



Background

Andean rain forests rank among the most species-rich ecosystems on this planet. This richness is partly caused by, and partly threatened by, human influence. To describe and map this multitude of organisms is a tremendous task in its own right. To understand and possibly predict the consequences of the complex interactions between man and the environment is an even greater scientific assignment. It is, nevertheless, the aim of the present project to take the first modest steps along that path.

The project will be based on data and results obtained through many years of collaboration between Latin American and Danish institutions in the fields of anthropology and biology. The novel angle of this project is the close integration of applied anthropological and biological sciences. The main objective of the project is to improve strategies and recommendations for sustainable management of

diverse tropical rain forest ecosystems and for a balanced and sustainable use of the natural resources. The project focuses on the effects that different kinds of land-use and cultural pressures have on species-rich rain forest ecosystems along the Andes.

Rain forests of the Andes

The Andes and adjacent Amazonian forelands sustain a very high biological diversity and form the most important centre on earth for the current biological diversification process. The complex geology and history of the area have produced extremely varied life conditions, which are partly responsible for its biological richness. Archaeological findings, however, suggest that man has used and influenced these ecosystems for millennia. Cultural pressures therefore also represent an important factor for the understanding of the current geographical pattern of biological diversity. It has even

been suggested that by maintaining an intermediate level of disturbance certain types of human land-use may result in higher levels of biodiversity than would be expected without any human activity.

Although indigenous people usually practice good resource management, some evidence suggests that severe habitat degradation also took place, periodically, in the prehistoric past. Current interventions that degrade the ecosystems to different degrees are due to re-settlement, logging, large-scale forestry, agriculture and industrialization. Although the rural population in South America is relatively stable, social problems lead to a large degree of re-settlement. Furthermore, the development is often driven by external markets where environmental costs are externalized. This leads to large-scale forest destruction, and often a minimal or short-term yield.



The Sumaco volcano, Ecuador. Photo: H. Balslev

Background - continued

Consequences of deforestation

Deforestation leads to habitat destruction and consequently to the extinction of plant and animal species. Destruction of forest, however, does not only mean loss of biodiversity. Native people are often unable to maintain their traditional rights, and lose their homes and the natural resources that support them because habitat conversion often leads to a decline in biological productivity. In many areas, the best ways for sustainable use may be the ones practised by indigenous people, because of their perception of the environment and their profound knowledge about the uses of organisms that provide food, clothing, shelter, and medicine. Losing biological diversity involves losing future economic and survival potentials.

The most severe consequence of forest loss in many parts of the Andes, however, is loss of the regulatory role with respect to hydrology and erosion control for the densely populated areas in the mountain basins. Loss of water resources here will often have severe socio-economic consequences. According to current theories the evolution of biological diversity in mountain forests appears to be closely cor-

related with areas that were hydrologically stable despite fluctuating global climates. This close correlation between biodiversity hot-spots and areas of particular life support value for man is a crucial factor for consideration in the development of regional land-use plans.

Options for research and management

The intentions of this project are to investigate regional patterns of biodiversity and habitats as modified today by human activity, and to conduct detailed studies of human perceptions and ways to use the environment. This will include suggestions for land zoning, which identify areas where certain development scenarios must be strongly deprecated. The main objective of the project is to use and combine these data and results, and elaborate, on a regional level, recommendations for sustainable use of diverse rain forest ecosystems and for the use of natural resources on an informed basis. A multipurpose management of forest resources could secure improved conditions for the present generation, while maintaining its richness for future ones.

This goal will be pursued by a joint force of Danish and South

American institutions covering the fields of botany, zoology, anthropology, socio-economics and environmental science. The institutions and individuals involved form a strong interdisciplinary research group and represent a long history of research in the region. A large data set has been accumulated over the years and will be used for the present project.

Study region

The project will focus on a region covering the forested slopes from Bolivia to Ecuador. The main reasons for choosing this region are its very high biological and cultural diversity, and the fact that it is an area of conflict between a rapidly growing population and a fragile and highly diverse forest ecosystem. Within this region, different practical situations exist with respect to the state of knowledge, infrastructure and cultural/political reality. The diversity of the region makes it well suited to develop and test the generality of model predictions and application tools. It also makes it feasible for developing methods for management plans, where knowledge based on well-studied areas is applied in less known regions.

Project modules

The project is divided into eight interconnected and interdisciplinary modules.

1) *Project databases and GIS*

The purpose of this module is to provide all project participants with a common data base. A Geographic Information System (GIS) constitutes the heart of the system and ensures that data are stored in a common geographical framework and provides tools for analysis and modelling. Project co-ordinator: Researcher Flemming Skov,

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2) *Mapping environmental constraints*

Biological organisms as well as human beings are constrained by the physical environment. It is therefore necessary to produce maps showing the distribution of the major environmental con-

straints within the region, such as climate, topography, geology and soils, vegetation structure, major habitat types and land-use.

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Project modules - continued

3) **Mapping biodiversity based on present day knowledge and new collections**

The purpose of this module is to map the known distribution of selected groups of plants and birds within the region based on the large existing data sets (mainly from Ecuador). Existing data often show a biased view of the actual distribution of biodiversity and will be supplemented by point collection of suitable taxa to fill in current collecting gaps.

Project co-ordinator:
Associate professor Benjamin Øllgaard.
Address: see module 2.

4) **Methodologies for standardized sampling and for modelling biological distributions**

The project's aim is to provide better estimates of biodiversity for the region by:

- 1) developing methodologies for modelling biological distributions based on environmental parameters and correlation analysis with satellite imagery;
- 2) developing methodologies for standardized sampling of species richness of indicator groups (see also module 3);
- 3) producing more reliable ecological maps (estimates based on remote sensing and correlations with biological indicators).

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5) **Environmental perception, local use of natural resources, and land-use classification and mapping**

To quantify the influence that various types of cultural pressure exert on biodiversity, it is necessary to study and classify

different uses of local resources. Indigenous peoples' perception and use of local resources will be viewed in a historical perspective. Cultural influence in the region, present and past, as well as the human use of the biological resources, will be assessed and mapped.

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6) **The influence of different cultural pressures on biodiversity**

The severity of present human activity influencing the environment and its biodiversity will be studied in a number of sites with different types of land use and degradation of indigenous cultures.

Project co-ordinator:
Dr. Inge Schjellerup.
Address: see module 5.

7) **Socio-economic scenarios: Prediction of future development trends**

To anticipate future development in the region, a socio-

economic analysis on a macro scale is needed.

A number of scenarios will be analysed, describing different regional trends of development regarding population growth, forestry and agricultural economics, mining and oil industry, and eco-tourism. These scenarios will make it possible to appraise economic, ecological, as well as human consequences of different routes of development.

Project co-ordinator:
Dr. Inge Schjellerup.
Address: see module 5.

8) **Decision support tools for better planning**

A suite of decision support tools for planners, scientists and local people are needed to provide recommendations on a regional scale for a better use of natural resources using an interdisciplinary knowledge base. The term „tool“ should be understood in the widest possible sense as *the* method best suited to deliver information in a given situation, *i.e.* computer programs, printed manuals on various levels, maps, or databases.

Project co-ordinator:
Researcher Flemming Skov.
Address: see module 1.



Indians' house in the mountain forests of the eastern Andes. Photo: Inge Schjellerup.

Participating institutions

- ◆ Department of Wildlife Ecology, National Environmental Research Institute, Denmark.
- ◆ Department of Systematic Botany, Institute of Biological Sciences, University of Aarhus, Denmark.
- ◆ Department of Ethnography, National Museum of Denmark.
- ◆ Zoological Museum, University of Copenhagen, Denmark.
- ◆ Universidad Católica, Quito, Ecuador.
- ◆ Centro de Datos para la Conservación, Quito, Ecuador.
- ◆ Universidad Nacional Mayor de San Marcos, Lima, Peru.
- ◆ Museo de Historia Natural, Lima, Peru.
- ◆ Universidad Mayor de San Andrés, La Paz, Bolivia.
- ◆ Universidad Nacional de Trujillo, Trujillo, Peru.

Collaborative partners

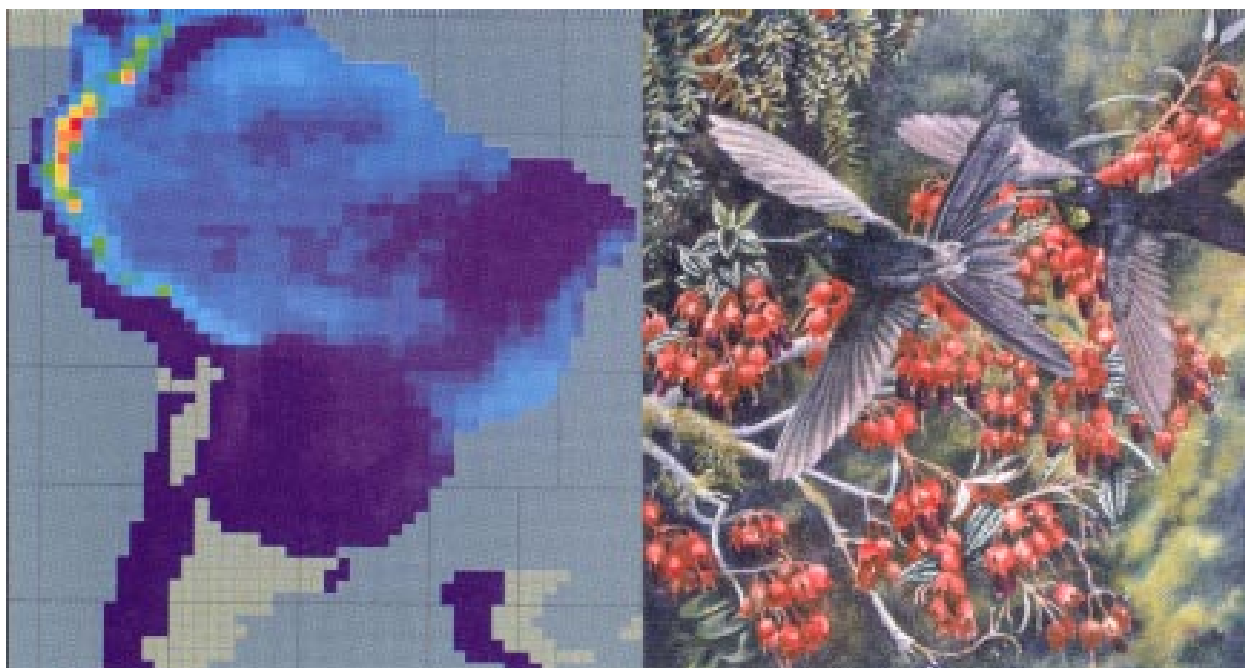
Close links are established to similar centres within the Danish Environmental Research Programme (SASA and SEREIN); DANIDA-financed ENRECA projects; and the Centre for Tropical Biodiversity which is financed by the Danish Natural Sciences Research Council. The project also collaborates with the Smithsonian Tropical Research Institute, Washington D.C., USA.

Further information

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Board of management

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- ★ Senior fellow, Dr. Inge Schjellerup, Danish Nat. Museum.
- ★ Senior lecturer Jon Fjeldså, University of Copenhagen.
- ★ Director, Alberto Padillo, Universidad Católica, Quito, Ecuador.
- ★ Dr. Niels Valencia, Museo de Historia Natural de San Marcos, Lima, Perú.
- ★ Director Emilia Garcia, Herbario Nacional de Bolivia, La Paz, Bolivia.



Left: species richness of hummingbirds. The red colour shows the highest number of species (78); the blue colour shows the lowest. Right: the hummingbird *Heliangulus zusi* is known only from a stuffed specimen from the Andes. It may now be extinct. Graphics and watercolour: Jon Fjeldså.