (called '3Q'), with the aim to record changes in landscape structure over time. Partners in this project are NIJOS, NIKU and NINA.

Data on landscape structure are developed from digital maps based on aerial photographs of selected representative sites. The various derived indicators of landscape structure from the digital maps have been related to selected measures of biodiversity (mainly vascular plants and birds), cultural heritage remains and both qualitative and quantitative measures of human landscape experience. The data were collected in the field, from existing data bases, as well as through surveys of respondents. Some preliminary patterns have already emerged.

Common framework
Landscape diversity turns out to be a common framework for explaining the landscape's richness of biodiversity and cultural heritage remains, as well as positive scores for human experience. Certain kinds of landscape diversity turn out to be more important than others. The number of both bird and vascular plant species are positively related to the diversity in different land types on a local scale. Observations of insects within the study plots did not show an association to landscape diversity at this scale, however. Insect species richness was more closely related to the supply of flowering plants suitable for feeding. Certain cultural remains like medieval grave mounds were also well correlated to the diversity of land types.

Management of the agricultural landscape will directly influence the kinds of properties of landscape structure which are monitored through the 3Q programme. Such properties also appear to be linked to aspects of biodiversity, cultural heritage and other values associated with the landscape. However, it is clear that relationships between landscape associated values and landscape structure need to be verified through adequate field sampling, as the relationships will depend on the relevant spatial scale under study and the aspects of landscape values and structure of actual interest.

Digital terrain analysis
– planning tool to conserve biodiversity and protect environmental values on land and in the sea

Trine Bekkby & Lars Erikstad

Habitat mapping and terrain modelling are well-established methods in evaluating the effect of technical encroachment on bio-communities in the terrestrial environment. While refining the methods for use on land, NINA researchers have recently started applying these tools for impact assessment and management planning in the coastal zone and marine environment.

Underwater landscape modelling
Landscape structures and the distribution of habitats are important for the distribution and survival of species. Hence, NINA's Landscape Ecology Group has developed methods for systematic landscape analysis, in which terrain modelling and integration of different environmental parameters are essential elements. This approach was developed for the terrestrial environment, but has been transferred to studies of the coastal zone and marine environment. The approach is now an integral part of NINA's work with environment impact assessments. One example is the EIA for the expansion of a large oil terminal in Telemark, Norway, including mapping of terrestrial and marine habitats, evaluation of conservation values and vulnerability.

A holistic landscape analysis depends on information on the distribution of species and ecosystems.

Terrain modelling of the subsea landscape has also been used to identify areas where the sediments are most likely to be affected by boat propellers causing turbid waters. This is an important approach when planning to meet increased boat activity within a fjord or other nearshore environments, both for identifying the general effect on the environment (with particular focus on potential release of toxic sediments) and to assess the potential problems for fishermen through clogging of fishing gear.

The kelp forest is an important and productive ecosystem along the Norwegian coast, supporting both the fishery and the kelp harvest industry. Since the 1970s, about 50% of the kelp forest of Northern Norway has been degraded by sea urchin predation. A suitability analysis may indentify areas suitable for restoration projects.

Landscape analysis: a combination of tools
A holistic landscape analysis depends on information on the distribution of species and ecosystems (e.g. vegetation cover). Although vegetation and land cover maps may be available, information is often lacking for several areas, or the maps may be outdated. Hence, NINA systematically includes digital analyses of aerial photographs and satellite images to obtain biodiversity assessments for inclusion in landscape models.

Landscape models including habitat mapping and assessments of conservation value and vulnerability provide a useful basis for land use suitability analyses. Landscape analysis tools provide an efficient approach to environmental impact assessments related to a range of infrastructure development and other activities both on land and in water. NINA has applied this approach on several types of projects, e.g.:

- Construction of golf courses is often controversial, and a thorough analysis of the environmental consequences at an early stage in the planning process may satisfy the demand for environmentally sound projects while catering for the needs of golfers as well as those of the local community.
- When planning for the development of roads and railways, tunnels may be a good solution to avoid serious negative environmental consequences. However, tunnels often present significant negative aspects in their own right. Mitigation of these impacts may be expensive. NINA has applied holistic landscape modelling to suitability analyses of alternative routes for rails or roads, including tunnel construction, in order to improve the environmental aspects of projects, and also to save costs.

Pollution causes ecosystem changes in the Russian – Norwegian border region

Nigel Yoccoz

The region around the Norwegian – Russian and Finnish border represents one of the most polluted areas in Europe. How does air-transported pollution over several decades influence the ecosystem in this part of Europe?

Large areas in the Norwegian – Russian – Finnish border region are or may be affected by pollution emanating from the Russian industrial complexes of Nikel and Zapoljarnyj. Pollution by sulphur dioxide (SO_2) and heavy metals including copper and nickel are likely to pose the main problems in the Norwegian – Russian border area, but organic pollutants potentially harmful to human health, such as Polycyclic Aromatic Hydrocarbons (PAHs), should also be considered. How does the dominant ecosystem in this region, the birch forest ecosystem, respond to the air-transported pollution, which has lasted for several decades?

A joint project to study the effects of pollution on the birch forest ecosystem in the Russian – Norwegian border region was started in 1999 by an international scientific group, consisting of biologists and remote sensing scientists from NINA, biologists from the Finnish Forest Research Institute (METLA), soil scientists from Institute of the North Industrial Ecology Problems (INEP, Russia) and geochemists from the Geological Survey of Norway (NGU).

The project focuses on the following aspects:
- Landscape features (remote sensing)
- Soil geochemistry (heavy metal loads and organic pollutants)
- Plant vitality (measurement of plant stress)
- Plant communities (lichens, mosses, vascular plants)
- Small mammals (voles and shrews), and bird (flycatcher) populations

Levels of carcinogenic organic compounds (PAHs) are higher in the soil humus layer within a radius of 10 km of Nikel; the levels are potentially harmful for human health.

The results represent the first simultaneous assessment of pollution levels and impacts as a function of distance from the pollution source and topography. Direct measurements of pollution levels were obtained by chemical analyses of birch and bilberry leaves. Pollution levels away from the source show, as expected, decreasing levels, but this decrease is much more rapid towards the west than towards the south, and stations NE of Nikel show the combined pollution effects of Zapoljarnyj and Nikel. Plant photosynthetic activity is very much reduced close to the smelter. Analysis of organic pollutants show that levels of carcinogenic organic compounds (PAHs) are higher in the soil humus layer within a radius of 10 km of Nikel; the levels are potentially harmful for human health. Beyond this distance the levels drop significantly.

The results obtained so far provide the necessary information about spatial variability in both pollution levels and ecosystem structure in order to set up a monitoring programme to detect future changes in the impacts of pollution.
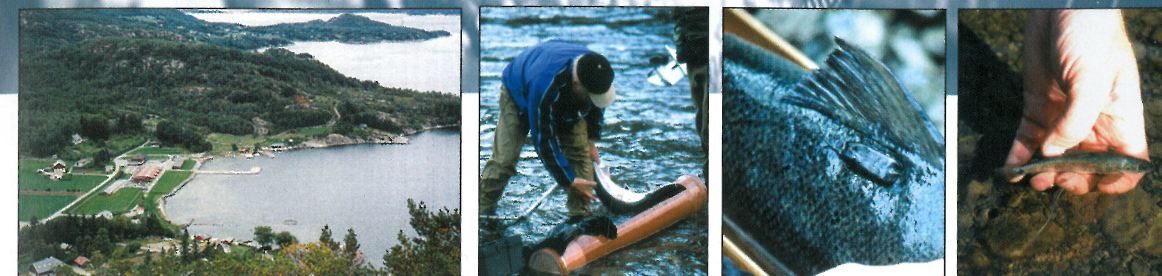
NINA Research Station at Ims in large EU project

Kjetil Hindar

NINA's research station for anadromous and freshwater fishes at Ims, southwestern Norway, provides data to a new EU research project aiming at a characterisation of how disease transmission from farmed fish affects wild populations of salmonid fishes.

In October 2001, NINA took on the EU research project "Impact of aquaculture on the immune response genes of natural salmonid populations: Spatial and genetic signatures and potential fitness consequences". The project, which is coordinated by Wageningen Agricultural University, The Netherlands, has received financial support from the Quality of Life research programme for three years.

Characterisation of how disease transmission from farmed fish affects wild populations of salmonid fishes.

The main objective of the project is to assess the extent to which disease transmission has, or has had, an impact on genetic variation in natural populations of Atlantic salmon and brown trout. This will be achieved by a comparison of the genetic dynamics at loci that are critically involved in the immune response (i.e. major histocompatibility complex genes, or MHC) with the dynamics of selectively neutral loci, both in the wild and in experiments. The immune response genes are important in the defence towards different pathogens such as bacteria and viruses. It is common to find higher genetic variability in these genes than in others, as higher variability can provide protection towards a larger variety of pathogens. For this reason, scientists also believe that fishes – as well as other animals – choose breeding partners on the basis of their immune response genes, but this hypothesis is still controversial.

Unique research facility
At the NINA Research Station at Ims we will conduct a number of experiments on mate choice and early survival. The Ims research facility is unique, as it allows estimation of reproductive success and the growth and survival of the resulting offspring (so-called fitness) under natural environmental conditions. This makes NINA an attractive partner in EU projects, and an indispensable partner in this project.

GLOBIO
The GLOBIO method provides an inexpensive, simple, scientifically based communication tool for mapping, at a large scale, human impacts on the biosphere resulting from increasing resource utilisation. The method relates probability of impact on biodiversity and ecosystems to distance to infrastructure, based on existing impact assessment studies. The method has been developed by NINA researchers in collaboration with UNEP and numerous research and management institutions in Norway and abroad.

Alien species with timber imports
Timber import from Russia to Norway has established a new pathway for dispersal of living organisms. In a small greenhouse experiment we tested whether bark and other litter material (a total of 280 l) from the timber ships contained living seeds. After three months, 116 plants were registered, representing 40 different species. Two of the species are previously not known in Norway. The experiment will be repeated on a larger scale in 2002. The preliminary results indicate that timber import represents a significant risk for introducing alien species.
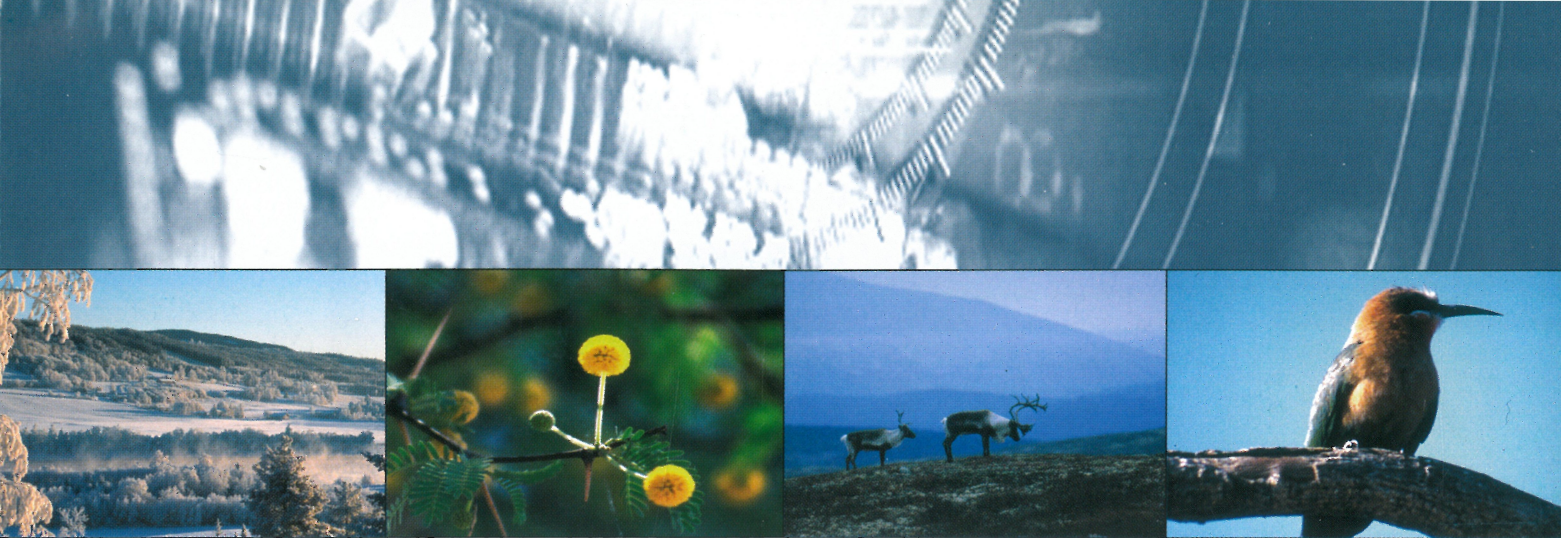
This is NINA

The Norwegian Institute for Nature Research is one of two research institutes in the Foundation for Nature Research and Cultural Heritage Research (NINA•NIKU). The Institute was established in 1988, with headquarters in Trondheim, additional research staff in Tromsø, Lillehammer and Oslo, and a research station for freshwater fish at Ims, near Stavanger. NINA employed a total of 150 staff in 2001. Of these, 95 were research scientists, 31 research technicians, and the rest administrative staff.

NINA´s major clients for research and contract work is the Directorate for Nature Management, the Norwegian Research Council, the Ministry of Environment, and other public sector institutions. On the national market, private industry and local authorities are also important. The Norwegian Agency for Development Cooperation, NORAD, international organisations and the Norwegian Research Council are important clients for our international activities.

NINA's expertise is mainly directed towards basic and applied research concerning sustainable use and conservation of natural resources and biological diversity, in areas such as:

- Land-use and nature management, including landscape analysis, in the coastal zone and on land
- Commercial development related to biological resources
- Harvesting and sustainable use of game and fish stocks
- Red-list evaluations and conservation planning
- Monitoring and time series analyses regarding natural resources
- Community development and local participation in resource management
- Research on conflicts in natural resources management, e.g. large predators vs. domestic animals, and outdoor recreational activities vs. forestry, agriculture or urbanisation
- Environmental databases – development, operation, use, and public information
- Pollution impact analysis and monitoring, in particular acid rain, heavy metals, radioactivity, and eutrophication
- Environmental impact assessments connected to infrastructure development and land-use changes

Turnover in NINA 2001
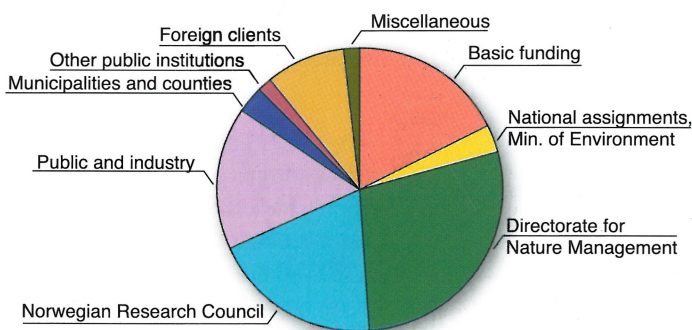
Total operating income 14.3 mill. USD

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