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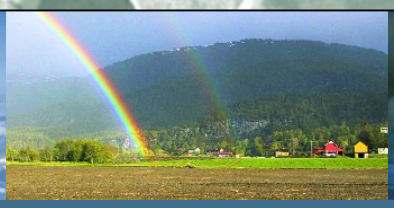
# Norwegian Institute for Nature Research NINA

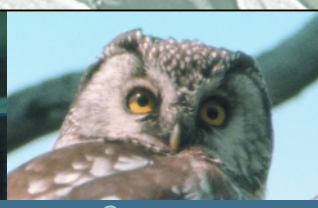
# annual report 2003

NINA
Norwegian Institute for Nature Research


TEAMWORK


ENTHUSIASM


INTEGRITY


QUALITY

Cooperation and expertise for a sustainable future

# Modelling marine habitats

Trine Bekkby, Eli Rinde, Lars Erikstad, Vegar Bakkestuen and Svein-Erik Sloreid

**As part of a national effort to map marine habitats and classify marine areas according to the EU Water Framework Directive, NINA, together with the Norwegian Geological Survey (NGU), have developed a modelling approach based on geographical information systems (GIS). The models apply knowledge on how abiotic parameters (e.g. depth, slope, terrain variability, wind exposure) influence the distribution and frequency of marine habitats.**

## Habitat modelling – a cost efficient approach

Since it is complicated, time consuming and expensive to map marine habitats, we have less knowledge of marine ecosystems than of ecosystems on land. The newly developed model approach provides a basis for planning marine ecological surveys and identifying the potential for different habitats within an area. NINA and NGU have carried out some field validation which indicates that this approach is sensible. Further analyses of data may result in revision of the algorithms and improvements of the models. This work is part of the projects MARMODELL and SUSHIMAP, and will contribute to the marine database MAREANO. The work is funded by the Norwegian Research Council, the Ministry of Fisheries, NINA and NGU.

## Modelling seabed substrate

The elements of the basic model described above can be employed to model both a whole system of marine habitats and special habitats of conservation or management interest. Sea-bed substrate, degree of exposure and depth are important factors in the EUNIS habitat classification system for the European Environment Agency (EEA). Based on digital depth models and data on wind strength and direction, we have developed an algorithm for modelling the degree of wind exposure. Sea-bed substrate may partly be modelled by using different indices for terrain variability. Here we show one approach for modelling potential soft seabed sediment (defined as concave areas with low terrain variability) in sheltered and medium exposed areas and potential rocky sea bed (defined as areas of very high terrain variability).

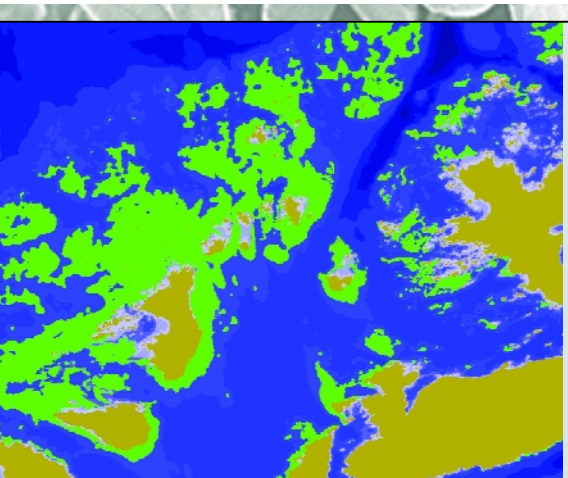
## Modelling potential areas of valuable habitats

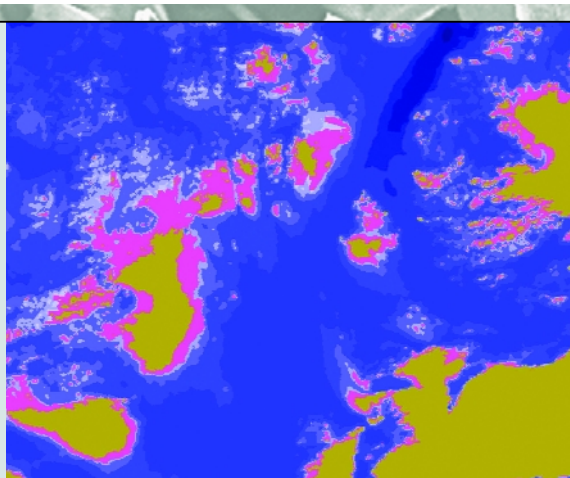
Our modelling approach is also suitable for finding potential areas of valuable habitat. Kelp forests have a particular significance for marine biodiversity along the Norwegian coast. They have different depth distribution depending on the degree of exposure. The more exposed the area, the deeper we find the kelp. In the most exposed sites on the west coast of Norway, dense kelp forests will reach a depth of 25 m. In areas with medium exposure, dense kelp forests may go down to about 20 m. On moraine deposits, the distribution of kelp forests will be overestimated, as the sea bed will consist of sediment not suitable for kelp. Moraine deposits are difficult to model, particularly based on marine depth data only.

Eelgrass beds is another valuable habitat type found in sheltered areas of medium exposure and moderate slope (<7 degrees) at shallow depth (<7m). Using our modelling approach, 70% of the modelled eelgrass locations were found in the correct 50x50 m cell or within the adjacent cells (i.e. a maximum of 125 m away from the observed location).

Shell sand is also a nutrient rich and valuable habitat for many species. We have modelled the potential distribution of shell sand at two levels. First we identified the primary accumulation sites, i.e. the locations where shells are most likely to be found after being transported from the site of the living organism. We modelled this accumulation site in the transition zones between exposed and sheltered areas in the outer coast. Then we modelled the secondary location of shell sand as the concave areas in sheltered locations with medium exposure. The secondary locations will to a large extent depend on the strength of currents, but such data are not yet available.







*The model approach provides a basis for planning marine ecological surveys and identifying the potential for different habitats within an area.*

*Left: Areas modelled as potential areas of kelp forest (green areas). The model is based on information about water depth and the degree of exposure.*

*Right: Areas modelled as potential areas of eelgrass (pink areas). The model is based on information about water depth, slope and degree of exposure. Photo: Trine Bekkby,*

# The ROSA project: A process to reconcile large carnivores and human society

Reidar Andersen, Håkon Hustad and John Linnell

**The return of large carnivores (wolves, bears, lynx and wolverines) to the Norwegian landscape is proving to be a conflict-ridden process. Social science research has shown that social conflicts associated with large carnivores may be just as intense as the material conflicts associated with the loss of livestock to carnivores. In other words, conflicting opinions and attitudes among different groups of people are as important for the development of the conflict as the direct confrontation between farmers and carnivores. Negative attitudes between different stakeholder groups may be as important for conflict escalation as diverging attitudes towards animals and nature. Reduced conflict levels are a prerequisite for successful carnivore management, and can only be attained by building mutual trust through dialogue and cooperation between researchers, management agencies and stakeholders.**

## Carnivores and society

The project "Large carnivores and human society – towards a flexible management (ROSA)" has been funded by, i.a., the Research Council program "The changing landscape" during the period 2000-2004. ROSA has recognized that it is impossible to find solutions that are perceived as perfect by any stakeholder group. Acceptable compromises have to be found. ROSA's ambition has been to identify, develop and facilitate such compromise solutions. ROSA is motivated by the fact that knowledge and understanding is developed in the interfaces between different organizations, stakeholders and positions. A *modus operandi* has been established where dialogue is used to develop fundamental principles and perspectives concerning future large carnivore management.

ROSA differs from earlier wildlife ecology projects in, (1) the extent to which social science is integrated into the project, (2) the focus on communication and dialogue with various stakeholders, and (3) the focus on applying knowledge to develop management procedures. Ideally, management goals should be achieved by means that are locally acceptable. This requires effective monitoring and adaptation to local conditions – in other words a flexible application of management measures.

Central elements of ROSA's work have included

- establishment of an advisory group with broad representation from stakeholders, wildlife managers, and scientists
- improved communication between stakeholders, researchers and managers
- identification of management tools that will secure a flexible management
- research projects in social sciences and ecology.

## Policy development

In 2002/2003 ROSA was given responsibility for a number of studies and reports (NINA fagrapport nos. 58-70) that formed the basis for a new government White Paper on the management of large carnivores (St. meld nr. 15, 2003-2004). A number of research institutions in Norway were involved, with ROSA coordinating to ensure that researchers and stakeholders interacted. The dialogue and synthesis work was achieved during four workshops where various actors with different background could interact in a structured and creative process. The main output from the project was advice, principles, and criteria for success, for future large carnivore management that were developed by the advisory group (NINA temahefte 22). The report was not intended to be a common manifesto for a specific policy, but rather a presentation of a common understanding of the consequences of various strategies.

A wide range of fundamental principles from ROSA were included in the White Paper, including:

- recommendations for a system of geographically differentiated management with different management units having their own goals
- recommendations to allow regional management great flexibility as long as they satisfy national minimum objectives
- adoption of a process to normalize the management of large carnivores by allowing local hunters to begin hunting carnivores as soon as population status allows.

This demonstrates that this form of working (interdisciplinary and participatory) in the interface between science and management can be very effective as a tool to ensure that available knowledge is utilized in political decision making processes.



*Photo: Roy Andersen*

# Nature based tourism – a growing business in Norway

Øystein Aas

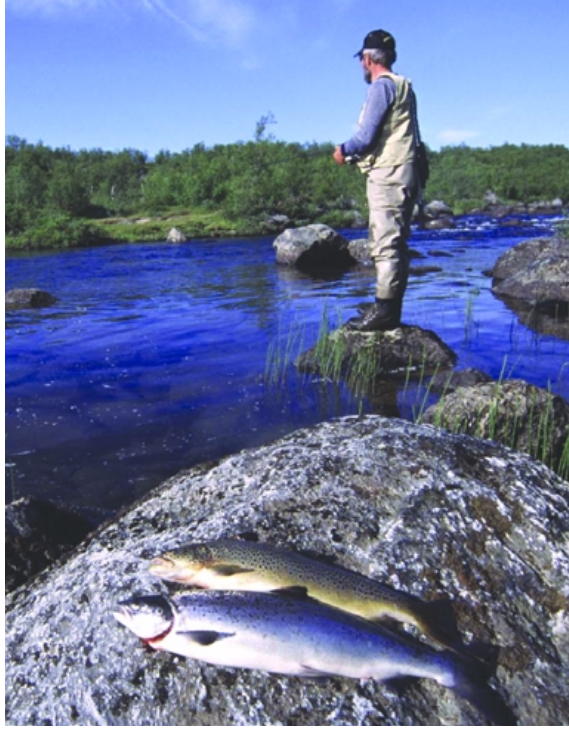


*Photo: Børre Dervo*

**Nature based tourism has a long history in Norway, but has only recently been recognized as an economically important element in Norwegian tourist industry. This segment of tourism may have significant impact, creating jobs and income, particularly in rural areas. A study conducted by NINA in 2003 reveals a large potential for improvement and growth. The study focused on entrepreneurs in the mountain region of South-Eastern Norway, investigating how they perceived the market situation, product development, the dependency on natural resources, the status and importance of cooperation within the sector, and their view of future opportunities.**

## Tradition and entrepreneurship

The actors in nature based tourism in Norway is a mix of private and public landowners, small businesses with focus on accommodation, and small businesses offering activity opportunities and experiences.

The public landowners (community commons, or "almenning") often act as if they were government authorities, and do not generally focus on development of nature based tourism in the community.

The private landowners, often with their main income from agriculture or forestry, are increasing group of entrepreneurs within this sector of tourism. Collaborative networks have been established, but many still operate on their own, missing access to competence in important areas. Fishing, hunting, and experiences related to traditional farms and farm life are important products.

The number of businesses offering activities and experiences such as rafting, climbing, horseback riding and wildlife viewing, is increasing swiftly. Important challenges for this group are quality control and safety, cooperation with hotels, and how to increase business volume.

The traditional businesses of hotels providing meals and accommodation for visitors coming to enjoy nature in one way or another, generally have larger economies than the other operators. They have a longer season and more people employed. Important challenges are co-operation with the other businesses and product development.

## Strategic thinking and a better knowledge base

Nature based tourism in Norway is a growing business, and the actors are optimistic. This is in contrast to the fact that many operators face major challenges in order to maintain and develop their businesses. Improved sustainability in the sector will depend on better co-operation among operators in order to provide the whole chain of services required by tourists. Improved understanding of the market, and development of products that are better adapted to market preferences, is a major issue.

*The actors in nature based tourism is a mix of different small businesses. The challenges of the traditional businesses of hotels providing meals and accommodation for visitors coming to enjoy nature are cooperation with the other businesses and product development.*
*Photo: Børre Dervo*



# BONIC – CAPACITY BUILDING AND RESEARCH FOR WILDLIFE MANAGEMENT IN BOTSWANA

Christina Skarpe

**BONIC – a five year collaborative research and post-graduate educational project with Botswana's Department of Wildlife and National Parks (DWNP), was formally ended with a workshop in Kasane, Botswana, 12-15 March 2003. During the five year project period, seven Botswana citizens have obtained their MSc degrees in wildlife and vegetation ecology, and the first of four PhD students obtained his degree in June 2003. The formal education programmes have been implemented in collaboration with Noragric and NTNU. The project has also provided essential scientific knowledge for the management of Chobe National Park and its elephant population.**

## Final workshop

The end of BONIC (Botswana – Norway Institutional Co-operation and Capacity Building Project) was officially marked with a workshop in Kasane, Botswana, 12-15 March 2003. Among the 45 participants were project researchers and students from Botswana and Norway, the invited keynote speakers Patrick Duncan, Norman Owen-Smith and Tony Sinclair, guests from DWNP, NINA and Noragric, and representatives of local NGOs.

## Research and capacity building

The main aim of the project has been to study the effects of the increasing elephant population on other components of the ecosystem in the Chobe National Park. Important themes were, e.g., soil and nutrient cycling, vegetation dynamics, interactions between large herbivores and vegetation, abundance and distribution of mammals and gallinaceous birds, and aspects of the ecology of impala, buffalo and lions in the area.

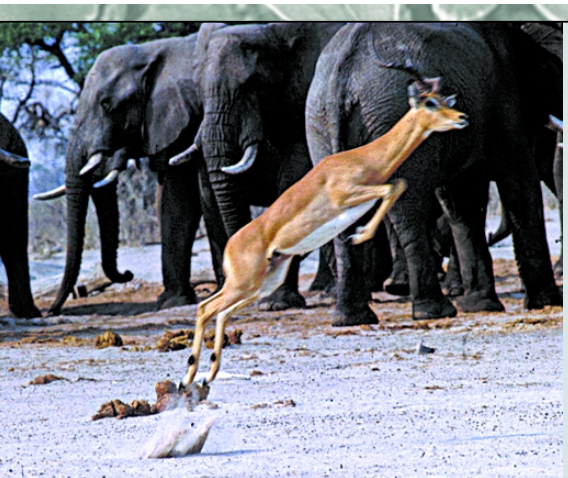
Profound changes have occurred in the ecosystems of northern Chobe during the last ca. 100 years. There is written evidence that the area close to the Chobe River were open flats in the end of the 1800's. After the ivory hunt had driven elephants virtually to extinction, and many of the other herbivores had been reduced by the cattle disease "rinderpest" in the early 1900's, woodlands of different types developed along the river. When the populations of elephants and other herbivores started to recover some decades into the last century, the woodlands were again reduced, and the dead and dying trees caused concern in Botswana. It was feared that the elephants were about to destroy the habitat, both for themselves and for other species.

However, the BONIC project has found little evidence for this. The heavily impacted vegetation close to the river is the habitat with the highest densities of animals, not only of species aggregating there in the dry season in search for water, but also in the wet season and including highly mobile species like gallinaceous birds. The woody riverine vegetation is rich in palatable browse species and the floodplains in nutritious grasses. There is little evidence of reduced carrying capacity for large herbivores in the are, rather the dominating species of browsers, grazers and mixed feeders have increased in numbers concurrently with the elephants.

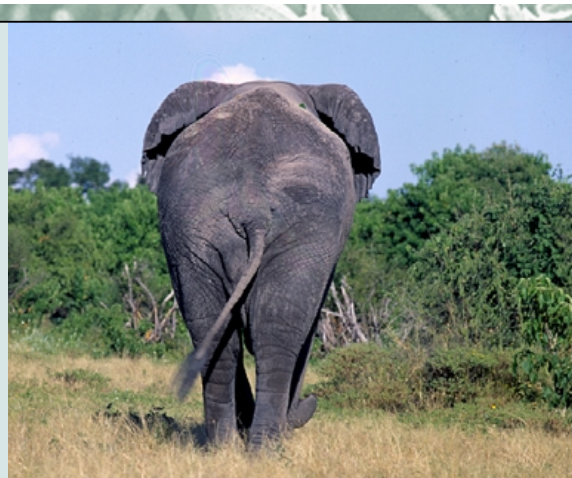
## Management advice

Thus, the results of the BONIC project do not indicate any ecological reason for reducing the number of elephants, which constitute a main asset for Botswana's rapidly expanding tourist industry. Nevertheless, there may be social and economic reasons to define boundaries for the area where the elephant population could develop freely. Outside that area, suitable means, including culling, could be applied to reduce or solve human - elephant conflicts. This could at the same time provide the opportunity for an increased consumptive utilisation of "surplus" animals and the marketing of various products as far as the CITES convention allows.



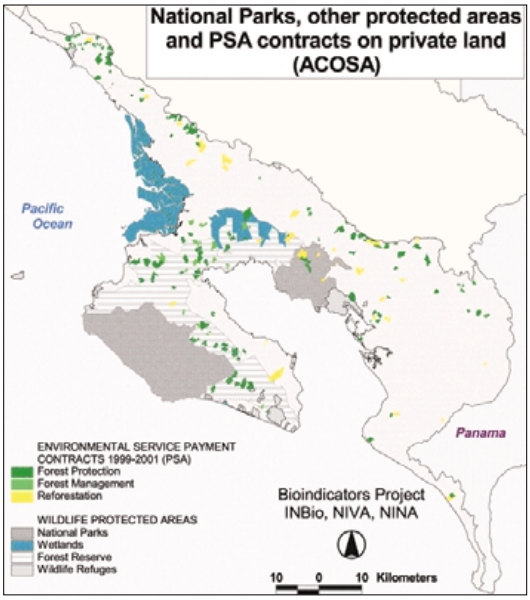


*The main aim of the BONIC project has been to study the effects of the increasing elephant population on other components of the ecosystem in the Chobe National Park in Botswana.*
*Photo: Christina Skarpe*



# Integrating biodiversity indicators and economic valuation in land use management decisions

David Barton (NIVA), Graciela Rusch, Jan Ove Gjershaug (NINA) and Marco Castro (INBio)




**How do we evaluate trade-offs between biodiversity conservation goals and economic revenues from different land uses? How is a balance found between conservation, public spending on protected areas, sustainable economic growth and development? Weighing conservation costs on private and public lands against available biodiversity measures is an overarching challenge faced by managers and decision-makers.**

## A collaborative effort

The project is a joint research effort by the Norwegian Institute for Water Research (NIVA), the Norwegian Institute for Nature Research (NINA), the Costa Rican National Biodiversity Institute (INBio), and it includes a collaborative agreement with the Australian Museum in the application of tools for trade-off analysis and the development of indicators of biodiversity values. The "Bioindicators Project" is supported by the Biodiversity Program of the Research Council of Norway.

## TARGET - a multi-criteria tool for conservation decision analysis

The Project adapts a range of biodiversity priority-setting methods originally developed in Australia. TARGET uses information on physical and biological georeferenced data sets to search for sets of areas that represent the biodiversity of the region. Fundamental to all TARGET analyses is that biodiversity is assessed in terms of the degree of "complementarity" of an area, i.e. its contribution to the overall biodiversity represented in a system of protected areas. The approach adopted by TARGET is novel in that it incorporates opportunity costs using a trade-off approach to search for a balance between conflicting land use objectives.

## Application in Costa Rica

We conduct trade-off analyses between the biodiversity complementarity of an area and its opportunity costs to prioritize the allocation of environmental service payments (ESP) to private land owners in Costa Rica's National System of Conservation Areas (SINAC).

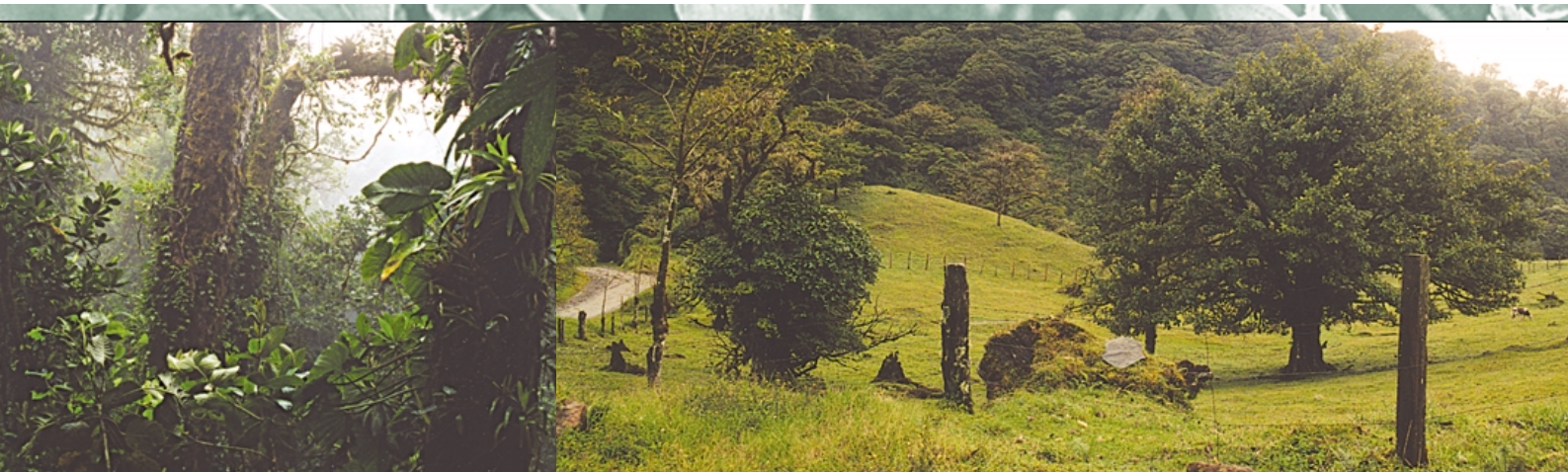
## Relevance for biodiversity management

Through collaboration with Australian institutions, and INBio's efforts in biodiversity inventorying, the project introduces world-class experience in conservation priority setting. The relevance of this conceptual framework relies on:

- the effort to develop biodiversity surrogates and to quantify biodiversity with the explicit purpose of establishing priorities among areas with conflicting land use alternatives
- the concept of complementarity in biodiversity value-setting
- the development of biodiversity indicators based on the best available information, that are flexible and that can be modified as more information becomes available
- the use of biodiversity value vs. opportunity-cost trade-offs in priority setting of public expenditure in terms of, for example, subsidies and compensation to private land-owners, and management costs of protected areas.



*Trade-offs between costs and conservation of alternative land uses. The "Bioindicators project" introduces world-class experience in conservation priority setting into the system of payments for environmental services in Costa Rica. Photo: Graciela Rusch.*



# Investigating the Biodiversity of Soil and Canopy Arthropods (IBISCA) 2003-2005

Frode Ødegaard

**Arthropods of tropical forests constitute the dominant component of biodiversity on Earth and are essential for structuring terrestrial ecosystems. This international collaborative project represents the first attempt to compare arthropod species richness in the soil and understorey vs. canopy habitats of a tropical rainforest, including a wide range of taxa and sufficient spatial and temporal replicates.**

## IBISCA 2003

NINA entomologist Frode Ødegaard was invited among several highly qualified entomologists to participate in this large-scale project in Panama. IBISCA 2003 was attended by 45 participants from 15 countries, including 23 professional entomologists, 5 professional botanists, 7 students (University of Panama) and 10 technical staff (including professional tree climbers, consultants and photographers). In addition, IBISCA 2003 enjoyed the visit of several outstanding professionals, e.g. Professor Edward O. Wilson (Harvard University), who kindly agreed to act as the official patron of the project. The project is coordinated by the Smithsonian Tropical Research Institute (STRI) and The Canopy Raft Consortium (CRC). Main sponsors of the project are Solvin-Bretzel and STRI.

*Frode Ødegaard (NINA) and Edward O. Wilson (Harvard University) attending the IBISCA-project in Panama, October 2003. Photo: S.J. Wright*

## Project goals

The main aims of the project was to study the vertical stratification and beta diversity of arthropods in a rainforest in Panama. The study sites were located in the tropical wet evergreen forest of San Lorenzo Protected Area near Colon City at the Caribbean coast. Field work concentrated on nine plots of ca. 400m$^2$, where the understorey/litter and canopy could be easily accessed. State-of-the art methods of canopy access were used, i.e. canopy fogging, canopy cranes, and canopy raft and peripherals. The different sampling techniques complement each other for the entomological study of rainforests, and this project represents the first attempt to combine them in a large-scale study. Spatial replication of the nine plots was performed during a field study of 5 weeks in September and October 2003. Seasonal replication of the sampling programme will be performed during three periods in 2004.

## Unique data set

The sampling programme generated considerable numbers of arthropods. Currently, this material is being processed, studied and databased. Our collective data matrix will summarize interactions at 9 sites between 12 sampling methods, four seasonal replicates and a yet undisclosed number of taxa and species. No comparable dataset currently exist for arthropods of tropical rainforests. Each participant will concentrate on studying the taxonomy, vertical distribution and beta diversity of 1-2 focal taxa. Frode Ødegaard is in charge of longhorn beetles (Cerambycidae) and bark beetles (Scolytinae). In the end, this will represent data on 30-40 focal taxa, representing a wide array of taxonomic diversity and life histories. Hopefully, the project will have far ranging implications for a better knowledge of the number of species on Earth, dynamics in tropical forests and conservation of biodiversity in tropical rainforests.




*The Canopy Raft is a 400 m$^2$ platform weighing 500 kg, consisting of air-inflated beams and PVC netting. A helicopter is used to lift it upon the canopy and move it between sites. Photo: R. Le Guen*

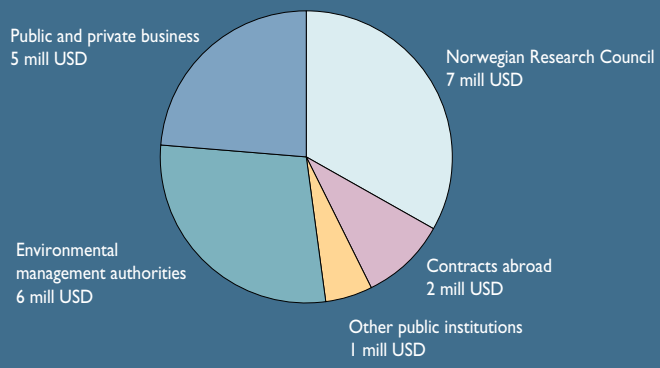
# Norwegian Institute for Nature Research NINA

**The Norwegian Institute for Nature Research** (NINA) is Norway's leading institution for applied ecological research. NINA is responsible for long-term strategic research and commissioned applied research to facilitate the implementation of international conventions, decision-support systems and management tools, as well as to enhance public awareness and promote conflict resolution. NINA employed a total of 168 staff in 2003. NINAs total operating income in 2003 was approximately 21 mill. USD.

The institute directs well-equipped laboratories and research facilities at seven locations in Norway. NINA offers broad-based ecological expertise covering the genetic, population, species, ecosystem and landscape level, in terrestrial, freshwater, and coastal marine environments.

In addition, NINA addresses a wide variety of interdisciplinary issues involving both ecologists and social scientists, and plays an important role in European and other international research activities. NINA is experienced in dealing with natural and human aspects of resource and biodiversity management in developing countries and Eastern Europe, and has actively contributed to capacity building and technology transfer by means of research cooperation and consultancy activities.

Turnover in NINA 2003




Total turnover: 21 mill USD

## NINA´s issues

NINA's expertise is directed towards basic and applied research, consultancy work, and advice to management and industry. Selected issues related to management of natural resources management and biodiversity are, e.g.:

- Land-use and nature management, including landscape analysis, in the coastal zone and on land
- Harvesting and sustainable use of game and fish stocks
- Community development and local participation in resource management
- Research on conflicts in natural resources management, e.g. large predators vs. domestic animals, wildlife vs. agriculture, and outdoor recreational activities vs. forestry, agriculture or urbanisation
- Commercial development related to biological resources
- Red-list evaluations and conservation planning
- Monitoring and time series analyses regarding natural resources
- 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

## NINA´s collaborative network in Norway and abroad:

- NODE is a multidisciplinary research and consulting consortium consisting of The Chr. Michelsen Institute (CMI) and Centre for International Environment and Development Studies (NORAGRIC), in addition to NINA.
- NINA is involved in collaborative projects and programmes with institutions in approximately ten developing countries in Central America, Africa and Asia, as well as a number of institutions in developed countries.

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