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# Perception of the National Park Stilfserjoch by the Local Population

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## Abstract

Several studies confirm the finding that nature conservation can not be successful without the involvement of the local population (COLCHESTER 2004; GRAINGER & GRAINGER 2003; TRAKOLIS 2001; WHITE & LOVETT 1999). Our study was conducted within the Nationalpark Stilfserjoch, which is due to its history and the very complex landscape with high human influence and wide altitude range predestined for an acceptance study (GAFTA & PEDROTTI 1997). In 2001, a representative survey of 1100 residents of the National Park has been carried out in face-to-face interviews, and acceptance has been evaluated considering ecological aspects (attitude towards natural resources and conservation), social aspects (effects of the national park on various groups of people and land use, relevance of and satisfaction with the park authorities), as well as political and economical aspects (management of protected areas, clash of economic and ecological interest).

Only 5.6% of the interviewees were against the Nationalpark Stilfserjoch, but we determined restricted support among 41% of the interviewees. By discriminant analysis, we elaborated the significant influence factors, which led to restriction of the protected area. The results exhibit a great importance of personal and general welfare. We further detect a high influence of culture and also of the attitude towards nature protection in general. With this knowledge it will be possible to develop instruments for politics and administration to increase acceptance.

## Keywords

national park, acceptance, influence factors, local population, management, nature conservation

## Study area

The Nationalpark Stilfserjoch covers an area of 134.620 ha (Fig. 1) and surrounds the entire massif of the Ortles-Cevedale group and its valleys. The Park's altitude is ranging between 650 m and 3899 m (Ortler). The conservation area borders with others (Swiss National Park, Nature Park Adamello-Brenta, Regional Park Adamello) and thus is of great strategic importance regarding its location in the centre of the Alps. The conservation area extends over two Autonomous Provinces (Bozen-Südtirol and Trentino) and one Region (Lombardia).

Because of the following reasons this National Park is predestinated for such a research: The National Park was pushed through in the year 1935 without any consultation of the population and partly against a strong objection. Besides imposing glaciers and high-altitude pastures, also low-lying valleys with extensive forests, farming areas and villages are located within the National Park. It is thus clear that conflicts arise in the contact zone between nature and managed areas. The population within the Park partly belongs to the Italian and the German speaking ethnic group. Hence also the cultural differences may affect the acceptance.

## Methods

To collect the survey questionnaire data we decided to carry out personal, face-to-face interviews to obtain a high return rate (BERNARD 1994). In spring 2001, 1100 residents were questioned within the entire National Park (400 in Bozen-Südtirol, 300 in Trentino, 400 in Lombardia). People of all municipalities belonging, at least partly, to the National Park were selected. The number of persons to be questioned per municipality was calculated in relation to the total inhabitants of the municipality and the respective proportion of area belonging to the National Park.

Contribution received at: 14.07.2005

All questions were used as independent variables in a stepwise discriminant analysis. The objective was then to analyse the influence factors for the voting behaviour of the interviewees. As dependent variable the 'Sunday question' was used: 'If you have to vote about the continued existence of the Nationalpark Stilfserjoch on next Sunday, how would you vote?'

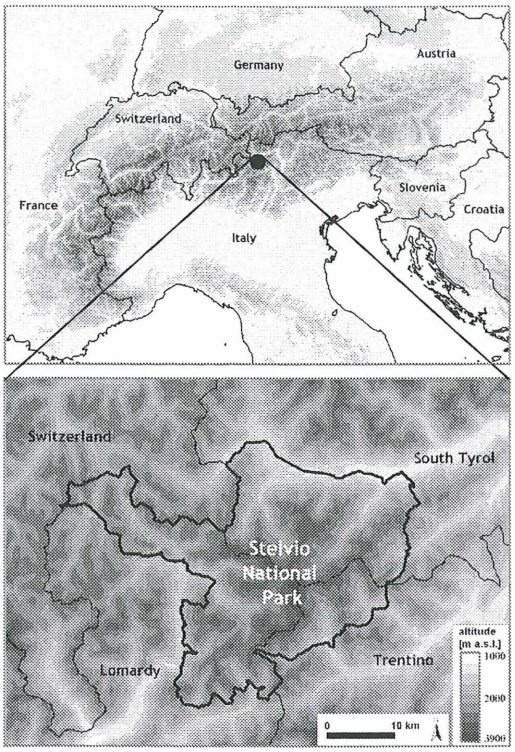


Fig. 1: Location of the Nationalpark Stilfserjoch.

## Results

Approximately half of the local population was in favor of the national park and only 5.6% did not vote for the continued existence (Fig. 2). Remarkably 41.3% of the interviewees would vote for the continued existence in case of new demarcation and zoning of the national park area. The amount of people who would abstain from voting was not taken into account for further analyses.

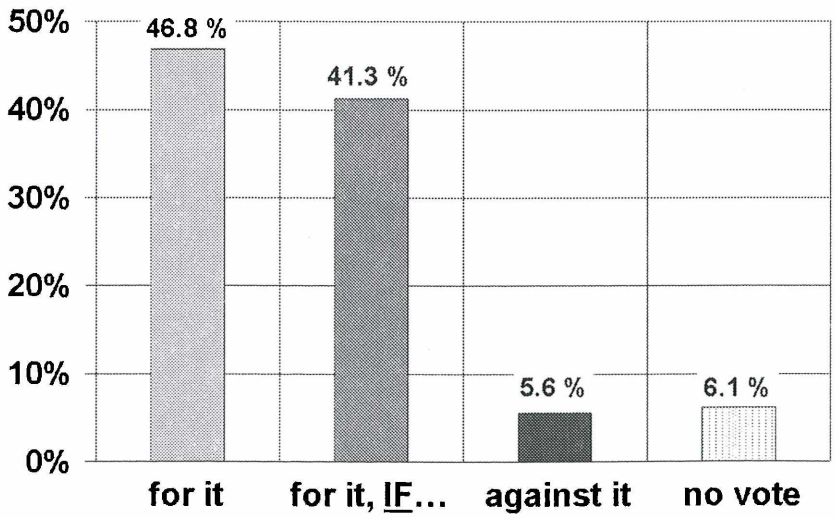


Fig. 2: Voting result to the 'Sunday question': If you have to vote about the continued existence of the Nationalpark Stilfserjoch on next Sunday, how would you vote?

Subsequently, the interviewees were classified into three groups according to their answer to this question by discriminant analysis. Altogether, 70 independent variables (answers) were available and 718 observations (interviewees) were valid for classification.

Tab. 1 exhibits that more than two third of original grouped cases were classified correctly (68.4%).

| Vote about the continued existence | | Predicted Group Membership | | |
|---|---|---|---|---|
| | | For it | For it, if.. | Against it |
| Count (%) | For it | **353 (81.0%)** | 80 (18.3%) | 3 (0.7%) |
| | For it, if new demarcation and zoning | 99 (28.6%) | **176 (50.9%)** | 71 (20.5%) |
| | Against it | 0 (0.0%) | 10 (20.4%) | **39 (79.6%)** |
| **68.4% of original grouped cases are classified correctly.** | | | | |

Tab. 1: The overall classification result of stepwise discriminant analysis using all answers as independent variables exhibits the correctly classification of 68.4% of original grouped cases. Dependent variable: 'Sunday question'

The most important influence factors for the successful separation of the groups were (1) effects on one personally, (2) effects on the population generally, (3) cultural group, and (4) reasonableness of nature protection.

## Discussion

Our results infer, that personal or general disadvantages resulting from provisions of the national park management lead to the rejection of the national park. To compromise existing problems will eliminate most doubts and is still confirmed by different administrations of protected areas (BURNS & HOWARD 2003; CONFORTI & CESAR CASCELLI DE AZEVEDO 2003; PULLIN & KNIGHT 2003). If there are no respectively accepted disadvantages for one personally and the population in general, exceeding 80% of the locals will accept the National Park Stilfserjoch. Apart from that: if not all doubts are eliminated, nearly 50% of the population would reject the national park.

Simultaneously, cultural differences must be widely considered (MEHTA & HEINEN 2001). Our results reveal that both the Italian speaking and the German speaking culture group overlap in the question of hunting and the effects on the population generally: hunt should be forbidden and negative effects must be minimized by communication and discussion. Besides, in the Italian speaking population, elder people are more skeptically than the young ones and the personal effects of the national park play the most important role. However, the German speaking population attached importance to the regulation of activities within the national park. Sensitive spots in this context were traffic, alpine pasturing, and collecting fruits.

Finally, the reasonableness of environmental protection must be communicated. Environmental education should be one of the key issues of activities within the protected area, to embed environmental protection in the consciousness of the local population (PALONIEMI & KOSKINEN 2005; DAOUTOPOULOS & PYROVETSI 1999).

Besides our results about significant factors influencing the attitude among local population, we would add another interesting aspect from the point of view of scientific research. We could proof that most people are not aware about the value of the scientific output from the national park. The results of question 3 of our questionnaire revealed, that the scientific research within a protected area/national park is only for 5.6% of the interviewees among the three most important goals, which should be pursued. Additionally, only 18.2% thought, that the reintroduction of extincted animals should be a goal. Consequently, it must further be the aim of all scientists to provide the local population and the management of protected areas with every important detail, which could strengthen a positive attitude in addition to abovementioned measures (BONAIUTO et al. 2002). Nature reserves are the hot spots to promote the value of nature.

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# Education for sustainable development in protected areas in Europe - Evaluation of educational concepts -

**Marion Leng**

## Abstract

This research project focuses on education for sustainable development, a concept fundamental to the realization of sustainable development. It analyses educational approaches taken by large protected areas in view of their potential contribution to sustainable development. As a theoretical framework, the project uses a specific educational theory. The advantage of this theory is that it allows concrete criteria to be established for assessing educational concepts in the protected areas. It includes two dimensions. The first is based on the definition of sustainable development set out in the "Brundtland Report" (WCED 1987). The second describes ways to engender active participation in sustainable development and stresses various fundamental competencies. This study combines both dimensions and sets out concrete competencies necessary for implementing sustainable development.

The study focuses on 24 large protected areas, comprising 8 National Parks, 8 Natural Parks and 8 Biosphere Reserves. The main geographical focus is on the alpine region and covers the four European countries Switzerland, Austria, Germany and France. The study is based on qualitative assessments and relies on interviews and data gathered in the protected areas. As a substantial result of the study, a kind of "manual" or "guide" will be developed which should enable protected areas to evaluate and build or extend their educational concepts with a view to education for sustainable development.

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## Keywords

Sustainable development, education for sustainable development, protected areas

## Project aims and duration

Agenda 21 states that all institutions engaged in the field of education should make a contribution to sustainable development, irrespective of whether they form part of the formal or informal educational sector. In contrast to formal education, which has already been analyzed by numerous studies, little research has been done on informal educational concepts and initiatives (i.e. education outside the classroom). This is especially true for education in large protected areas.

As set out in their objectives, education forms a central task for National Parks, Natural Parks and Biosphere Reserves. At the same time, Parks and Biosphere Reserves increasingly state their intention to actively contribute to sustainable development. But the three categories of protected areas still lack a normative standard for the realization of education *for sustainable development*. The question therefore arises whether the different objectives of protected areas are really compatible with this intention or whether they need to be adapted to more explicitly support educational aims. Here the study wants to make an essential contribution.

As a substantial result of the study, a kind of "manual" or "guide" will be developed which should enable protected areas to evaluate and build or extend their educational concepts with a view to education for sustainable development.

Work on the project started in January 2004 and will probably be completed by the end of 2006.

## Study area

The study focuses on 24 large protected areas, comprising 8 National Parks, 8 Natural Parks and 8 Biosphere Reserves. Since these categories conform to international standards set out by the IUCN and EUROPARC, international comparison is simplified. The main geographical focus is on the alpine region and covers the four European countries Switzerland, Austria, Germany and France.

Contribution received at: 18.07.2005

## Methods

The study is based on qualitative assessments and relies on interviews and data gathered in the protected areas. The survey is carried out in two stages. The first is a content analysis of documents relevant in the educational context of the park. The second is personal interviews with experts and actors engaged in education in the protected areas.

For analysis, categories are required to measure the implementation of education for sustainable development. A first set of categories is established on the basis of the theoretical framework concept. During the course of the survey these are modified and fine-tuned in response to the data gathered.

## Results

The following hypotheses reflect the actual state of the study and the tendencies that have so far become apparent. They will have to be verified by the data.

Independent of the category of protected area (National Park, Natural Park and Biosphere Reserve), all protected areas have a clear intention to contribute to sustainable development. However, there is considerable variety in their definition of sustainable development, ranging from an exclusively ecological point of view to a more comprehensive idea that focuses on the interdependencies of the ecological, socio-cultural and economic dimensions. The contribution a protected area perceives to sustainable development is often influenced by the circumstances that let to its foundation. Even if global aspects of sustainable development do not feature amongst the specific aims of a protected area, they nevertheless include these global aspects as an implicit part of their vision. Their understanding of sustainable development is really that of sustainable regional development. According to this, the global aspect is not an explicit topic within the educational aims of the parks.

Generally, understanding the concept of sustainable development is of fundamental importance for understanding and implementing education for sustainable development. But the general aims of protected areas to contribute to sustainable development and to provide education still lack a close connection. Instead of referring to one another, the different aims seem to be pursued independently, which means that potential synergies are lost. Protected areas are often very good at initiating and managing innovative projects that can be judged as important steps towards sustainable development in the regional context. As examples of guiding principles of sustainable development, these should be integrated much more in the educational field in future.

## Discussion

In addition to scientific research that is done *on* protected areas, research initiated *by* the protected areas themselves should receive much more recognition as a relevant contribution to future environmental science.

Research is one of the most important potentials of protected areas. Protected areas especially Biosphere Reserves are regarded as privileged places of research in the environmental field. Results of research obtained in such small areas can be regarded as models for a wider geographical context.

For the local and regional population, research in protected areas can be a starting point for actively shaping their future. It contributes to a better understanding of the natural and socio-cultural environment and produces and pushes innovative processes. If possible, research should therefore be included more prominently in the planning and management of protected areas.

Communication of results is a key condition of socially relevant research in protected areas. Results should be communicated on two levels: firstly, within the protected areas themselves in order to initiate further innovation, and secondly on a national and international level to support networking with other protected areas.

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# Alpine Habitat Diversity - HABITALP
# Towards an integrated spatial development in the Alpine Space

**Annette Lotz**

## Abstract

The preservation of natural and cultural landscape diversity is an essential demand of the Alpine Convention. The protected areas of the Alpine Space are the preservation centres for the most precious habitats and an important part of the European NATURA 2000 network. The preservation tasks for these habitats (e.g. European Habitat Directive) require transnational strategies and applications integrating the different national approaches on the basis of a common landscape dataset.

Based on colour infrared aerial images HABITALP will contribute to the integrated spatial development in the Alpine Space by developing standardized methods for the census and analysis of landscape diversity.

Under the leadership of Berchtesgaden National Park these methods will be applied to 11 protected areas of the Alpine Space and allow for a common vision on surveillance and management questions. The resulting comparable landscape datasets and their accessibility through a common alpine database will create a considerable potential for further transnational activities. The standardization of methods will enable both repeated application for monitoring purposes and transfer to further alpine areas.

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## Keywords

Alpine Space; Alpine Convention; landscape structure; habitat diversity; European Habitat Directive; NATURA 2000; habitat monitoring; transnational database; landscape management; sustainable spatial development

## Project aims and duration

The major HABITALP objective is to develop and to apply within the same project repeatable methods for the standardized census and analysis of landscape datasets in 11 alpine protected areas. Both methods and results are aimed to contribute to the Alpine Convention and the European Habitat Directive. They will set an important basis for further transnational activities in the Alpine Space or other high mountain areas. The project has been scheduled for four years and will end in October 2006.

## Area of study

The study area comprises 11 protected areas situated in five different countries throughout the Alpine Space: in France Parc National des Écrins – Parc National de la Vanoise – ASTERS Conservatoire des Espaces Naturels de Haute-Savoie, in Italy Autonome Provinz Bozen – Parco Nazionale dello Stelvio – Parco Nazionale Gran Paradiso – Parco Naturale Mont Avic – Parco Nazionale Dolomiti Bellunesi, in Switzerland Parc Naziunal Svizzer, in Austria Nationalpark Hohe Tauern and in Germany Biosphärenreservat Berchtesgaden.

Contribution received at: 07.08.2005

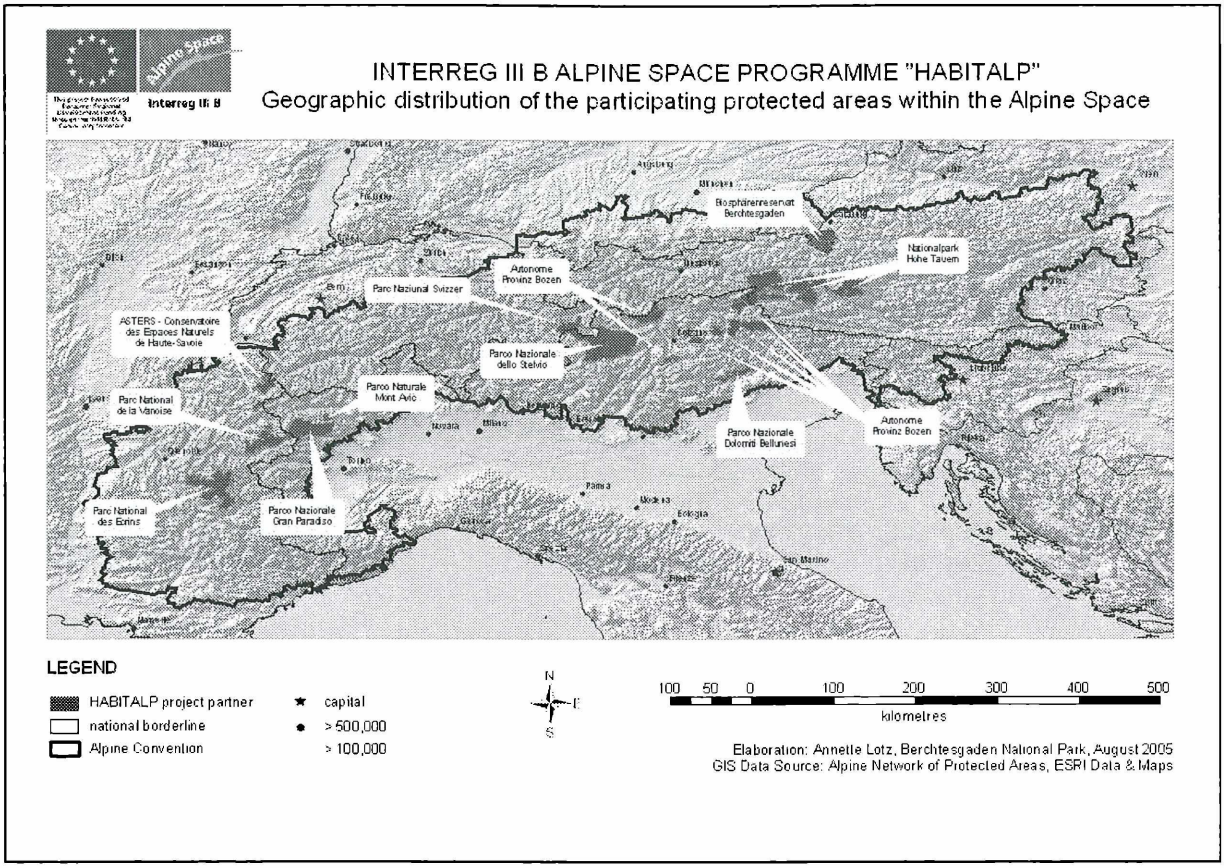


Fig. 1: Distribution of HABITALP partner areas throughout the Alpine Space

## Methods

Technical project activities started with the organisation of flights for the participating protected areas and the census of their surface by colour infrared aerial photographs. Landscape structure is presently determined by the interpretation of the available digital aerial images.

The interpretation is done by a hierarchical habitat classification code which has been developed for this kind of aerial images by specialized authorities in Germany. This code has already been successfully applied to Berchtesgaden and Hohe Tauern National Parks within an INTERREG II A project. HABITALP will now achieve a considerable enhancement of the previous method as well as the transfer from the eastern Alps to further protected areas in the central and western Alps. Due to the high diversity of alpine habitats in the project area numerous extensions of the present habitat key were expected.

Based on the interpretation data common methods for defining the relationship between HABITALP and NATURA 2000 habitats, the possibilities of their surveillance (long term monitoring) and the diversity of the landscape are presently developed. All data will be compiled in an extendable transnational spatial database which can be accessed by internet.

An ambitious objective of HABITALP is to achieve a high degree of standardization for the 11 alpine landscape datasets. From the very beginning this objective implies a most thorough collaboration on technical details within the entire project group. The benefit of standardization is the comparability of the datasets. This is an indispensable prerequisite for comparative studies and common transnational strategies.

A specific characteristic of the HABITALP project is that all project partners contribute to all work packages and that the subsequent work packages are based upon the results of the preceding ones. Furthermore the heterogeneity of project partners with regard to their different languages and states of previous experiences is comparatively high. Due to this complex project structure special emphasis had to be put on precise communication of technical issues and exchange of available know how. The Alpine Network of Protected Areas as an integrative part of the project community provided intense support.

## Midterm results

The first step towards alpine standardization was the set up of technical tender specifications in three project languages for the flight parameters and the production of digital ortho-photos. It was followed by the development of a common interpretation key which can describe all habitats occurring in the partner areas (see also publication DEMEL & KIAS in this volume). The harmonized application of the delimitation and interpretation methods by all project partners is ensured by the common training of the local interpreters and the production of alpine reference documents in the three project languages (interpretation key and guidelines for its application).

Another innovative result of the HABITALP project will be the transnational spatial database. Compared to other existing databases the HABITALP database does not compile the mere references to available datasets but the data itself. This is a question of appropriate treatment of huge data amounts and their accessibility by internet. Set up and installation of the database were realized through a cooperation between the University of Applied Sciences in Weihenstephan (confer publication DEMEL & KIAS) and the Swiss National Park.

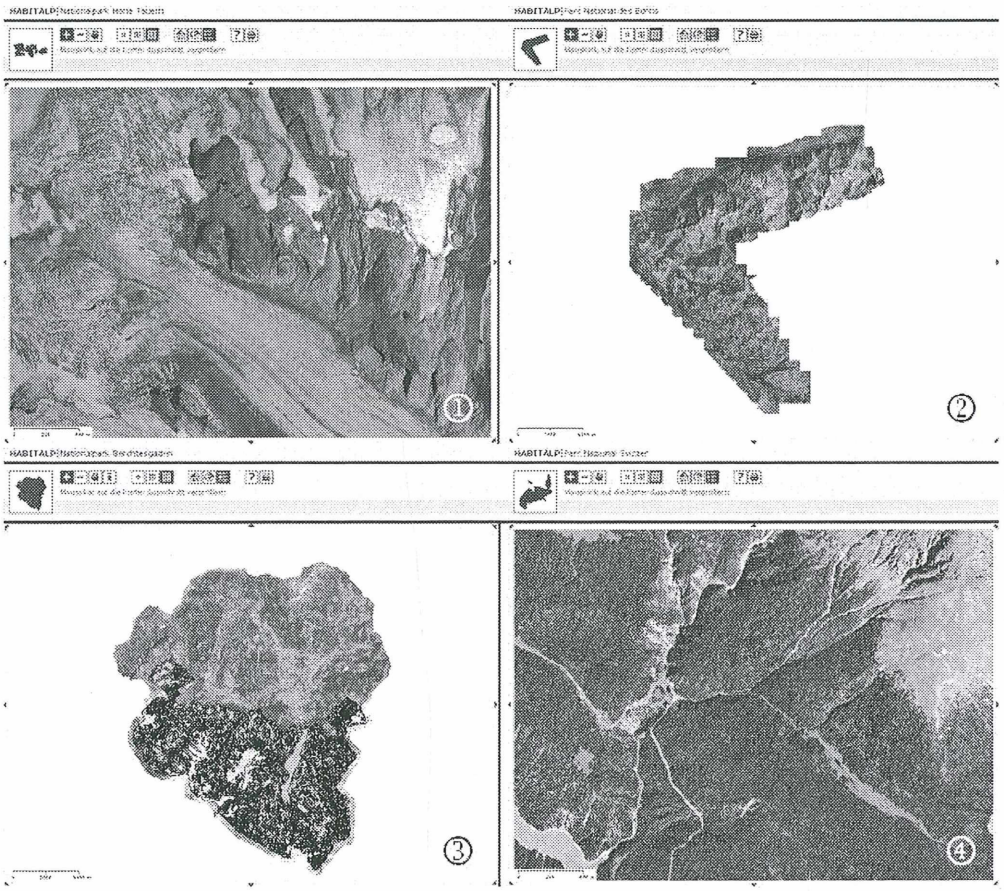


Fig. 2: Screenshots of HABITALP transnational spatial database. Digital orthophotos of Nationalpark Hohe Tauern 1:10.000 (1), Parc National des Écrins 1:150.000 (2), Nationalpark Berchtesgaden 1:150.000 with interpretation data (3), Parc Naziunal Svizzer 1:10.000 (4).

Project implementation showed that the terminology of many technical fields is too specific to be well understood in the English language. Therefore the highly ambitious technical project aims require a considerable oral and written translation effort. All major technical references are translated into the project languages and major conferences are supported by professional oral translators. This communication structure could only be realized thanks to the support of the Alpine Network of Protected Areas.

In order to treat the huge amount of data and documents created in four languages a specific management and scientific coordination system was established on alpine, regional and local project levels. The regional level allows for the aggregation of scientific questions and supports the alpine integration of local characteristics. Major emphasis is put on vertical and horizontal exchange between and within these project levels.

## Discussion

Some difficulties were encountered to realize flights because of weather conditions. Based on the temporal constraint to accomplish data census, evaluation and sophisticated analyses in the same project these difficulties will affect the maximum of achievable results within the available project duration. However the approach itself is not put into question (see publication Demel & Kias).

From the present point of view the integration of the extremely heterogeneous local specifics into one common transnational and multi-lingual result is considered the most demanding objective of the project both on technical and administrative level. Considerable time was needed to establish a well working management and coordination system which can cope with the development of sophisticated methods and their subsequent application within the temporal project constraints. The permanent revision of the alpine reference documents in the course of integration and their simultaneous application impose a special complexity on the implementation. Furthermore the achievable degree of standardization is subject to many influences and deserves a more detailed discussion.

But it is exactly this kind of difficulties that explain why the HABITALP database represents an enormous added value for the accessibility of high precision landscape data and an essential and innovative step towards an integrated and sustainable spatial development of the Alpine Space.

The availability of standardized and transnational landscape data allows for manifold thematic analysis far beyond the simple identification of habitats and numerous further applications beyond the project. Spatial and statistic analysis are equally possible and allow for various cartographic products.

The HABITALP landscape diversity and NATURA 2000 studies represent just two fields of application that will provide an interesting outlook on the potential that HABITALP habitat data can offer both to local and alpine applications in landscape management. This classifies HABITALP a pilot project in this field.

As an effect of a strengthened network of alpine partners and a more profound awareness of alpine identity the project's long term impacts can be a gradual upgrading of transnational land use management and innovative strategies for transnational planning and control instruments.

## Special discussion in the light of the ALPENCOM symposium

Scientific research in protected areas has to keep pace with the global development which demands a more and more intense exchange between disciplines and countries.

Alpine protected areas are even more intensely unified by belonging to the same biogeographical region. The implementation of transnational obligations like the Alpine Convention causes a flood of heterogeneous data to be evaluated for common strategies.

It needs highly ambitious projects like HABITALP to tackle the question of standardization, the integration of local data and its aggregation to a level that can serve as basis for political decisions. This requires a close and interdisciplinary cooperation of managers and researchers to find out about the practical demands of the protected areas and to deliver the appropriate results. HABITALP tackles this objective by modelling landscape diversity and finding out about the use of aerial image habitat data to NATURA 2000 identification and monitoring.

HABITALP in the present state is still a highly technical project and difficult to explain to the non-scientific public. However once publicly relevant management decisions have been taken on the basis of HABITALP data a more general public can be expected to take notice of the importance of high precision digital habitat data. As the HABITALP approach supports not only the preservation of natural but also of cultural landscape diversity socially relevant impacts of management decisions are imaginable as well.

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# Pollutant-related mapping of lichens on the Integrated-Monitoring-site Zöbelboden in the Reichraminger Hintergebirge, Oberösterreich, Austria

**Wolfgang Mayer, Roman Türk**

## Abstract

An intensive research station of the Federal Environmental Agency for Air Quality Control is situated at Zöbelboden in the Reichraminger Hintergebirge. After a basic study in 1993, a repeated investigation of epiphytic lichens was carried out in 1999. Samples of lichen vegetation on a total of 81 trees were taken by various methods and evaluated in regards to pollution levels. This study will be repeated again in summer of 2005.

A comparison of the species found during the pollution related mapping study with the potential lichen vegetation shows a severe reduction in epiphytic lichen vegetation on the sample trees in the biomonitoring project area. Macrolichens frequently show clear limitations in vitality. While the coverage of nitrophilic and toxitolerant species increased, the coverage of more sensitive species was reduced.

A multifaceted analysis was also carried out on the results of 1999. On the whole, there has been a measurable decrease in air quality in the period between 1993 and 1999.

## Integrated monitoring and research area

Since 1992 the Federal Environment Agency Austria for Air Quality Control runs a research station for measuring the air quality at the Zöbelboden in the National Park Kalkalpen. This station is part of the Trans-European network Integrated Monitoring, which investigates the long term effects of long range air pollutants originating from wide areas of Europe and other parts of the northern hemisphere. The minimum study areas have a size of 1 $km^2$, in which the pollutant input and its long term effect on the concerned ecosystems are monitored. The air pollutants are measured continuously, while the specific research on the effects on the diverse parts of the ecosystems is carried out periodically. The Zöbelboden was chosen as research area as an ECE Integrated Monitoring site because it is situated in the north exposed Calcareous Alps, where the polluted air streams coming from North-West are dammed up (HOFMANN 1996, TÜRK et al. 2001).

## Material and Methods

The first pollutant related mapping study on the Zöbelboden was carried out 1993 by Hofmann. This study was repeated in 1999 by TÜRK et al. (2001). A further study will be carried out in summer 2005.

In 1993 Hofmann did relevés on 70 marked trees and he registered the cover and the frequency of crustose, foliose and fruticose lichens according to the method of HOFMANN (1992, 1993). He assessed coverage, size of the thalli and the area of the damaged part of the lichens growing on the best covered part of the stem in a defined altitude of the stem.

The repeated mapping study in 1999 was expanded by using the methods of TÜRK & ZIEGELBERGER (1982) and the VDI-Guideline 3799 (1995). To find the areas of relevés on the bark in further studies, the top left hand corner was marked by coloured pins. A multifaceted analysis was carried out on the basic data of the results.

## Results and Discussion

At the mapping studies in 1999 in total 99 epiphytic and epixylic lichen taxa were found. This high number of species is caused by favourable conditions of humidity. Also the high amount of dead woody litter increases the diversity of lichens. According to the list of threatened lichens of TÜRK and HAFELLNER (1999) there are many endangered and heavily endangered species. The species inventory corresponds to the climatic conditions in the kolline and montane step of the Northern

Contribution received at: 04.08.2005

Calcareous Alps. On many specimens of macrolichens a reduced vitality is recognizable on an unusual change of colour and on reduced growth.

The distribution of the lichen species in the mapping area and its surroundings shows significant differences between windward and leeward situation of the ridges. In sheltered areas with only a slight effect of the air pollutants is the potential lichen flora developed, whereas in the exposed sites of the monitoring area the diversity of lichens is reduced. Comparing the results between 1993 and 1999 a deterioration of the vitality of lichens and a reduction of the coverage of sensitive species could be observed, whereas toxitolerant species increased the coverage and abundance. The presence of nitrophilous lichens like *Melanelia glabratula* and *Hypotrachyna revoluta* indicates a permanent eutrophication of the bark by air pollutants. Also the coverage and the vitality of the more or less acidophiytic *Hypogymnia physodes* decreased between 1993 and 1999. According to the sheltering effects caused by the orographic position of the areas zones with different pollution levels were found. The areas of the plateau on the top of the Zöbelboden was slightly polluted, the basic slopes were strongly polluted. Unpolluted areas could not be found. The same air load as 1993 was detectable at 40 % of the sites in 1999, at 54 % of the sites a deterioration.

The investigations at the Zöbelboden are an example for advanced science in a National Park. The previous and present results have a national and international significance because they clearly demonstrate the development of the air quality in Central Europe and in the edges of the northern parts of the Eastern-Alps. The registration of the lichen flora in the complete area of the National Park Kalkalpen would be a great support for the interpretation of the results of the pollutant-related investigations on the lichen vegetation in the Zöbelboden.

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# Trout Exam-Invest

# The resettlement of the Danubian clade of brown trout in the region of the National Park Hohe Tauern

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## Abstract

'Trout ExamInvest' is a project funded by the EU, local governments and private sponsors. Partners are the Department of Zoology and Limnology, Research Centre for Agriculture and Forestry Laimburg, National Park Hohe Tauern, Alpenzoo Innsbruck

Most Austrian waters belong to the Danube drainage system. Autochthonous trout is therefore expected to be of Danubian mitochondrial haplotype. During an extensive search for autochthonous brown trout six populations of homogenous Danubian haplotype could be found.

Successful reproduction of the population from the Anraser See (2538 m) was the basis for stocking experiments. Twenty seven months after stocking a high mountain brook as well as a lowland brook the recapture rate was much higher in the high mountain brook. In addition, growth rate of fish in the high mountain brook by far exceeded the growth rate of brown trout in the lowland brook. This indicates that fish reproduced from relic population like that in Anraser See are well adapted to high Alpine areas and ideal for restocking of remote waters like that in the National Park Hohe Tauern.

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## Keywords

brown trout, autochthonous, genetic analyses, reproduction, stocking, monitoring

The project started in 2002 and will last until 2008. Aim of this project is to trace relic populations of brown trout, to secure their survival, and to create brood for stocking.

## Introduction

During the last ice-age the European river systems have been formed. After glacier retreat the emerging rivers have been colonised by brown trout, *Salmo trutta*. Nowadays at least five genetically distinct lineages of brown trout are found (BERNATCHEZ 2001). The major part of Austrian water bodies belong to the Danubian drainage system and it may be assumed that most autochthonous populations of brown trout in Austria belong to the Danubian clade (WEISS et al., 2001). In the Middle Ages man started to stock brown trout from the rivers in fishless lakes and brooks.

Beginning in the late 19$^{th}$ century trout populations began to decline due to the destruction of natural habitats by human activities. As a consequence intensive stocking activities were initiated. However, most of the stocked brown trout belonged to the Atlantic lineage. Furthermore, American species, namely the rainbow trout, *Oncorhynchus mykiss*, and brook trout, *Salvelinus fontinalis*, have been introduced. This introduction of allochthonous material led to altered population structures in most Austrian waters (LARGIADÈR & SCHOLL, 1996; OSIMOV & BERNATCHEZ, 1996; HANSEN et al., 2000; WEISS, 2000, 2001; DUFTNER et al., 2003).

Only in a few remote lakes and rivers descendants of the ancient populations survived until now. The InterregIIIA-project 'Trout Exam-Invest' aims to locate these indigenous populations of brown trout, to reproduce them and to build up autochthonous brood stocks.

Contribution received at: 20.07.2005

## Searching for autochthonous trout populations

Promising waters where selected by the following criteria: being remote, being separated from larger rivers by a barrier preventing the entrance of possibly stocked trout, and the absence of a stocking record during the last decades. 20 to 30 brown trout from each of these lakes or brooks where caught and a small piece of the anal fin was preserved in ethanol for genetic analyses. The fish were marked individually with visible implant tags and released. So far, genetic analyses of the samples revealed seven populations with haplotypes belonging to the Danubian lineage in Tyrol and Salzburg (based on the complete sequence of the mitochondrial control region). Within the area of the National Park Hohe Tauern sixteen brooks and three high mountain lakes were surveyed for autochthonous brown trout populations

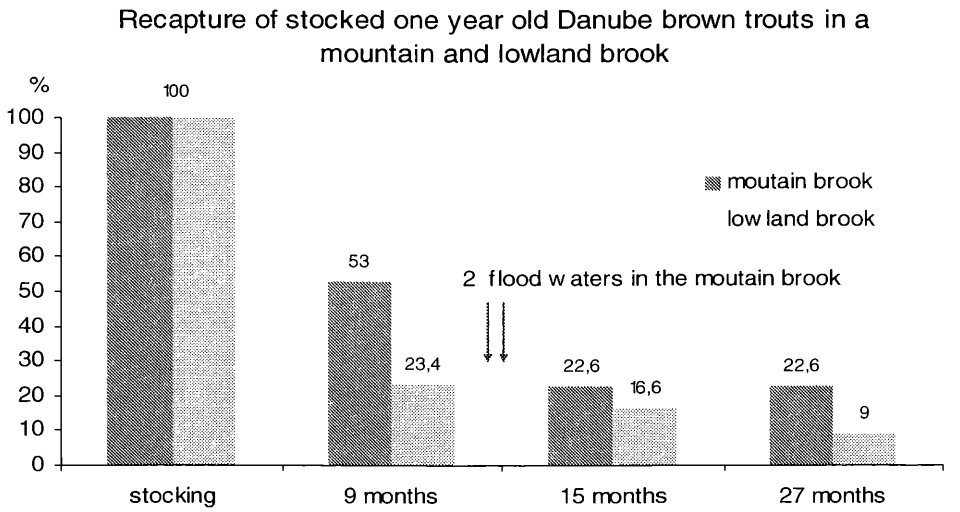
## Stocking experiments

The criteria adopted to identify brooks to search for autochthonous populations were also used to identify brooks for stocking, expanded by the requirements for enough food, high structural diversity and habitats for all developmental stages.

The fish from the lake Anraser See where among the first being identified as an autochthonous brown trout population (DUFTNER et al. 2003). Successful breeding of these fish at the Institute of Zoology and Limnology (Innsbruck University) provided the opportunity for first stocking experiments. Two different brooks where stocked with one year old fingerlings, the Kristeinbach (a high mountain brook at about 1,620 m a.s.l.) and the Fohlenhof Laue (a low land brook at 620 m a.s.l with slowly flowing water). The field-experiment lasted for 27 months.

Fish from the Fohlenhof Laue were of week condition during the entire period and the total number of recaptured fish declined steadily. In contrast, the fish in the colder Kristeinbach showed excellent growth. Despite two flood waters, at the end of the experiment 22% of the stocked animals could be recaptured in the same section of the brook where they have been released (Fig. 1).

Fig. 1:




Percentage of fish recaptured after 9, 15 and 27 month after stocking in a mountain and lowland brook.

The high proportion of recapture and good growth rate of the Danube brown trout in a mountain brook shows that these fish are well adapted to rough environmental conditions while those released in a lowland river appear to be less competitive compared to brook and rainbow trout and brown trout of Atlantic origin (Tab. 1).

## Discussion

Brown trout embodies the history of a typical European fish. Therefore, the continuous disappearance of local populations and the efforts to stop this trend lead to a high interest not only by fishermen but also by the general public. This was demonstrated by several contributions in professional journals, local newspapers, as well as in national and international TV programmes. Autochthonous brood stocks are required to counteract the import of foreign material. The growing interest even in very specific approaches assures and increases the socio economic value of natural sanctuaries.

Growth of stocked yearlings

Mountain brook

| | stocking | | | after 9 months | | | after 15 months | | | after 27 months | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Lt cm | Wt g | Kf | Lt cm | Wt g | Kf | Lt cm | Wt g | Kf | Lt cm | Wt g | Kf |
| mean | 17,3 | 52,6 | 1,0 | 19,4 | 70,9 | 0,9 | 20,9 | 85,9 | 0,9 | 23,5 | 136,8 | 1,0 |
| max | 19,7 | 80,0 | 1,2 | 22,8 | 118 | 1,2 | 23,9 | 138 | 1,0 | 26,8 | 226 | 1,2 |
| min | 14,3 | 29,0 | 0,8 | 17,2 | 44 | 0,8 | 18,5 | 53 | 0,8 | 21,4 | 98 | 0,9 |
| growth | | | | 2,1 | 18,3 | | 3,6 | 33,2 | | 6,2 | 84,2 | |

Lowland brook

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mean | 15,6 | 38,6 | 1,0 | 16,1 | 33 | 0,8 | 17,4 | 41,4 | 0,8 | 18,9 | 62,0 | 0,9 |
| max | 20,9 | 96,0 | 1,2 | 18,8 | 48 | 1,0 | 19,3 | 60 | 0,9 | 21,4 | 94 | 1,0 |
| min | 10,2 | 10,3 | 0,8 | 12,8 | 15 | 0,5 | 14,0 | 21 | 0,6 | 15,4 | 33 | 0,8 |
| growth | | | | 0,5 | -5,5 | | 1,8 | 2,8 | | 3,3 | 23,4 | |

Lt = total length, Wt = weight, Kf = condition coefficient

Tab 1: Allometric data and growth of the stocked fish in the Fohlenhof Laue and Kristeinbach.

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# The use of molecular markers for the characterisation and rehabilitation of indigenous trout populations in the Central Alpine region

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## Abstract

The brown trout (*Salmo trutta* L.) represents one of the most differentiated vertebrate species. However, human activities such as habitat alteration, overexploitation and introgression of non-native hatchery fish led to an alarming reduction of population variability. This is particularly evident for vast parts of the highly fragmented alpine area. Because of these facts the Interrreg IIIA-project "Trout-Examinvest" was initiated in order to achieve the following goals:

- Genetic characterisation of local trout populations
- Identification of potential autochthonous populations
- Establishment of indigenous hatchery strains for conservation management

In the framework of our project two molecular techniques were applied: (i) sequence analysis of the complete mitochondrial DNA control region and (ii) analyses of a number of variable microsatellite DNA loci. As was shown in previous studies, mitochondrial DNA revealed to be a useful tool in the screening of frequencies and distribution patterns of the major trout lineages. On the other hand, microsatellite DNA data delivered more detailed information about within-population genetic diversity and population structure as well as about hybridisation between native and introduced trout lineages. Based on these findings we point to the necessity of using a combined approach of molecular analyses to select and establish indigenous trout breeding strains for future stocking and repopulation measures.

## Keywords

Brown trout, Marble trout, *Salmo trutta* L., *Salmo (trutta) marmoratus* C., microsatellite DNA, mitochondrial DNA

## Introduction

The brown trout, *Salmo trutta* L., represents a typical element of the Eurasian fluviatile fauna. It is characterised by high degrees of morphological and ecological plasticity including landlocked as well as migratory life-history forms. In the last decades many local populations have been affected by human influences, such as habitat degradation, overexploitation and the introduction of domesticated hatchery reared trout strains. The severe threat status of a number of brown trout populations throughout Europe was underlined in several studies based on ecological and genetic data (e.g. GARCIA-MARIN et al. 1991; RUZZANTE et al. 2001). Despite the fact that fish species in the alpine region are often restricted to island-like habitats and are thus particularly vulnerable to anthropogenic disturbances, there is only limited information about the genetic composition and the actual endangerment of local trout populations in this area (WEISS et al. 2001; DUFTNER et al. 2003). For this reason the Interreg IIIA-project "Trout-Examinvest" was started as a common initiative of the Research Centre for Agriculture and Forestry Laimburg (South Tyrol, ITA), the Department of Zoology and Limnology at the University of Innsbruck (AUT), the Alpenzoo Innsbruck (AUT) and the Nationalpark Hohe Tauern (AUT). The main goals of the sub-project being carried out at the Research Centre Laimburg are to (i) genetically characterise the local trout populations in the Italian province of South Tyrol (marble and brown trout) and the Austrian provinces of Tyrol, Salzburg and Carinthia (brown trout only), (ii) to identify potential autochthonous trout populations and (iii) to give scientific support for the establishment of indigenous hatchery strains for future rehabilitation programs.

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## The use of molecular markers for conservation management of local trout populations

In the present study two different molecular approaches have been applied: sequence analysis of the entire mitochondrial DNA control region and analysis of variable microsatellite DNA loci.

Analysis of mitochondrial DNA is widely used in phylogenetic, phylogeographic and population genetic studies because of its relatively high degree of variability, the absence of recombination and its rather simple applicability (reviewed in MORITZ 1994). Previous studies analysing highly variable regions of the mitochondrial genome of the brown trout identified five major mitochondrial DNA lineages distributed in different areas of Europe (reviewed in BERNATCHEZ 2001). These studies also demonstrated the impact of fish translocation on local trout populations, which was either caused by unintentional escapes from fish farms or by stocking activities with domesticated trout strains (e.g.: GIUFFRA et al. 1994; HANSEN et al. 2000). Similar findings were also made in our study area in the Central Alpine region, where most of the analysed populations displayed a variable number of individuals with mitochondrial DNA haplotypes belonging to the non-indigenous Atlantic clade, of which some were characteristic for hatchery reared trout strains. In contrast, we identified few unaffected populations in remote creeks of the Northern Alps (see also DUFTNER et al. 2003). Nevertheless, mitochondrial DNA sequence data were an insufficient tool to assess possible hybridisation events between native and introduced trout lineages, since mitochondrial DNA is strictly maternally inherited and thus gives no information about the paternal ancestor (DEGNAN et al. 1993; AVISE 1998).

Therefore, it is necessary to analyse nuclear markers in parallel. Microsatellites are simple tandemly repeated DNA sequence elements exhibiting a high degree of variability based on differences in allele size (i.e. number of repeats per allele). Currently, these markers are widely applied for the identification of individuals, for parentage and pedigree analyses as well as population genetic studies. In addition, microsatellite data were shown to be an efficient tool for addressing past and recent hybridisation events (HANSEN et al. 2001). In our study the analysis of allele frequencies investigated at twelve microsatellite loci by using a Bayesian individual assignment approach (PRITCHARD et al. 2000) revealed varying degrees of genetic introgression of non-indigenous trout lineages into native populations. However, by combining microsatellite and mitochondrial DNA data with information about the colour patterns of single fishes, it was possible to identify pure autochthonous individuals even within hybridised marble trout populations.

Without doubt, the use of a combined approach including different molecular markers and sophisticated data analysis methods will serve as an important tool for the elaboration of conservation management strategies. However, in order to ensure long-term survival of indigenous trout populations, solely scientific efforts will not be sufficient. Therefore, genetic assessments should be part of a broader management framework, involving fisheries practitioners as well as policy-making institutions and local conservation initiatives.

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# Monitoring of visitor flows and visitor needs as a basis for protected area management

**Andreas Muhar, Arne Arnberger, Christiane Brandenburg**

## Abstract

The objective of this paper is to discuss the research and management needs for monitoring of recreational uses in protected areas, to provide an overview of visitor monitoring methods and to demonstrate their practical application in systematic monitoring programs for three specific protected areas with different character, Dürrenstein Wilderness Area, IUCN Cat. Ia/b, Donau-Auen National Park, Cat. II, and Wienerberg Protected Landscape, Cat. V.

Options for data analysis are discussed using three examples: Analysis of trail use intensity, forecast of visitor numbers based on the weather situation and the day of the week, and identification of the social carrying capacity of an urban protected area.

## Introduction

Scientific research and monitoring programs in Alpine protected areas, in particular in national parks, frequently focus on ecological aspects such as vegetation and wildlife. Compared to that, social aspects of park management, such as recreational uses, are not equally recognised as essential components of a research program. Very often, recreational uses of protected areas are, if at all, only investigated with regard to the ecological carrying capacity of the site, but usually not included in a comprehensive research and monitoring framework, which also considers the various social aspects of recreational uses, such as the social carrying capacity, spatial and temporal displacement behaviour as a consequence of crowding, and inter-group conflicts.

Systematically acquired quantitative and qualitative information on recreational use can be relevant for various different aspects of protected area management (HORNBACK, EAGLES 1999, MUHAR, ARNBERGER, BRANDENBURG 2002, CESSFORD, MUHAR 2003), such as:

- Identification of the social, economic and political significance of the recreational uses
- Identification of relations between use levels and physical and social impacts
- Evaluation of visitor compliance with use regulations
- Identification of problem spots within the protected area
- Minimisation of conflicts between user groups
- Identification of demand trends and generation of forecasts of visitor numbers and visitor activities
- Definition of design standards for visitor facilities
- Provision and allocation of infrastructure and services

Currently there is hardly any standardisation of visitor monitoring schemes throughout the various protected areas in Europe, therefore it is very difficult to compare results from individual areas.

## Monitoring methods

A large number of methods for quantitative and qualitative monitoring of recreational uses in protected areas is available (see Tab.1). The choice depends on the data needs for visitor management and on the specific situation on-site, which may include aspects such as energy supply, susceptibility to vandalism or service intervals. Some methods such as video observation may also interfere with the visitors' privacy and will therefore not be appropriate in some remote areas.

Contribution received at: 15.07.2005

| monitoring methods of recreational uses | | | visitor numbers | direction of motion | routes | spatial distribution | group size | visitor characteristics (age, sex) | visitor characteristics (origin, motivation etc.) | visitor behaviour |
|---|---|---|---|---|---|---|---|---|---|---|
| direct methods | interviews | oral interviews | | | x | x | x | x | x | x |
| | | written interviews | | | x | x | x | x | x | x |
| | direct observation | roaming observers | (x) | (x) | (x) | (x) | (x) | (x) | | x |
| | | fixed counting stations | x | x | | x | x | x | | (x) |
| | indirect observation | automatic cameras | x | x | | x | x | (x) | | x |
| | | time-lapse video | x | x | | x | x | (x) | | x |
| | | aerial, satellite imagery | (x) | (x) | (x) | (x) | (x) | | | |
| | counting of access permits | tickets sold | x | | | | | | | |
| | | permits issued | x | | | | x | | | |
| | counting devices | turnstiles | x | (x) | | | | | | |
| | | photoelectric counters | x | (x) | | | (x) | | | |
| | | pressure sensitive mats | x | (x) | | | | | | |
| | | pneumatic tubes | x | (x) | | | | | | |
| | | inductive loop sensors | (x) | (x) | | | | | | |
| | self-registration | trail registers | x | x | (x) | | x | | | |
| | | summit books | x | x | x | | x | | | |
| | | hut registers | x | x | x | | x | | | |
| | | GPS-tracks | | x | x | | | | | (x) |
| indirect methods | mapping of traces of use | garbage | (x) | | | (x) | | | | |
| | | trail deterioration | (x) | | | (x) | | | | |
| | | vegetation damage | (x) | | | (x) | | | | |
| | | footprints | (x) | (x) | | (x) | | | | |

Tab. 1: Methods for monitoring of recreational uses in protected areas (CESSFORD, MUHAR 2003, MUHAR et al., 2005)
x = direct relevance; (x) = limited relevance or relevance only in conjunction with other methods

As illustrated in Tab.1, no single method will satisfy all data needs for the management of a particular protected area, therefore the standard procedure should be to combine individual methods. This is particularly indispensable when applying automatic counting devices such as photoelectric counters or pressure sensitive mats: all such devices need careful cross-checking, e.g. by correlations with results from other monitoring methods such as personal observation. Further, quantitative data from visitor counting can be reasonably overlaid with data from interviews.

Table 2 shows the method mixes chosen for three protected areas in Austria with different protection status, recreational use levels and management challenges.

## Data Analysis

Quantitative data on recreational uses together with collateral data (e.g. weather, season, daytime) provide the basis for numerous analysis methods. The following examples have been chosen to illustrate the spectrum of possible analyses and models:

| Protected Area | IUCN-Type | Use levels/types of touristic/recreational uses | Management challenges | Research methods applied |
|---|---|---|---|---|
| Dürrenstein Wilderness Area (Lower Austria) | Ia/Ib | • low use levels<br>• hiking, nature observation<br>• most visitors from the region | • exclusion of recreational use in core areas (primary forests)<br>• minimisation of disturbance of key species (grouse)<br>• visitor information about protection goals<br>• stabilisation of visitor numbers at current level | • periodic counting at car parking areas<br>• periodic counting at trail network nodes<br>• roaming observers in remote locations<br>• interviews at mountain hut (routes, motivation, activities) |
| Donauauen / Lobau National Park (Vienna) | II | • high use levels<br>• walking, biking, jogging, dog walking<br>• most visitors from neighbouring residential areas | • ecological carrying capacity<br>• minimisation of wildlife disturbance<br>• total annual visitation<br>• guiding of recreational uses<br>• minimisation of inter-group conflicts<br>• leashing of dogs | • permanent time-lapse video counting at main entrance points<br>• periodic counting at trail network nodes<br>• interviews (routes, motivation, activities) |
| Wienerberg Protected Landscape (Vienna) | V | • very high use levels<br>• walking, biking, dog walking<br>• most visitors from immediate neighbourhood | • total annual visitation<br>• social carrying capacity<br>• crowding<br>• minimisation of inter-group conflicts<br>• leashing of dogs | • permanent time-lapse video counting at trail network nodes<br>• interviews (motivation, activities, crowding perception, displacement behaviour) |

Tab. 2: Combinations of recreation monitoring methods applied in three protected areas with different visitation characteristics and management challenges (BRANDENBURG 2001, MUHAR, LEDITZNIG 2004, ARNBERGER 2003)

Analysis of trail use intensity

Visitors to the Dürrenstein Wilderness Area were asked to mark on a map the route that they took or planned to take. By linking the route data and other interview results, an analysis of spatial use patterns was possible (Fig. 1). The spatial distribution of visitor use was then linked to the visitor counting data. With the support of such frequency maps the most heavily used paths could be identified, and potential conflicts highlighted between nature conservation and recreational goals.

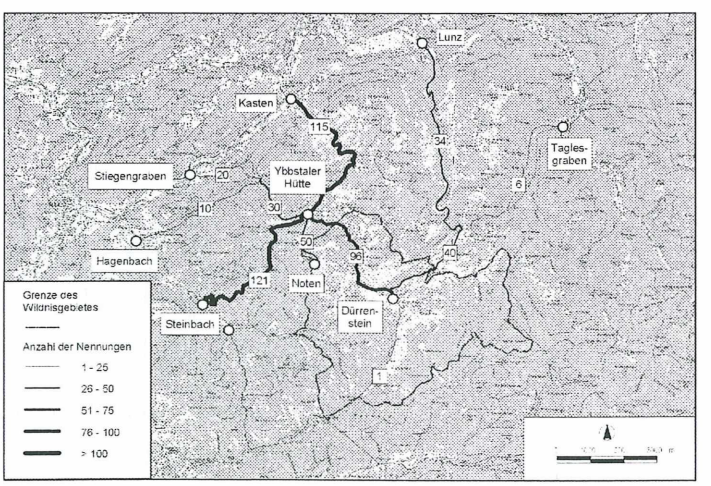


Fig. 1: Spatial distribution of visitors to the Dürrenstein Wilderness Area, derived from 182 interviews (MUHAR, LEDITZNIG 2004)

Forecast of visitor numbers in a national park

In the Danube Floodplains National Park visitor numbers and visitor activities were gathered with permanent time-lapse video recording systems. Meteorological data were provided by a nearby meteorological registration station of the Central Institute of Meteorology and Geodynamics in Vienna (ZAMG). In linear regression models the daily totals of the various user groups such as bikers, hikers etc., the differentiation between workday and weekend, the Physiological Equivalent Temperature (PET), the precipitation as well as the type of cloud cover, were included. With the models it was possible to quantify how the visitor types and the daily visitor numbers are influenced by day of the week and the weather (BRANDENBURG, 2001).

| Extent of interference | Total number of visitors | Bikers | Hikers |
|---|---|---|---|
| Workday, weekend and holiday | high | high | high |
| Precipitation | small | moderate | small |
| PET | high | high | moderate |
| Cloud Cover | moderate | moderate | small |
| Interaction between weekday and PET | moderate | high | moderate |
| Value of model | adj. $R^2$=.745 | adj. $R^2$=.769 | adj. $R^2$=.629 |

Tab. 3: Explanatory value of the total number of visitors per day and the user types

Identification of the social carrying capacity of an urban protected area

Protected area management requires information about the tolerance thresholds of user groups for encounters and other social factors. A trade-off approach was applied for the recreation area Wienerberg (ARNBERGER, 2003), using a stated preference model with digitally calibrated images displaying various trail use scenarios including such factors as number of visitors, user type, presence of dogs on or not on a leash, etc (Fig. 2). Social carrying capacities were developed by asking user groups whether the presented recreation scenario was so unacceptable that they would shift their use away from the presented section (Fig. 3). Stated preference results were then linked with video observation data, resulting in an estimate of the number of hours which are assessed as beyond the limits of social carrying capacity in course of a year.

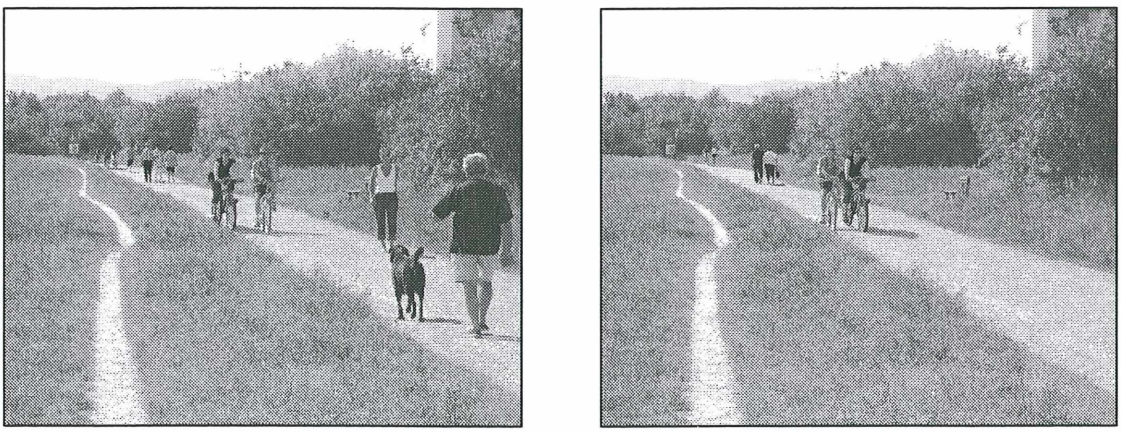

Fig. 2: Example of systematically manipulated images depicting different levels of six social setting attributes

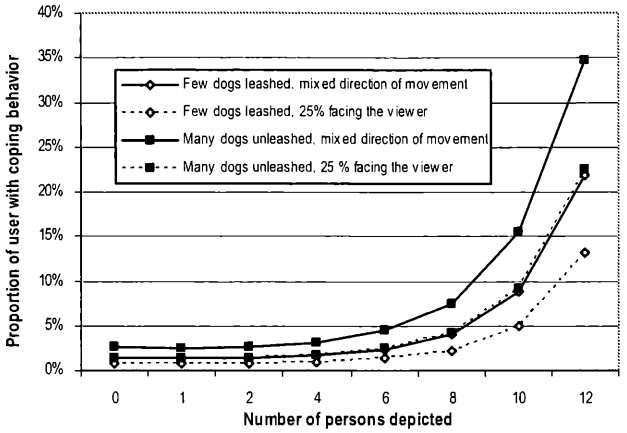


Fig. 3: Share of respondents with use displacement behaviour

## Conclusions

The implementation of a visitor monitoring needs careful consideration of the specific management challenges and the resulting data needs. Only systematic monitoring schemes will provide reliable data for management authorities to support management decisions. Such monitoring programs therefore need to be planned well in advance and with an appropriate time horizon in order to be able to detect temporal and spatial trends and variations in visitation numbers, visitor activities and behavioural patterns. In order to achieve comparability between individual protected areas at national or European level, standards for data acquisition and data management need to be developed.

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# Effects of experimental flooding on the River Spöl, Swiss National Park

**Uta Mürle, Johannes Ortlepp**

## Abstract

Following the construction of two reservoirs in the late 1960s, the discharge of the River Spöl, Swiss National Park was reduced and regulated. Elimination of river changing floods caused a degradation of river morphology and of habitat conditions for benthos and brown trout (*Salmo trutta* L.). In 1996 a flood program was implemented to enhance ecological conditions in the Spöl River. Due to the experimental floods (since 2000), most alluvial fans in the channel were scoured downstream, bed sediments were less embedded, and variation in channel depth increased. Macroinvertebrate densities were reduced up to 90%. Recovery to pre-flood densities occurred within few weeks but the species composition changed significantly. Fish abundance was not reduced by the floods and only few fish were killed or stranded. The quality of fish habitat, spawning grounds in particular, was noticeable improved. The condition of trout remained relatively constant, even though food resources were altered to some degree.

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## Keywords

river management, flow regime, flushing flood, colmation, macroinvertebrates, fish stock, spawning conditions, Swiss National Park, Salmo trutta

## Project aims and Duration

The experimental flood program aimed at testing an annual flood regime intending to restore riverine dynamics. Investigatins focused on how floods must be managed in order to cause minimal, yet regular flow disturbance which is required to maintain riverine dynamics in a near natural state.

Representatives of the Engadin Hydroelectric Power Company, the Swiss National park, regional Fisheries authorities and hydrobiologists developed a program concerning these experimental floods. This program included a slight reduction of the residual water discharge and the storage of this water for flushing floods. The calculations were based on the different energetic values of the two reservoirs. Finally no losses of energy-equivalents resulted from the flushing program.

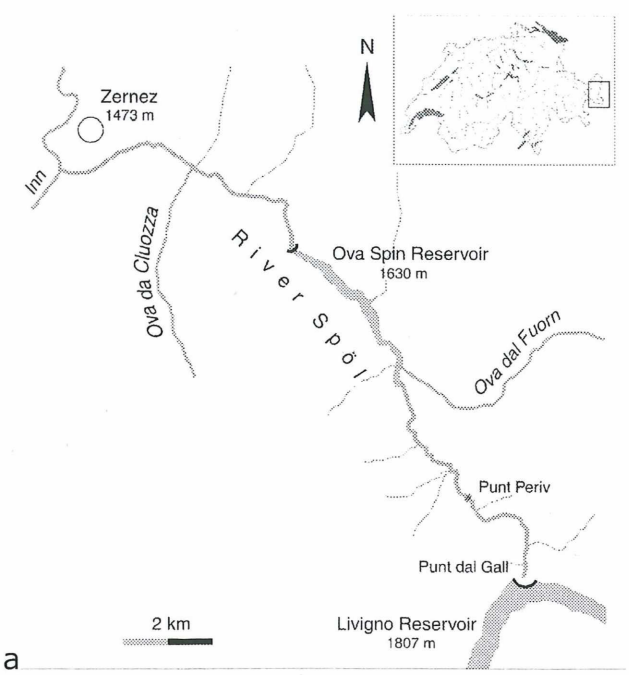
The effects of the experimental floods were studied by several working groups (EAWAG, University Berne, Hydra). On the basis of the results of the first three years (2000-2002) the dynamic residual flow regime was optimized and maintained in subsequent years.

## Study area

The Spöl River flows from the central alpine Bernina massif to the Inn River, a tributary of the Danube (fig.1). The National Park of Stelvio (Italy) and the Swiss National park encompass a major portion (> 80 %) of the catchment area. Following a fierce political campaign in 1956, Switzerland and Italy agreed to use the Spöl for hydroelectric production even though the river was part of the Swiss National park then. The Punt dal Gall dam and the Ova Spin dam were finally completed in 1970.

Before regulation, the Spöl River had an average annual discharge between 6.6 and 12.5 $m^3/s$ and peak discharge reaching 36 to 140 $m^3/s$. Following dam completion, discharge was regulated at average 1 $m^3/s$ from Livigno reservoir and average 0,6 $m^3/s$ from Ova Spin reservoir. Since 2000, residual flow in Spöl River is reduced slightly and 1-3 floods (maximum discharge: 11-45 $m^3/s$) are released from the two reservoirs during summer (fig. 2).

Contribution received at: 20.07.2005



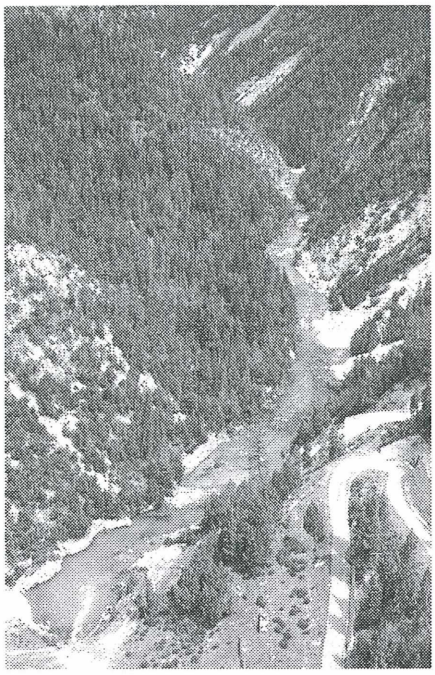




Fig. 1: a. River Spöl in the study area

b. River Spöl view from Punt dal Gall dam

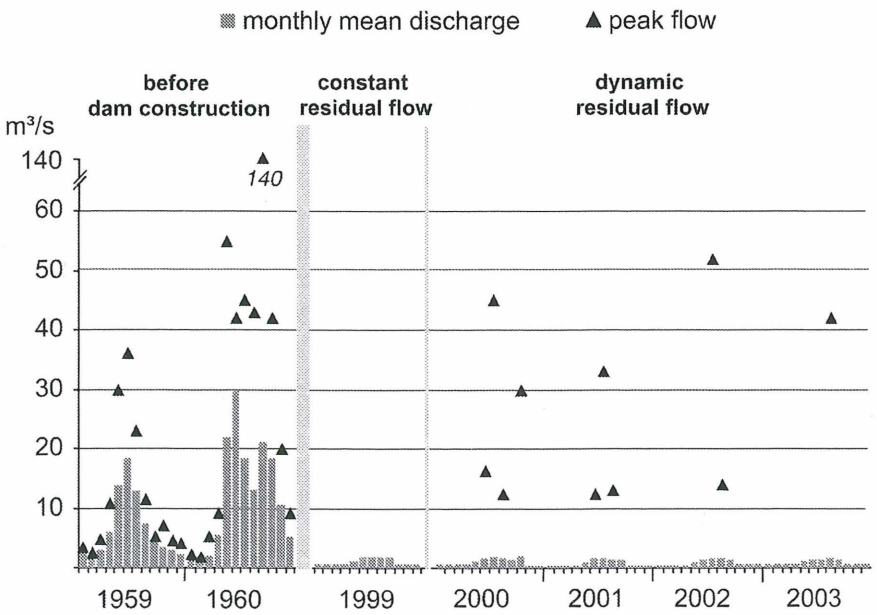



Fig. 2: Discharge of river Spöl (Pt. d. Gall)

## Methods

Suspended sediment was determined using IMHOFF funnels. Substrate transport was observed using marked substrata of 2 to 30 cm diameter.

Changes of river morphology, riverbed structure, sediments, and macroinvertebrate abundance were observed before the floods and after each flood. Morphology and substrate characteristics were mapped. 38 transects were measured (theodolit). At selected transects the bottom substrata was mapped and the degree of colmation was categorized. Sediment samples were taken at 15 sites by means of a Surber sampler, the particle size distribution was determined by sieving. Sediment freeze cores were taken to assess the sediment structure of deeper layers.

The macroinvertebrates of the Spöl were collected twice a year since 1996 at 6 sample sites. Additional samples were taken before and after each flood (EAWAG).

The fish stocks were examined before and after floods using electro-fishing. The loss of fish was estimated after each flood by counting dead or stranded fish. The spawning redds of trout from Livigno reservoir to Punt Periv (2.7 km) were mapped annually at the end of November.

## Results

The highest concentrations of suspended sediments (17.5 ml/l) occured during the first flood in June 2000, during following floods sediment volume was mostly less than 4 ml/l. Maximum concentrations occurred during the rising limb of each flood. Gradully increasing concentrations of suspended sediments were observed downstream, indicating that the input of lake sediment was negligible.

The floods caused a significant removal of sediments at the foot of debris fans within the active channel (fig.3). The mobilization of material from the debris fans resulted in extensive accumulations of gravel and sand in the riverbed and adjacent floodplains in the first flood year. The floods of the following years scoured newly built gravel banks and further eroded benthic sediments. A greater variation (coefficient of variation in %) in water depths, suggesting an increase in habitat variability, was measured after the floods.

Gravel and cobble are the predominant sediment classes in the Spöl. The average D50-value before the floods was 62 mm, increasing to about 76 mm after the first flood year. The floods changed the substrate composition, slightly increasing coarse sediments by erosion and gravel by deposition. The percentage of fine material (silt, sand) in the upper layer of substratum was reduced, as indicated by the reduction in substrate colmation (fig. 4). However, besides reducing the amount of fines in bed sediments, other colmated areas were covered with loose gravel.

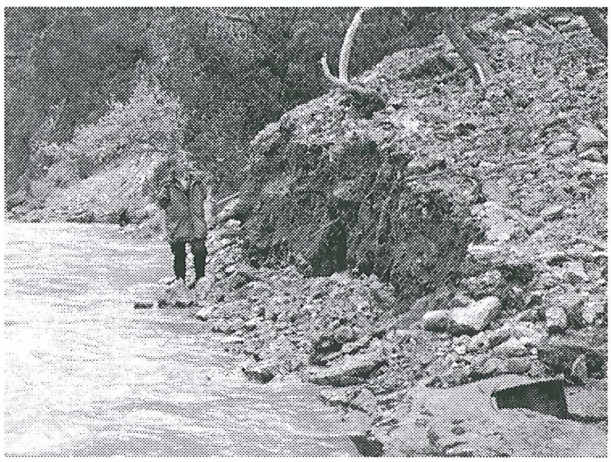


Fig. 3: Debris fan, eroded by the experimental floods

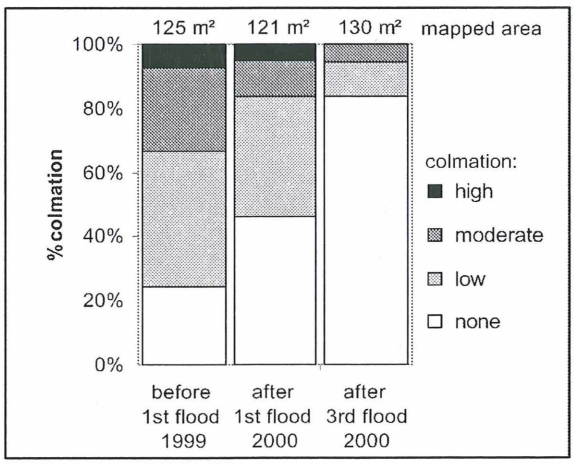



Fig. 4: Substrate colmation

Stability of river bottom and enhanced growth of aquatic plants favoured the mass occurrence of *Gammarus fossarum* and *Crenobia alpina* during constant residual flow regime. With the artificial floods macroinvertebrate densities were reduced up to 90% - depending on discharge, yet recovery to pre-flood densities occurred within a few weeks (Robinson et al. 2003). The species composition changed: the abundance of may- and stoneflies increased, while the abundance of *Gammarus fossarum* and *Crenobia alpina* decreased.

Fish abundance was not reduced by the floods and few fish (<2%) were killed or stranded. The quality of fish habitat, spawning grounds in particular, was noticeable improved. Food resources were altered to some degree. The condition of trout remained relatively constant (condition factor 1). In the 2.7 km long study section downstream of Livigno reservoir the number of redds increased about four-fold since initiation of the flood program (fig. 5).

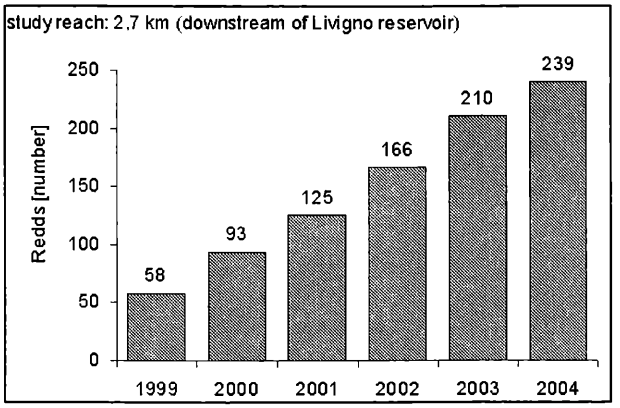



Fig. 5: number of redds

## Conclusions

The numerous changes in river morphology and habitats show that a flood regime program can mitigate the negative consequences of a reduced and regulated discharge. However, the desired effects occur solely with a frequent number of relatively high magnitude floods. The number and magnitude of future floods can be determined after assessing the sediment input from the side-slope tributaries and debris slopes in an adaptive management approach. Further efforts towards optimizing a dynamic discharge regime should consider the biological effects like the substantial algal development of the residual water regime.

## Acknowledgements

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## Appendix

*Does the flood of data, as well as the current methods and standards really help the practitioners and those who are responsible?*
In the case of River Spöl, research activities were initialised by practical problems: the need of artificial flows to flush reservoirs as well as the river bed. Up to this time scarce local data were available to implement a program for flushing floods.

*What results does research in Protected Areas need to achieve to be useful for Protected Area Management at the best?*
To evaluate the influence of the flushing flows on different morphological and biological components of the river, it was of special importance to have a pool of data that describe the status and limits of variation of these biological, hydrochemical and morphological components. We had to collect most of these data within one year, what is very little time to explore biological fluctuations. Moreover, access to original data or biological samples was required.

*Did the remarkable scientific achievements of the protected areas successfully anchor in the minds of the general public?*
The local residents are very interested in the scientific and applied research in the national park. This is demonstrated by the well attended information events in the Nationalparkhaus in Zernez.

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# Biodiversity of flower visitors: Enabling and threatening factors for the existence of species – rich communities

**Johann Neumayer**

## Abstract

Many flower visitors have declining populations or are in danger of being extinct and lack of nectar and pollen supply is thought to be a main factor for threatening. For studying the effects of decreased resource supply for the autochthonous visitor community honeybees were introduced temporarily in a naturally honeybee-free valley. In the vicinity of the beehives nectar supply decreased significantly and also abundance and species number of flower visitors decreased. At times with low nectar supply these effects could be measured till distances of more than 800m from the beehives and they can be expected till more than 1500m. Similar effects can be expected in all cases, where competition between flower visiting insects increases. Examples are alpine meadows after end or change of management or alpine pastures after having been overgrown by shrubs. In these cases flower supply as well as species number of flower visiting insects decrease significantly, as can be shown for bumblebees and butterflies.

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## Keywords

biodiversity, flower visitors, resource partitioning, nectar supply

## Project aims and duration

Aim of the project was to investigate the effects of decreased nectar supply for a subalpine flower visitor community. The project was realized in July and August 2001. Some comparison data is derived from other investigations about flower visitor communities in the Hohe Tauern, conducted by the author between 1994 and 2003.

## Area of study

The study was conducted in the Mühlbachtal (Niedernsill, Salzburg, Austria). The area „Lärchach" in the „Fuscher Tal" served as comparison area. Both areas are situated in a South to North extending valley in an altitude between 1650 and 1750 m asl and show a similar vegetation. The nearest beehives were at least 5 km away from the study and comparison sites and were located at least 800 m below. All other flower ecological data, used for comparison purposes, also was obtained in the Fuscher Tal.

## Methods

Two honeybee hives were placed in the Mühlbachtal at an elevation of 1650m asl from the end of June to the end of August 2001. In a distance of 10, 30, 90, 270 and 810m from the beehives study sites with an area of 80m² were marked. They were named according to their distance from the beehives as 010m, 030m etc. In the Fuscher Tal three comparison sites (named as site 1, 2, 3) of the same size were marked.

Nectar supply of eleven plant species regularly visited by honeybees and autochthonous insects was measured in the course of the day on both the study and comparison sites – or just beside in the same distance from the honeybee hives. Nectar quantity and concentration was measured every two hours between 9 am and 17 pm CET from ten flowers per species. The obtained data from 200 nectar measurements was analyzed statistically in a matrix of four daytime periods and the five distances from the beehives.

Contribution received at: 18.07.2005

Every ten days flower supply was counted once and all flower visits were censused every two hours in the same intervals as nectar measurements. Observations of flower visitation were conducted as standardized transect observations (40 m transect length, 2 m breadth of observation) at times without precipitation and temperatures above 12°C. Further methodic details are described in NEUMAYER & PAULUS 1999. For calculation of flower visitor abundance (both per 1000m² and per 1000 flowers or inflorescences) only observations of flower visiting individuals were evaluated.

## Results

Nectar sugar supply

Nectar sugar supply of eight of the eleven investigated plant species was significantly lower at the study sites than at the comparison sites. Additionally in two further species it was significantly lower at the sites 010m und 030m than at the sites 270m und 810m (t-tests; *Calluna vulgaris*: p = 0,0072, *Senecio ovatum*: p = 0,0286). Diminution of nectar sugar supply increased in the course of the day and in the vicinity of the honeybee hives.

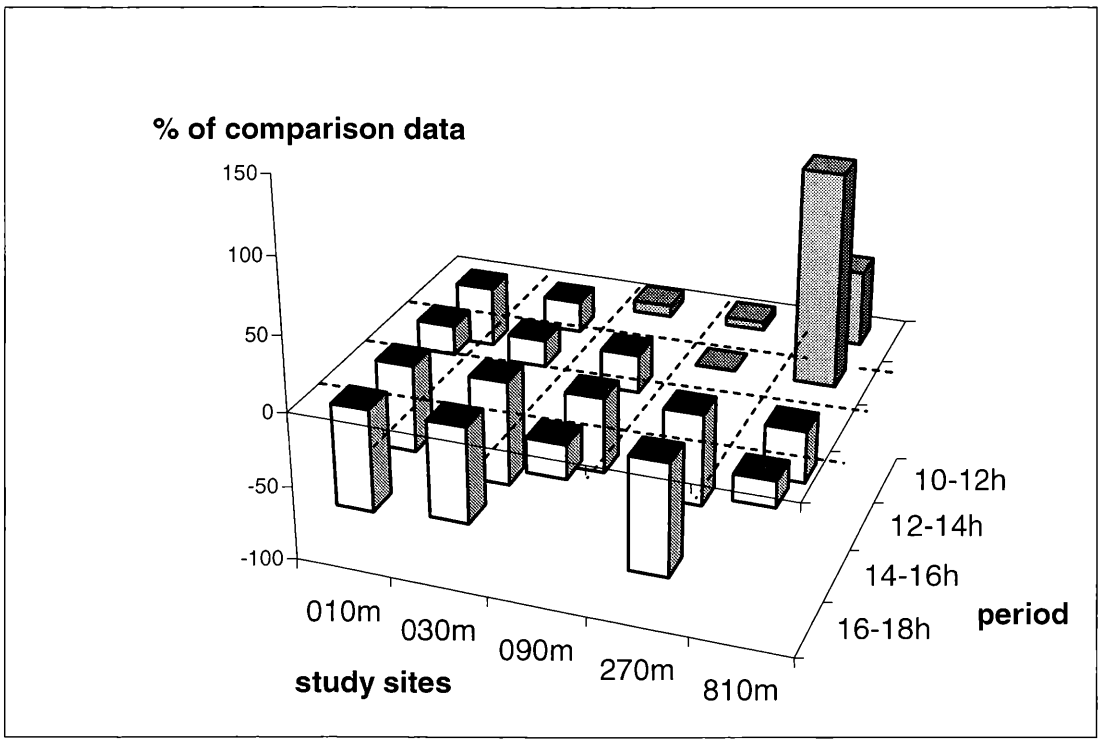


Fig. 1: Mean decrease of nectar supply of the investigated plant species in the course of the day and in different distance from the honeybee hives.
Nectar sugar supplies of the single plant species at the study sites were related to the comparison data from the Fuscher Tal, that were taken as 100%.

Flower visits

Until the 20th of July no differences of flower visitor abundance between study sites and comparison sites could be detected. From the 20th of July onwards flower visitor abundance at the study sites 010m and 030m was significantly lower than at the sites 270m and 810m (t-test, p = 0,0354). Between 12 and 4pm these differences increased (fig 2). Whereas this was a short distance effect, the decrease of flower visitor abundance was found at all study sites in the period between 1st and 20th of August. Also the number of flower visiting species of bees, hoverflies, butterflies and day-active moths (Apoidea, Syrphidae, Lepidoptera) was evidently lower in the vicinity of the honeybee hives (t-test: p = 0,0513). Flower visitor abundance showed a significantly positive correlation with species number (r = 0,9119;***).

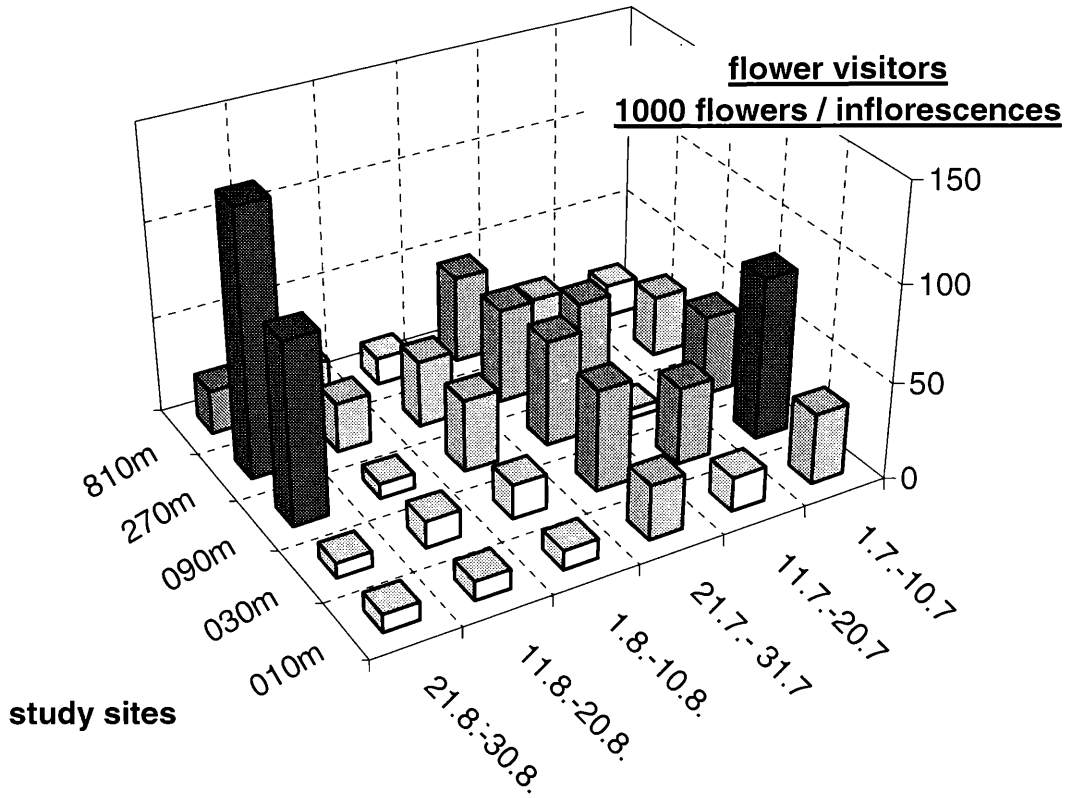


Fig. 2: Flower visits/1000 flowers or inflorescences between 12 and 4pm at the study sites in the course of the season.
Column color: white: 0-20 visits, light grey: 20-40 visits; dark grey: 40-60 visits; black: > 60 visits.

## Discussion

Different strategies for the optimization of resource exploitation allow many species of flower visitors to coexist, although strict specializations are rare. Considering the fact, that the currencies in the trade between insect pollinated plants and flower visitors are – with few exceptions – only nectar and pollen, the importance of resource supply on the "common flower market" is obvious.

The introduced honeybees were able to reduce resource supply: In ten of the investigated eleven honeybee-visited plant species, they reduced nectar sugar supply significantly at least at distinct times of the day in the vicinity of the hives. This effect increased in the course of the day and with proximity to the hives (fig 2). Similar, although probably rather smaller effects can be expected to pollen supply (compare NEUMAYER & PAULUS 1999), but could not be considered in this study.

Also the autochthonous flower visitor community was affected increasingly by the honeybees during the course of the season: In the middle of August, when flower supply decreases rapidly, frequently it comes to a bottleneck situation in nectar and pollen supply (NEUMAYER & PAULUS 1999). Just at this time the decrease of flower visitor abundance reached all study sites and also the species number of visitors showed a minimum (unpublished data).

It is of importance for nature conservation, how far negative effects for other flower visitors can be expected from honeybee hives. Taking into account the mean flight distances of honeybee foragers, in times with low flower supply one can expect a significant decrease of nectar sugar supply and autochthonous flower visitor abundance up to distances of more than 1500m from the hive. Especially flower visitors with a small action area around the nest site as many wild bees are potentially threatened by honeybees.

Similar effects can be expected when flower supply decreases. For instance this is the case, when communities of tall herbs – that have a peak of flowering in August, when overall flower supply decreases, are destroyed. Other frequent examples with high relevance for conservation are alpine meadows, changing into pastures after giving up of mowing, or pastures becoming overgrown by shrubs. Indeed species number and abundance of bumblebees and butterflies decrease from alpine meadows over alpine pastures to shrub communities (NEUMAYER & PAULUS 1999 and unpublished data). Traditional management of alpine meadows enables a large, highly diverse and long lasting flower supply, that can by far not be reached by any other biotope type in mountain areas. So this anthropogenic biotope must be a main target for conservation.

## Acknowledgements

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# Value based decision making process for strategic visitor management in the Natura 2000 area Lech River Valley, Tyrol

**Yvonne Pflüger**

## Abstract

The Lech valley with the river Lech and its tributaries is an alpine river valley in Austria with a considerable amount of naturally free flowing stretches. The ecological and scientific significance of the Natura 2000 area lies in its high biodiversity and the occurrence of numerous internationally endangered species within the dynamic braided river stretches. Apart from that the area contains a high number of recreational and educational values as well. The area, which is situated within day travel distance of the cities Innsbruck and Munich, is renowned for its biking and hiking trails and its unique water sport opportunities. Nevertheless, most intense impact occurs from the daily use of the local population in the densely populated Lech valley area nearby. Due to its long and narrow shape the protected area is very vulnerable to impacts and therefore, to avoid negative impacts on natural values from recreational use, not only a management plan, but also a visitor strategy has been developed as part of an extensive European Union LIFE funded project.

The decision making process for the establishment of the visitor management concept was based on a GIS supported risk analysis: First current ecological and recreational values have been located and assessed. Subsequently hotspots have been defined in areas, where those contrasting values overlay. These hotspots were defined in areas of high ecological vulnerability and high visitor impact from intense recreational use. This hotspot analysis served as a basis for discussion and co-operation with the local population and stakeholders to agree on management solutions. As a result specific management actions were defined and the allocation of visitor infrastructure was planned accordingly. As a response to the need for more detailed information about recreational uses and users a visitor monitoring concept was included in the visitor strategy as well.

This paper describes practical planning policies to highlight the need for strategic planning of recreational use in protected area management based on the comprehensible evaluation of the hazard potential from uses and the vulnerability of ecological values.

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## Keywords

Natura 2000, visitor management, risk analysis, values, GIS

## Introduction

Area description and project outline

The Natura 2000 area Lech valley of Tyrol (within the political district of Reutte), covers 41 sqkm, and contains parts of the river Tiroler Lech including the floodplain areas and its forests, the most significant tributary streams and parts of the bordering montane forest stands. The Natura 2000 area represents an impressive ecosystem with enormous scientific significance and contains important recreational and educational values. The ecological significance of the Tiroler Lech lies in the dynamic power of its water and the occurrence of numerous native plant and animal species including those especially adapted to riverine ecosystems.

In 2001 an extensive European Union LIFE funded project was launched at the Lech River, which includes a total of 53 individual projects. The project aims at conserving and restoring the fairly natural, dynamic fluvial habitats by revitalising both the Lech and its tributary streams. A total of 7.82 million Euros are available in order to carry out the project, which is also to have positive economic impacts on the region. As part of the LIFE funded project a visitor management concept has been developed in close co-operation with the local population, which builds the basis for this paper about applied visitor management issues and tasks.

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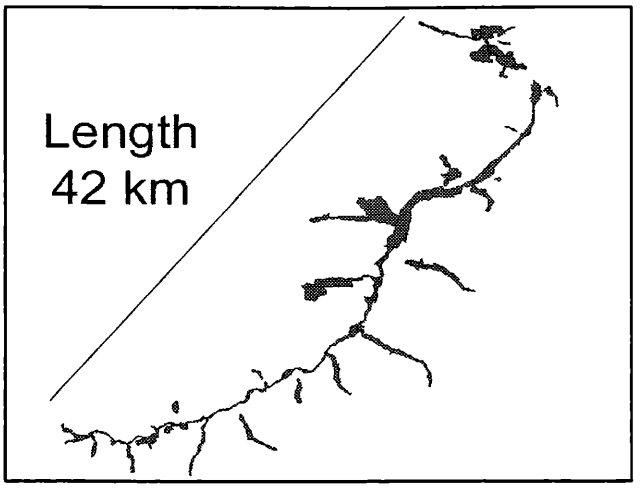


Fig. 1: Due to limited space the protected area along the Lech river and its tributaries does not contain buffer zones. Its long and narrow shape makes it more vulnerable to impacts.

Nature conservation tasks

The river Lech represents an important nesting habitat for riparian species. Nowhere can comparable populations of Goosander *Mergus merganser* (which has its most significant occurrence in Austria in Lechtal), the Common Sandpiper *Actitis hypoleucos*, Little Ringed Plover *Charadrius dubius*, Dipper *Cinclus cinclus*, be found. The extensive riparian forests serve as a habitat for numerous bird species of extraordinary diversity compared to other alpine areas.

The Little Ringed Plover's preferred breeding ground is on gravel banks devoid of vegetation. The Common Sandpiper, on the other hand, finds more protection for its nest in the sparse vegetation of pioneer plants. For both species, the Lech is one of the less outstanding remaining breeding grounds in Austria.

The habitat of the grasshopper *Bryodema tuberculata* is to be found at slightly raised places of alpine river gravel banks. Owing to the fact that such places have almost disappeared, this big and beautiful species is today threatened with extinction.

The lady's slipper is one of the rarest and most spectacular orchids. This orchid, classified in Austria as an endangered species, feels most comfortable in the half shaded surroundings of floodplain forests, developing a one to two-flowered inflorescence with large blooms. The distinctive plant with its large, yellow blooms in the shape of a slipper, flowers from May to July. In this time thousands of visitors arrive in the area to see the blooms.

## Problem statement

Regional context and recreational use

At the Lech river, as at other rivers in Central Europe, for a long time protection from the water and creation of land were the main focus of the structural water measures that were undertaken. Since having satisfied these needs, different aims have become more and more important today, namely to conserve and re-create a fluvial landscape with a character as close to nature as possible, which offers place for leisure time activities, recreation and the experience of nature. Due to its long and narrow shape, settlements and business sites are directly bordering the significant protected area. The floodplains and the river bed areas have traditionally been used for recreation by the local people due to easy access from the nearby settlements. Their activities are ranging from sun bathing and children playing on the gravel banks to picnicking and camping in the nearby floodplain forests. Apart from these unofficial uses by local people from adjacent residential areas, there is a very popular officially marked biking and hiking trail that runs along the river bed. Finally, there are kayakers and rafters travelling down the stream and landing on gravel banks.

Therefore, the pressure on the protected area from this variety of uses is generally very high, although there are local differences in the activities and frequencies of visitors (e.g. intensive use of the area around the flooded gravel pit, partly high frequencies on biking trails). Visitor management is difficult to implement due to the shape of the area. Furthermore, the possibilities for providing visitor facilities, which do not cause a disturbance, are restricted because of the many contact points to the river areas. More or less all floodplains are easily accessible, as there are numerous entrances and foot paths leading in. This also makes effective visitor monitoring difficult to implement. Specific data about the numbers, activities and impact of visitors as a basis for the

visitor strategy are lacking. Taking this into account a visitor monitoring concept has been developed as part of the preparation of the visitor management concept by the Bodenkultur University, Institute for Landscape Architecture and Landscape management (ARNBERGER, 2002).

Due to the increasing popularity of the area, a large potential for the development of tourism is predicted. The Lech river lies within day travel distance of the cities Munich and Innsbruck, which is part of the reason for the variation of visitor frequencies and user groups during a week. Whereas the use by local people from adjacent residential areas is more evenly spread on weekdays, high user densities occur on weekends from city dwellers arriving by car. Those getaway visits are often day trips or 2-3 day visits that tend to focus on a specific activity (e.g. biking along the river) or area (e.g. visiting the blooming "Lady's Slipper orchids").

## Goals and objectives

The region is interested in triggering regional development and stimulating sustainable tourism and marketing. Nevertheless, there is an increasing pressure on an area that has to be safeguarded as much as possible. So, sustainable and environmentally sound development of tourism and recreational use/infrastructure should be guided by a visitor strategy.

The development of this regional visitor strategy including direct and indirect management actions was the first step to co-ordinate and link management measures in order to maximise their positive effects. The visitor strategy should include:

- Offering improved educational facilities and hiking trails in order to promote a gentle sustainable recreational use
- Areas for experiencing nature and opportunities for locals to use certain areas of the riverbed
- Information strategy (media, folder, panels) and corporate design
- Facilities (educational trails, visitor centre, view points)
- Identification of spatially, temporally flexible especially protected low impact zones within the ecological core zones, on the basis of a conflict analysis and continual observation (max. 10 % of the Natura 2000 area)
- Rangers in the field (information, control) and excursions (environmental education)
- Monitoring of the number of visitors, activities and their impact as a basis for effective future visitor management would be highly desirable.

In order to ensure acceptance of the visitor strategy among the local communities close co-operation with regional stakeholders and tourist organisations was a prerequisite for establishing the concept and particularly for defining management measures.

## Methods

Value based decision making process

As a basis for the spatial planning of management measures, a GIS supported decision making process has been applied. The methodical approach was based on spatially and technically defining ecological and recreational values within the area in order to be able to analyse current conflicts and to avoid future conflicts that could occur from planning new visitor infrastructure.

First, all available ecological data to represent the current condition of the protected area had been gathered and evaluated. The most significant studies about habitat structure (CERNY, 2001) and wildlife (LANDMANN, 2002) were used to build a geographical information map that contains information about the current sensitivity of the protected area. For this purpose the entire area had been covered by a field inventory and subsequently the data were integrated in the map and database. On the one hand, the database "ecological values" contained information about the value of a biotope type and its structure. On the other hand, information about habitat potential for various bird and mammal species was included. Therefore, the assessment of the sensitivity of a biotope was not exclusively linked to the estimation of its vulnerability to disturbance, but rather on its own ecological value *and* its value as a habitat. Obviously, this sensitivity of a habitat type can differ considerably from the vulnerability of wildlife species living there (e.g. gravel banks severing as nesting sites for sensitive bird species). Hence, first the value of each biotope type was estimated and categorised generally for the entire project area, then the value of each habitat was defined individually by the occurrence of valuable wildlife species within. It was assumed that the occurrence of several endangered wildlife species made an area more sensitive to impact than none or one. Furthermore, it was considered that open areas without buffers are more susceptible to impact.

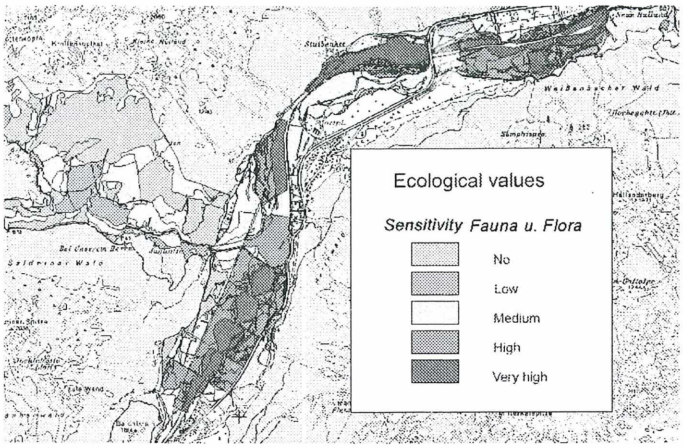


Fig. 2: The map shows the high ecological value of the free flowing stretch of the river Lech with its sinuous water channels and highly variable flows.

Subsequently, the recreational infrastructure (hiking, biking, mountain-biking trails, cross-country skiing, parking lots) and unofficial uses (picnic, barbecue, rafting and kayak, foot paths leading to the river banks) have been mapped in detail, assessed and categorised according to their impact. In accordance to relevant literature the impact for the uses had been defined as follows (SCHNEIDER-JACOBY, 2001; REICHHOLF, 2001; WALLS, 1999; YALDEN, 1990):

- Visitor frequency: Due to the lack of current visitor data, such as user frequencies, user densities had to be estimated based on interviews with locals and specialists familiar to the area.
- Visitor use: Visitor uses were categorised according to their intensity and impact on wildlife.

Biking and cross country skiing along the marked bike trail were considered as less intense than mountain biking and hiking. The highest impact occurs from uses that actually intrude into the habitat such as barbecuing on gravel banks or walking on foot paths leading into the floodplain forests.

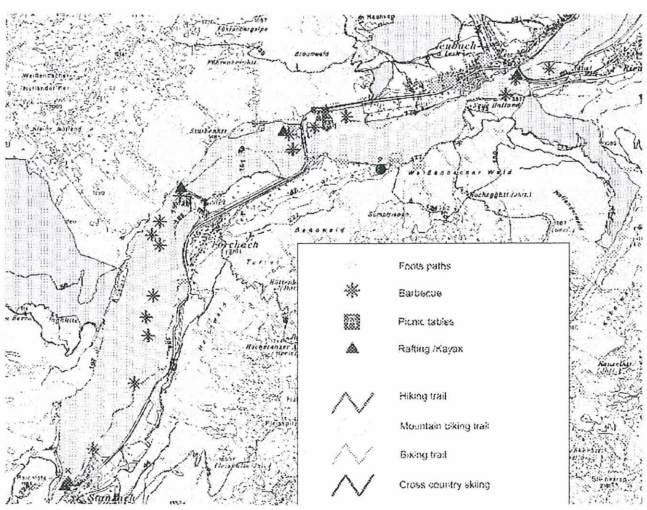


Fig. 3: At the Middle Lech (see Fig.2) high user densities and various recreational uses are concentrated on the attractive gravel banks of the river stretch.

Risk analysis model

The decision making process for the establishment of the visitor management concept was based on a GIS supported risk analysis. As in other risk analysis models (EGLI, 1996) the following process was applied: First the current ecological values had been located and assessed (sensitivity to damage). Then the impacts from the visitor infrastructure and use (danger defined through the frequency and intensity of recreational use) had been overlaid in a 100m buffer (MARGRAF, 2001). Consequently the risk was defined in areas, where those contrasting ecological and recreational values conflicted. Hence, hotspots were defined in areas of high ecological value (vulnerability) and high visitor impact from intense recreational use.

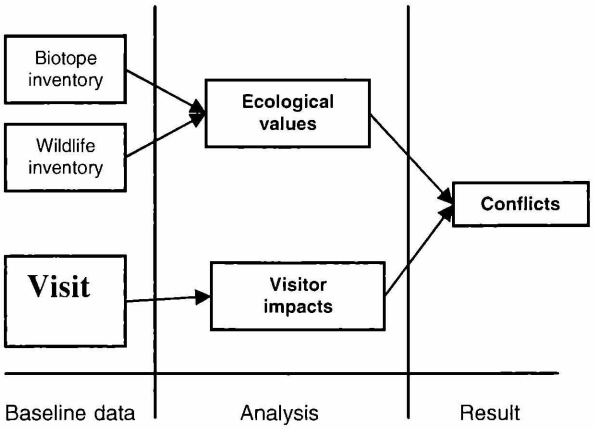


Fig. 4: The methodology is based on overlaying ecological values and visitor impacts to define hotspots and areas of intense conflict.

This hotspot analysis served as a basis for discussion and co-operation with the local population and stakeholders to agree on management solutions.

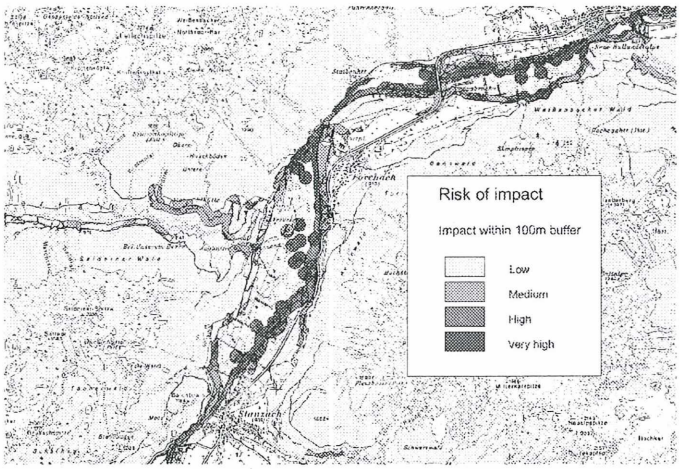


Fig. 5: The map that has been developed as part of the risk analysis shows the areas of intense conflict. The application of a GIS based planning process allowed to cover the entire Natura 2000 area in the spatial analysis.

GIS application

The results of the field inventories were digitised and processed into digital theme maps by using a Geographical Information System (GIS; Programme: Arc View). The work with GIS does not only provide a graphical representation of very high quality, but also allows to carry out spatial analyses and the overlay of the different content maps (e.g. ecological values and recreational uses) as described above.

## Management goals and objectives

Proposed management plan

As mentioned above, the definition of current hotspots (where ecological and recreational needs are conflicting) served as a basis for spatially defining measures for visitor management in order to protect intrinsic ecological values and to fulfil the visitors' need for recreation and environmental education.

First, the biking trail that runs along the Lech river was allocated on one side of the river according to the results of the risk analysis. At the moment the trail frequently splits up and is partly marked on both sides, which leads to impact on both river banks and makes orientation difficult. After the definition of *one* axis, that changes river banks where necessary, all planned visitor infrastructure was concentrated in 21 visitor management zones along this axis in order to channel use on specific sites through facility design and to reduce impacts in the areas in between.

In contrast, the areas of highest ecological value were defined as low impact zones. The management zones are generally located close to areas of current high user densities, as locals will probably continue to use those places that they are accustomed to. The detailed planning of attractive visitor management zones should help to provide alternatives to currently used sites and thus subconsciously influence visitor behaviour and use. Various types of infrastructure will be integrated in the management zones:

- Interpretative paths
- Viewing platforms
- River access & recreation zones (located at sites of current river revitalisation projects)
- Rafting and kayak exit points
- Information points and visitor centre
- Outside of the visitor management zones the following measures will be applied:
- Low impact zones, where uses and access can temporarily be regulated
- Rangers operating in the field

All funds will be invested in the maintenance of the infrastructure along the axis, while other paths will eventually become less attractive and could partly be screened (especially foot paths in the floodplains). Psychological barriers (such as handrails along educational trails) and sufficient information about impacts will be used to avoid signs.

Implementation and perspective

One of the main tasks in the development of the conceptual visitor management strategy was the public involvement in the planning process in order to gain acceptance in the region. Therefore the proposed visitor concept has been presented to the communities and tourist organisations and discussed in detail. Consequently, adaptations according to local needs have been made.

The management measures will be implemented over the next ten years. The installation of two educational trails and three viewing platforms has been integrated in the LIFE funded project and will thus be carried out as pilot projects.

## Discussion

The fact that the development of a visitor strategy was integrated in this extensive LIFE project highlights the increasing importance of recreational use and its strategic planning in protected area management. The LIFE project aims at triggering a development, though afterwards the funds for the implementation of the entire set of management measures depend on the protection status that the Natura 2000 area will be transferred to in national legislation. The national protection status "nature conservation area "or "national park" are currently being discussed for the Natura 2000 area at Lech river, which will make a difference in funding on a Bundeslaender and state level.

It proved to be important to involve local communities in the planning process and to convey understandable (technical and graphic) information about conflicts between current recreational uses and the need to safeguard conservation interests.

Finally, a conceptual visitor strategy appeared to be essential to co-ordinate the sustainable development of recreational infrastructure in the region and to protect the intrinsic ecological values outdoor recreation actually depends on.

## Acknowledgements

The Provincial Government of Tyrol, Department of Conservation, initiated and commissioned all parts of the LIFE funded project within the Natura 2000 area at the river Lech, including the visitor strategy described above.

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# The Black woodpecker (*Dryocopus martius*) as focal species in alpine protected areas

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## Abstract

Woodpeckers have a stronger affinity to forest and woodlands than do most of other taxa. Most woodpecker species depend on forest resources as large trees and deadwood, that are very important for other animal taxa, but also the first to be removed from managed forest. Therefore it seems feasible to use woodpeckers as focal species in forest management of alpine protected areas.

In the present study we systematically evaluated the suitability of the black woodpecker (*Dryocopus martius*) as an indicator, in the Italian Alps, of a closer to nature forest condition and as an "umbrella species" for other components of forest biodiversity.

To this aim we performed a habitat selection analysis and a census on relative abundance and number of species of cavity nesting birds and ground beetles, in three protected areas.

Our data show that black woodpecker cannot be used as a reliable indicator of a closer to nature forest condition, since, only in some areas, the presence of black woodpecker for both breeding and feeding was associated with variables as large trees and deadwood.

However, black woodpecker was found to be a predictor of the number and abundance of mountain cavity nesting birds, suggesting for an ecological role as an "umbrella species", though only for few species. Black woopecker is an important element of forest biodiversity especially where other important forest species, usually used as focal species, as other alpine woodpeckers and Cappercailly are absent.

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## Keywords

Black woodpecker, forest biodiversity, umbrella species, alpine protected areas.

## Introduction and aims

Protected areas play an important role in conservation of biodiversity. In order to develop sustainable ecosystem management strategies, scientific research focusing on the relationship between habitat characteristics and specie diversity is required [1].

To reduce costs in monitoring and management of biodiversity, several shortcuts have been proposed, as focusing on one or few indicator species [2]. Among different approaches to indicator species, the "umbrella species" concept, namely the idea that there are some species encapsulating the requirements of other co-occurring and less demanding species seems to be one of the best [3], although by now, there are only few studies that empirically validated this concept (in Europe: 4,5).

The black woodpecker (*Dryocopus martius*), that is the largest woodpecker of Palearctic region, uses different forest habitat both for breeding and feeding [6] and plays an important ecological role in European forest ecosystems as keystone species for large-sized cavity nesting birds [7].

Some studies carried out in Europe reported evidence suggesting for a possible role of black woodpecker as an indicator of old-growth forest conditions [8,9]. However, also evidence against this hypothesis has been provided [10,11]

Although the black woodpecker is the largest, well distributed, resident bird on the alpine forest areas, there are only few studies on its ecology on the Alps.

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In the present study the suitability of the black woodpecker as indicator specie of closer to nature forest conditions and its possible role as "umbrella species" for other components of forest biodiversity were systematically investigated in protected areas of Italian Alps.

## Study areas

The study was carried out from 2001 to 2003 in 3 different protected areas: Orobie Valtellinesi Natural Park (Lombardy), Sciliar Natural Park (South Tirol), Vedrette di Ries Aurina (South Tirol).

## Methods

As for the habitat selection, 96 breeding sites and 101 feeding sites were identified and compared with 151 control plots, randomly selected in high forests inside the studied areas.

The following characteristics of habitats were considered in the study: tree diameter (1.30 m dbh), tree height and tree species for each of the 12 trees nearest to the breeding, feeding and random trees, tree basal area, tree density, volume of logs, % of understore cover, and the Shannon Diversity Index of the tree height and species.

Specie richness and relative abundance of both a set of 7 cavity nesting birds and ground occurring beetles, were assessed at 14 black woodpecker breeding sites and 18 randomly selected sites in Orobie Natural Park. For the analysis, birds species were grouped in two categories: "Ubiquists" (occurring in suitable habitat from the bottom to the tree line), and "Mountain specialists" (mainly distributed in the mountain zone of the alps, above approximately 1000 m above the sea level).

## Results

To examine whether and which of the habitat components predicted the presence of black woodpecker, logistic regression models were applied, separately for breeding and feeding sites.

As for breeding sites, average diameter ($p=0,000$) and density of tree ($p=0,049$) entered in the logistic regression model as significant predictors.

As for feeding sites, the volume of dead logs ($p=0,001$) and the Shannon Diversity Index ($p=0,02$) were significant predictors.

Moreover, to evaluate the possible effect of the areas at alpine scale, subsequent separate logistic regression analysis for each of the 3 protected areas were carried out. The analysis revealed a more articulated pattern of results: as for the breeding sites, in Orobie three variables were significant predictors of black woodpecker presence, namely the average diameters, the volume of dead logs and the basal area; in Ries the average diameters and the basal area and in Sciliar the Shannon Diversity Index, density of tree and the basal area. As for the feeding sites, in Orobie both the volume of dead logs and the % of understory cover were significant predictors, while in Sciliar only the contribution of volume of dead logs was statistically significant. No significant predictors were found in Ries site.

As for the relationship between abundance and specie diversity of cavity nesting birds and beetle and black woodpecker presence, number of species and relative abundance of "Mountain Birds" were found to be positively related to the presence of black woodpecker. Regression analysis carried out on the data also showed that the average diameter was the significant predictor of woodpecker presence/absence as well as of number of species and relative abundance of "Mountain Birds".

## Discussion

In line with some previous findings [10,11], our data show that the black woodpecker cannot be used as a reliable indicator of a closer to nature forest condition. In fact only one of the 3 most relevant characteristics of the natural forest (presence of old trees, dead logs and different forest structure, as evaluated by the Shannon Diversity Index), namely the presence of old trees, was able to distinguish between breeding and random sites in a logistic regression model.

Moreover our findings show that black woodpecker can be used as "umbrella species" for the other Mountain birds, even though only a few number of birds species have been considered in the present study.

However, the pattern of predictors was not completely consistent over the 3 protected areas, the data show that black woodpecker selects variable that are uncommon in managed forest and plays a relevant role in forest ecosystems.

Future developments of research in alpine forest protected areas might therefore include the black woodpecker in a broader set of other birds species to be evaluated and, eventually used as focal species for conservation management.

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# LIFE-Nature Projects for the Conservation of the Bearded Vulture in Crete, Greece: Public Awareness Campaign and Results

**Michalis Probonas, Stavros Xirouchakis, Kostas Grivas**

## Abstract

The Bearded Vulture (*Gypaetus barbatus*) is considered as one of the rarest raptors in both Greece and Balkans, since its breeding population can be found only in Crete and the relevant number of breeding pairs of the species is only four. In 1998, DG Environment of the European Commission funded a LIFE – Nature project on the **"Conservation of the Bearded Vulture in Greece" [B4-3200/98/444]**, which was implemented by the NHMC and the Hellenic Ornithological Society (HOS) during the period October 1998 – February 2002.

In the framework of the same funding measure of the European Commission (LIFE – Nature 2002), the Natural History Museum of Crete, in collaboration with the Forestry Department of the Region of Crete and the Municipality of Inachorio, undertook the implementation of a new project on **"Conservation Actions for the Bearded Vulture and Biodiversity in Crete" [LIFE02NAT/GR/8492]**. The duration of the project is four years and its implementation started on July 2002. The main objectives of the aforementioned project are the implementation of the most urgent conservation actions for the species in Crete and the elaboration of specific conservation measures in mountainous areas of Crete.

The project LIFE02NAT/GR/8492 aims to the conservation of the current population of the Bearded Vulture (*Gypaetus barbatus*) in Crete, as well as the conservation of the biodiversity of the island, through the confrontation of specific human threats to wildlife (e.g. direct execution and use of poisons, low food availability, desertification of ecosystems and habitat degradation etc.). In addition, the project aims to the environment-friendly development of rural areas, through the promotion of ecotourism and local products at the project sites.

Apart from the conservation of the Bearded Vulture population, the project focuses on the conservation of Crete's biodiversity. Through the implementation of certain actions, species such as the Griffon Vulture (*Gyps fulvus*), the Golden Eagle (*Aquila chrysaetos*), the Bonelli's Eagle (*Hieraaetus fasciatus*), the Peregrine (*Falco peregrinus*) and the Lanner (*Falco biarmicus*), which are also protected under Directive 79/409/EEC, are expected to benefit significantly from the project.

A wide public awareness campaign has been implemented all over Crete, since the scientific achievements for the effectively protection of the species is better to be widely disseminated. The main actions of the aforementioned campaign are the following:

- Design and implementation of an effective warding scheme in the Wild Life Reserves of mountainous Crete from relevant Forest Services and Hunting Associations. Wardens of Crete attended relevant seminars for improving their specific knowledge on raptors' biology, observation and warding. The seminars were organised by the Natural History Museum of Crete (NHMC) and the proceedings of the seminars are already available in printed and electronic version.
- Establishment of three Information Centers in Crete and function of a mobile exhibition for raptors' conservation in upland communities throughout the implementation of the project.
- Publication of information material, e.g. leaflets, posters, documentaries, stickers, T-shirts.
- Promotion of environment-friendly agricultural and pastoral practices through a relevant wide campaign for agri-environment regulations of the European Union, and also support for the verification and promotion of local biological products.
- Organisation of Workshops on: a) Sustainable Farming and Extensive Pastoralism; b) Collaboration with Tour Operators of Crete; c) Conservation of the Bearded Vulture (Network of LIFE projects); d) Avian Scavengers (focusing on Vultures); and e) Balkan Network on the Bearded Vulture.

Contribution received at: 12.07.2005

- Creation and maintenance of a website for the project (http://www.nhmc.uoc.gr/life_gypaetus/).
- Environmental education material.
- Organisation of nature festivals in two mountainous areas of Crete for two consecutive years (2004 and 2005).
- Promotion of ecotourism in the mountainous areas of the project, which will be based to the particular value of the natural and human environment. The action includes the restoration and signing of old mountainous trails, the construction of bird observatories, the establishment of Information Centres, the organisation of exhibitions and fests, and the production of relevant information material (e.g. ecotouristic guides).

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**Conference Volume** | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 181-185

# Development of a nationalpark consistent wildlife management in a model region of the Gastein valley.

**Friedrich Reimoser, Richard Zink**

## Abstract

Within the hunting districts of the Hohe Tauern National Park (NP) methods of wildlife management consistent with IUCN Kat.II criteria have been developed and tested over a period of several years. A monitoring system has been established to: (i) investigate population dynamics of wild ungulate species and their habitat use, (ii) analyse the impact of wild ruminants on the development of forest vegetation, and (iii) enable an objective success control of applied measures. Results are presented.

## Keywords

wildlife management, national park, ungulates, monitoring

## Project Aims

- Development of a national-park consistent wildlife management, particularly minimizing regulation of wildlife populations by shooting.
- Prevention that impacts of wild ungulates on forest vegetation remain acceptable.
- Creation of concepts to make wild ungulates visible for park visitors.
- Establishment of monitoring systems related to population dynamics and temporal/spatial distribution of wild ungulates as well as browsing impact on forest vegetation.
- Observation of the health status of wild ungulates.

## Duration

Since 1998

## Study Area

The whole study area covers 83 km² and has a range of elevation between 1080-3250m asl. It consists of two smaller valleys connected with the Gastein main valley ("Kötschachtal" and "Anlauftal"). These valleys are situated in the NE part of Hohe Tauern NP close to the community of Badgastein. The study area is part of the wildlife region "Gastein-Ost" (166 km²), which is a subunit of the Wildlife Ecological Spatial Planning (WESP) established in 1993 for the whole province of Salzburg. The two valleys represent two hunting districts with different land owners who have leased their hunting right to the national park since the beginning of the project.

## Methods

The following factors were investigated:

- Habitat evaluation (seasonal habitat suitability).
- Regular counts of wild ungulates in key areas and defined time windows throughout the year (field observations).
- Animal behaviour (activity and distribution patterns via field observations) depending on different regulation strategies (interval hunting, focus hunting).
- Browsing impact on forest vegetation (sampling, fenced control areas; cf. REIMOSER et al. 1999).
- Intensity of game damage (browsing and bark stripping) depending on supplemental feeding strategies during winter for red deer (*Cervus elavus*) and roe deer (*Capreolus capreolus*).
- Spatial distribution of red deer using GPS-GMS satellite technology.
- Organ samples of ungulates shoot or died by other reasons were analysed in the lab concerning the status of health, condition, rumen content, parasites, and heavy metal load.

Contribution received at: 13.07.2005

## Results

Regulated wildlife species

Within the study area only wild ungulates species (red deer, roed deer, chamois) are regulated mainly depending on their impact on forest vegetation (browsing, bark stripping). Most necessary is a regulation of the wide ranging red deer to support the prevention of game damage particularly in the neighbouring hunting districts. 30 to 45 red deer were shot per year. Regulation done by two professional hunter of the national park is focused on females and calves. Adult males (trophy antlers) are not shot in the national park. Roe deer can be considered a problem due to selective browsing and hence its impact on diversity of tree species in the study area but there is almost no conection with neighbouring hunting districs. Approximately 20-26 roe deer are shot per year. Chamois (*Rupicapra rupicapra*) lives mostly above the timber line in high altitudes and migrate less across the national-park border. Therefore regulation is of less importance (about 10-14 individuals are shot per year). All other game species (mammals and birds) are not hunted.

Red deer habitats and areas for ungulate census

Red deer lives almost in the entire study area. During summer the animals prefere open areas in high altitudes up to 2500m. In winter they are concentrated around the feeding stations (see figure 1). The most suitable habitats in the different biological phases are visible figure 1.

The areas for systematic ungulate census are shown in figure 2. The census is carried out six times a year (mid winter/February; early spring/April; late spring/June; mid summer/July-August; autumn/rut/September-October; late autumn/November). The highest numbers were counted in mid summer (up to 330 red deer with increasing tendency). The counted numbers can be understood as an index (minimum number) for population size and development. The sex ratio of red deer is close to 1:1, the growth rate is relatively low (about 60% related to the number of all females in spring).

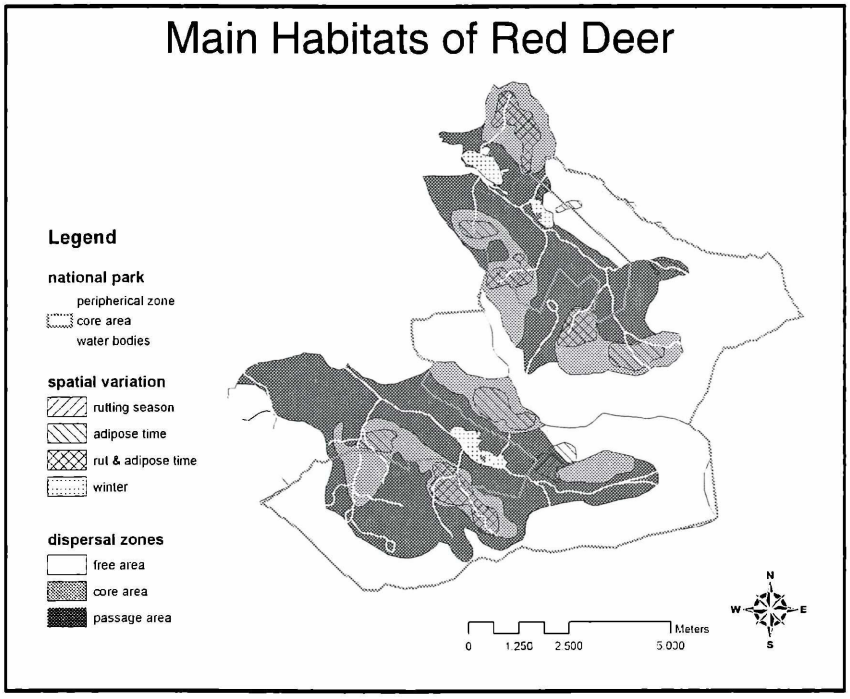


Fig. 1: Main habitats of red deer in the study area depending on seasonal biological patterns: fatness (summer), rut (autumn) and winter. Greyish squares indicat winter feeding stations for red deer. One of them is situated within the study area in the peripherical zone of the national park, two of them are outside the study area.

Spatial distribution optained by GPS-GMS satellite technology

Figure 3 shows an example for the seasonal movement of a female red deer in the "Kötschachtal" In Summer the deer used open grassland above the timber line (Tischlerkar), during spring and autumn it stood partly out of the study area (close to green meadows in the valley).
In a first step about 10 female individuals will be fitted with a radio-collar to investigate spatial migration pattern throughout the year and whether they leave the study area. Up to now six individuals are marked.

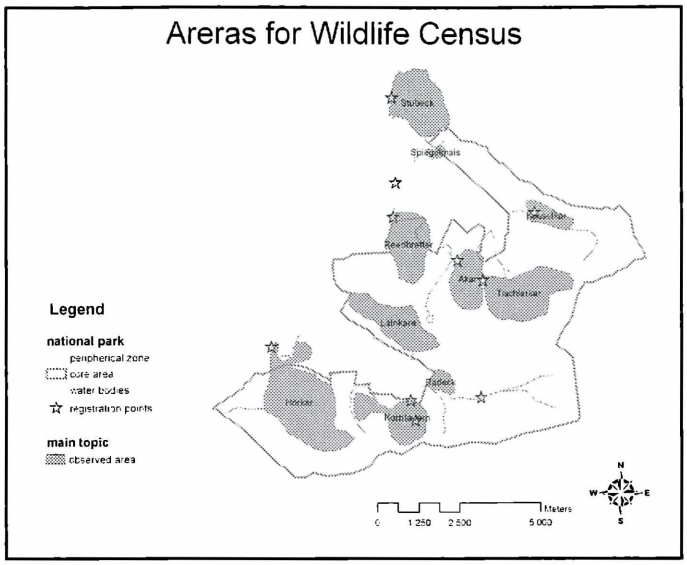


Fig. 2: Areas for wildlife census

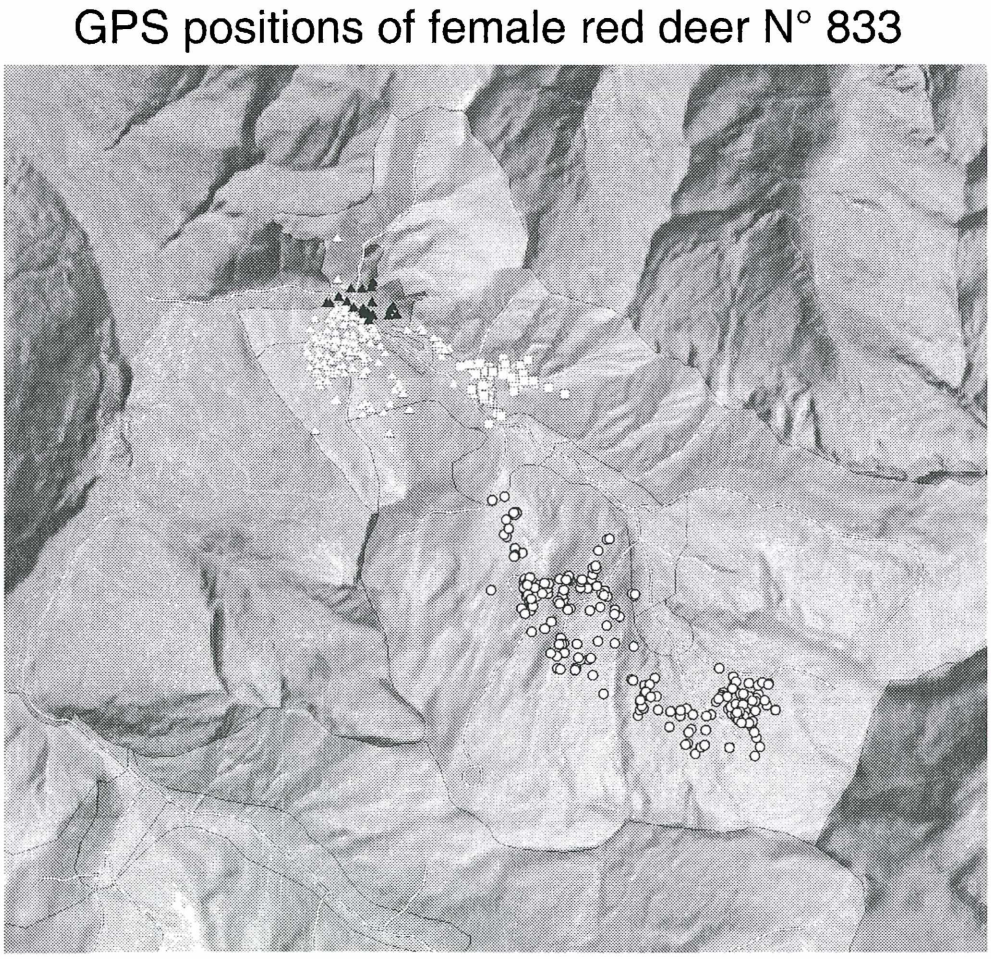


Fig. 3: Seasonal movement of female red deer N° 833 in 2004. Circles for summer, squares for winter (close to the feeding station) and triangles for spring and autumn (dark triangles outside of study area).

Regulation of ungulates

In order to become an internationally accepted national park (IUCN Kat.II) a main aim of wildlife management is to minimize the area (and duration) in which regulation activities occur. Following this aim the area where ungulates had to be shot could be reduced to 17% of the total study area. Only a very small part of this area (Kötschachtal, east) belongs to the core zone of the national park (figure 4). Focal hunting (figure 4; 7,2% of area) means intensive hunting activities during the whole hunting season (May until December) and is used to displace ungulates from sensitive forest regeneration areas which are very susceptible to game damage. Interval hunting (7,1%) means intensive but short duration of regulation (some days with suitable weather conditions for hunting) with periods of some weeks in between without any hunting activities to make wildlife less shy when fulfilling the shooting plan. Optional hunting (2,9%) means additional regulation areas used if otherwise minimum number of shooting can not be achieved.

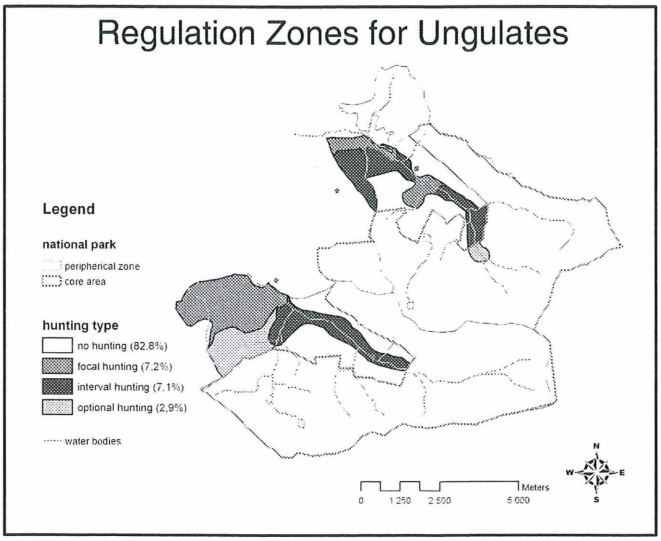


Fig. 4: Types of regulation zones for ungulates in the study area.

Impact of ungulates on forest vegetation

Sampling was established to monitor the impact of ungulates on forest regeneration. In the "Kötschachtal" the impact slightly decreased wheras in the "Anlauftal" a slight increas could be registered (figure 5). Since 2003 in addition fenced controll patches (exclosures, 6*6 m) were established to analyse the effect of browsing more accurate when comparing fenced patches (without deer) and unfenced patches (impacted by deer) every three years (REIMOSER et al 1999).

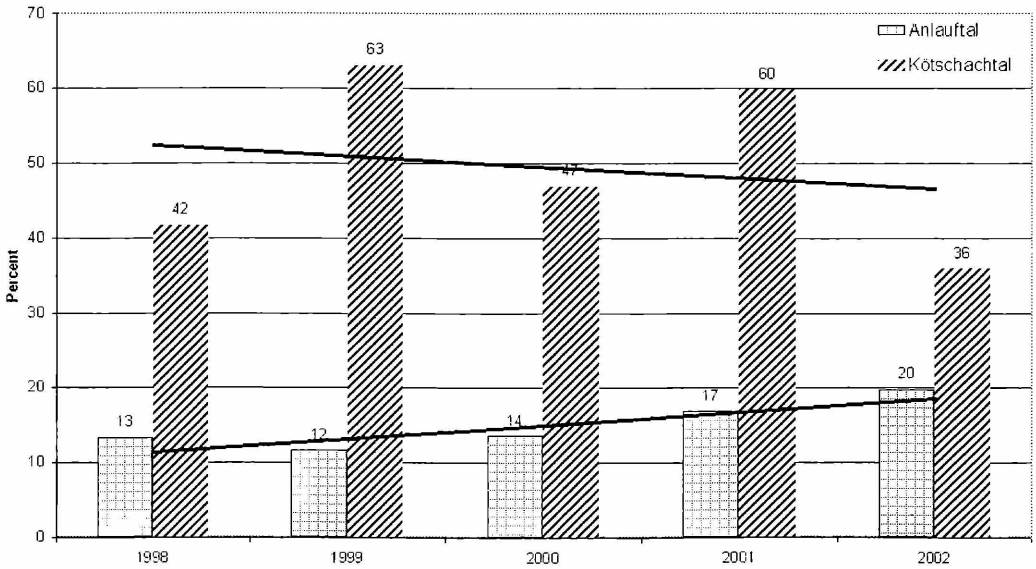


Fig. 5: Development of browsing intensity (proportion of top twigs browsed per year) in the hunting districts Anlauftal and Kötschachtal

## Discussion

At the beginning of the project there were particular difficulties to harmonize the new and restricted ungulate-regulation strategy of the national park with the common hunting strategies of the neigbouring hunting districts. In addition we faced similar harmonization problems concerning supplemental winter feeding strategy within the whole wildlife region.

One of the effects of the new management in the study area of the national park was reinforcement of discussion concerning the increasing red deer population and the responsibility to reduce and stabilize the population on a lower level. The question was, which hunting district (inside or outside the national park) is able to shoot the minimum number of red deer (females and calves) that is defined every year for the entire wildlife region by the public administration. To answer this question the spatial and seasonal distribution of red deer had to be investigated more accurately. One of the results of the current ungulate management was an increasing aggregation of red deer in optimal grazing habitats above and at the timber line during summer. Our regulation strategy neither allows shooting red deer in open areas above the timber line (it's the case in summer) nor at the feeding station (winter). Therefore regulation by shooting became much more difficult. There is only a short time period to carry out the neccesary regulation of red deer in spring and autumn (particularly May and October/ November). The beginning of the hunting season had to be started earlier (May instead of June) in order to fulfill the shooting plan.

Now an advantage is the increased activity of red deer in open areas during daylight that allows park visitors more frequent deer observation.

Following factors were important for a successful wildlife management in the study area:

- Clearly defined management targets.
- Qualified staff.
- Wildlife Ecological Spatial Planning (WESP; REIMOSER 1999) on large areas in cooperation with neighbouring hunting districts.
- Establishment of a systematic long-term monitoring of ungulate populations (development, seasonal distribution) as well as their impact on vegetation to for an objectivy the discussions.

General aspects to wildlife research in national parks:

- National Parks provide a good opportunity for ecosystem research based on a consequent long-term monitoring of key factors such as wildlife in the natural system. The results of such investigation offer knowledge generally useful as a basis for sustainable development of cultivated landscapes (REIMOSER 2002).
- Basic research as well as applied research in national parks can be very useful for sience and practise if the results are systematically connected in a holistic sense. This needs a better cooperation between the researcher of different domains and the practitioners (REIMOSER 2003).

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# A lab above the clouds (II) Aerosol and trace gas measurements at the Sonnblick Observatory

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## Abstract

Within the project "Backgroundmeasurements Sonnblick" major inorganic aerosol compounds as well as the trace gases sulphur dioxide, nitric acid and ammonia were collected with filterpacks at the Sonnblick Observatory (SBO). Daily samples were collected from Dec. 2002 until Oct. 2004.

The major inorganic aerosol compounds nitrate, sulphate and ammonia showed average concentrations ranging from 5,5 to 15 nmol/m³, while the trace gases nitric acid, sulphur dioxide and ammonia range from 2,9 to 19 nmol/m³. The calculations of summer to winter ratio represent the seasonal changes of the concentration values of the individual compounds. The highest ratio is found for ammonia, where differences between summer and winter concentrations are very pronounced. Sulphur dioxide, on the contrary does not present a marked seasonal cycle. Scavenging ratios were calculated to compare aerosol data with precipiation samples. The recent measurements were compared with a data set collected from 1991-1993 and we found good agreement between both series. Another comparison was performed for particulate sulphate determined with the Filter packs and a High-Volume at the same time at Sonnblick and showed good agreement.

## Keywords

Aerosols, trace gases, Sonnblick, scavenging ratios, sulphate, nitrate, ammonium, sulphur dioxide, nitric acid, ammonia, oxalat

## Introduction

The seasonal concentrations and the vertical distribution of atmospheric aerosols and trace gases depend on the strength and variability of their emission sources, their air chemistry behaviour and meteorological conditions. To get information about the vertical distribution of air constituents sampling sites at higher elevations are needed in addition to ground based measurements. These sampling platforms can either be airborne (e.g. airplane measurements) or they can be situated at mountain slopes or even mountain tops. As already mentioned before (A Lab above the clouds I) the SBO provides such a sampling platform.

## Results

Seasonal cycles of aerosol compounds and trace gases

The trace gases nitric acid and ammonia as well as the aerosol components nitrate, sulphate, and ammonium, showed lower concentration values in the winter months (November till January), than during the summer months (June tili August). In comparison with previous measurements at Sonnblick (KASPER and PUXBAUM, 1998), the increase of nitric acid concentrations occurred slightly later and is less pronounced. The concentration values for sulphur dioxide do not show marked difference between winter and summer. Except for these differences, the results of the recent measurements correspond widely with the trends of the years 1991 till 1993. (Figures 1a and 1b). Basically, both the measured concentration range and the annual cycle are very similar, especially in the winter months. That is the time when Sonnblick is influenced by the free troposphere.

Contribution received at: 15.07.2005

The evaluation of trace gases showed major differences, although the basic trends remained. During both sampling periods sulphur dioxide showed only a weakly pronounced seasonal cycle. Elevated concentrations are not driven by the air status at the site (like it is the case for the aerosol compounds), but rather determined by long-distance transport and cloud events (TSCHERWENKA et al. 1998).

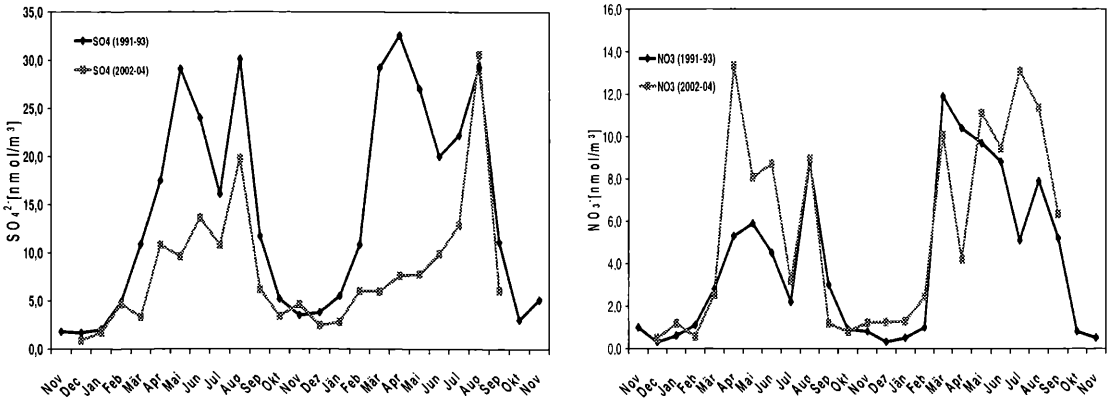


Fig. 1a and 1b: Comparison between aerosol measurements in 1991-93 and 2002-2004 for particulate sulphate and nitrate

Comparison of oxalate and sulphate concentrations

In attempting to characterize the organic aerosol fraction as well the determination of oxalate was included in the sampling program. Organic acids represent a significant contribution to the organic aerosol, in the range of 10% (LIMBECK and PUXBAUM 2000). Oxalic acid, a dicarboxilic acid that is very water soluble, is most frequently found in aerosol samples and often shows elevated concentration values. With respect to oxalic acid formation in the atmosphere, different mechanisms were discussed in the literature. The biomass combustion represents an emission source, whereas both the direct emission and the photochemical formation of this acid in an exhaust-gas plume are possible. Also anthropogenic sources are considered for the oxalic acid emission, whereas here the photochemical formation from hydrocarbon of antecedence is important.

Figure 2 compares the seasonal cycle of sulphate and oxalate at Sonnblick. The annual cycles of both compounds show good agreement, although oxalate concentrations are generally more than one order of magnitude lower than sulphate concentrations.

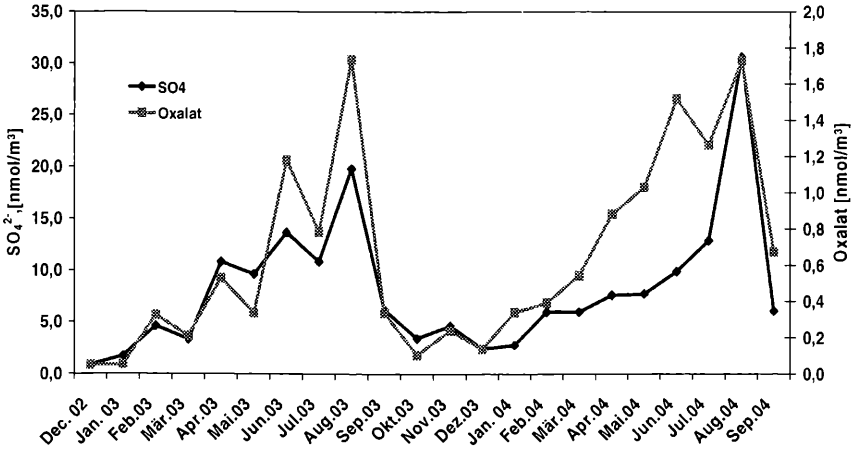


Fig. 2: Comparison between sulphate and oxalat concentrations

Comparison of aerosol data and gas phase concentrations and precipitation data

The collection of precipitation samples on a daily basis are carried out routinely since 1987 in cooperation with the Local Authority of Salzburg.

The concept of scavenging ratios is based on the simplified assumption that the concentration of a component in precipitation is related to the concentration of the respective compound in the air. Using this approach it has to be held in mind that the transfer of airborne compounds into the liquid phase and further to snow or rain is extremely complex (Slinn, 1984). Aerosol particles can act primarily as condensation nuclei. Thus they are already included in the cloud water drops when they form. Furthermore aerosol particles can be collected by the existing droplets via both, impaction and diffusion processes. Trace gases can also be dissolved in droplets. Especially nitric acid is very well soluble and reactive. In case of sulphur dioxide the uptake in the liquid phase does not depend only on the compound concentration in the gas and liquid phase, but also on another reaction partners (e.g. oxidation of sulphite to sulphate by hydrogen peroxide).

Sulphate, nitrate and ammonium determined in precipitation samples can be related to aerosol phase sulphur, nitrate and ammonium (aerosol scavenging) and to the trace gases sulphur dioxide, nitric acid and ammonia (gas phase scavenging).

Figure 3 show the annual cycle of concentrations in gas phase and in precipitation. Unfortunately, between November 2003 and May 2004 there was a longer loss of precipitation measurements because of a failure of the instrument for collection of precipitation. Even so, the regular trend of the concentration values in aerosol and in snow can be recognized.

Comparison between Filter packs and High-Volume

During the period of October 2002 untill September 2004 the SBO was one of six sampling sites operated within the EU project 'CARBOSOL'. In this project weekly aerosol samples were collected with a High-Volume Sampler $PM_{2,5}$ on quartz fiber glass filters. Figure 4 shows an intercomparison of the seasonal trend of sulphate measured with both methods, filter packs and High-Volume sampling. The results agree very well and can be taken as a starting point for further aerosol measurements at SBO based on High Volume sampling.

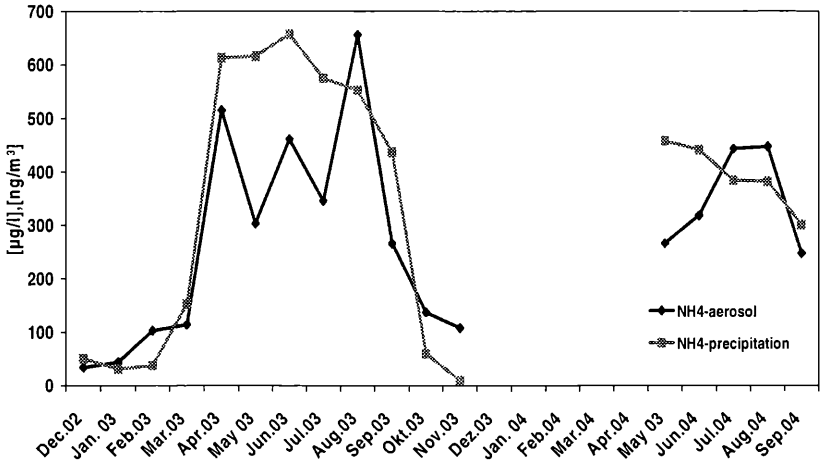


Fig. 3: Comparison aerosol and precipitation data for $NH_4^+$

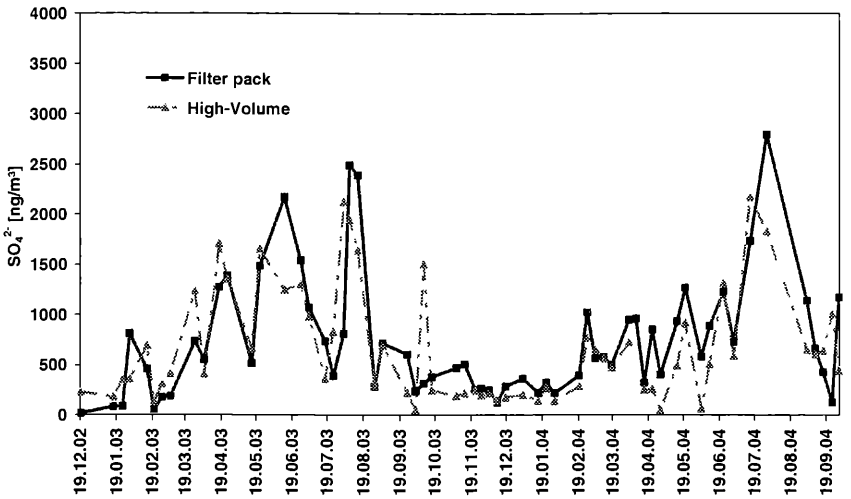


Fig. 4: Comparison between Filter pack and High-Volume for $SO_4^{2-}$

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# "Leben 2014": Perspectives for Regional Development in the National Park Region Oberpinzgau/Hohe Tauern (Case-Study) – Methods and selected Results

**Thomas Schauppenlehner, Andreas Muhar, Bernard Freyer**

## Abstract

The inter- and transdisciplinary project "Leben 2014" (= Life 2014) in the Nationalpark region "Hohe Tauern", Salzburg was a research and teaching project initiated by the BOKU University Vienna and the University of Salzburg. The Project was funded by the Austrian Cultural Landscape Research Program (KLF). During the project time 50 students from six disciplines (Geography, Sociology, Communication Sciences, Landscape Planning, Agriculture and Forestry) supported by 18 researchers from both universities worked on possible futures (scenarios) for the Oberpinzgau region together with more than 300 local participants (FREYER et al. 2004). The project concept was based on the scenario technique adaped for transdisciplinary case studies (SCHOLZ, TIETJE 2002, GAUSEMAIER et al. 1996).

The students and local participants were organised in 6 different inter- and transdisciplinary working groups, so called "polarity fields". Based on the results of detailed system analyses, each group developed various szenarios for the year 2014, which then were evaluated by local habitants. In a final step the groups elaborated convertible projects in context of the best-rated szenarios. Examples and results were taken from the polarity field "wilderness & culture" referring to the subject of the symposium.

## Keywords

Case Study Teaching, Scenario technique, Inter- and Transdisciplinarity

## Time Schedule

The lifespan of the project was 3 years from June 2002 to June 2005, subdivided into 3 phases.

Phase I, (June 2002 to September 2003): The prearrangement phase included the develoment of a network for all participants, the organisation of preliminary lectures for the students and the multi staged work out of themes in collaboration with local participants.

Phase II, (October 2003 to September 2004): In the beginning of the main phase, the students completed their lectures as a preparation for thematical and methodical pretensions of the project (until April 2004). The core phase started in April 2004 and was separated in 2 field phases in the Oberpinzau region (each with a duration of two weeks), a interim time (also two weeks) and a post-processing time of three weeks for finalising the reports.

Phase III, (October 2004 to July 2005): The final phase of the project was dedicated to reporting and publishing the results of the case-study. A first documentation of the results was published in April 2005 in the form of a handbook for the region (GLANZER et al. 2005). A second task for the phase was the embedding of the results in the region by identifying local responsibles and support for the implementation of the first convertible projects.

## Polarity Fields and Cross-section groups

Students and local participants were constituted in 6 working groups named "Wilderness & Culture", "Single & Together", "Inside & Outside", Fast & Slow", "Tradition & Innovation" and "Young and Old" The formation of these groups was based on the analysed results of the selection of themes in project phase I.

A polarity field represents a field of tension (MUHAR et al. 2005) and enables an interdisciplinary approach. The conception was based on the idea to integrate students from all six disciplines as well as local participants in each group to provide a wide range of knowledge. The size of the groups varied from 12 up to 33 members. Each polarity field was supported by lecturers from both universities (2-3 persons) to ensure a stable disciplinary and methodical background.

Contribution received at: 05.08.2005

Among their work in the polarity fields, the students participated in cross section groups named scenario technique and superior methods, data management, layout & speech, gender & cultural aspects, group monitoring, transdisciplinary coordination & communication as well as group process guidance, for superior working tasks and comprehensive interchange.

## Scenario technique – the methodology basis

The project conception was based on the scenario technique (GAUSEMEIER et al. 1996), adapted for transdisciplinary case studies at the Swiss Federal Institute of Technology (ETH) in Zurich (SCHOLZ, TIETJE 2002), which was structured into several process phases. First step was the scenario planning with problem definition and the definition of questions and goals. This was followed by the system analysis with data collection and identification of system components as well as influencing factors and their characteristics. System benchmarking was the next step using methods like SWOT, influence analysis and social network analysis. Based on the results of these steps the students developed scenarios by choosing key factors and description of scenario characteristics. This resulted in short scenario stories how the year 2014 could look like.

## Scenarios for 2014 from the polarity field "wilderness and culture"

"Big Bio Business": Marketing of a biological and sustainable production by installing networks for processing, marketing and sales and the creation of a sector comprehensive brand "Oberpinzgau"

"Oberpinzgau – Today and Tomorrow" (trend scenario): Tourism as well as agriculture and forestry still have an important function in the region. There is a larger dichotomy between the national park region in the south and the easy accessible touristic regions in the north of the valley.

„Beautiful new old world Oberpinzgau": The region is well-positioned for eco- and nature tourism. Due to the climatic change, the winter ski tourism disappeared. To provide a "perfect natural scenery" the farmers get paid by the tourism companies to obtain meadows, pastures and mountain pastures.

"Much wood outside the hut...": Snow- and timber line rise in consequence oft the climatic change and the lack of cost-effectiveness for agriculture in unfavourable sites increases. As a bulk of the forests is semi-natural, this quality results in a wood-Cluster and a brand for semi-natural products.

These scenario storys were evaluated by local habitants in a public scenario evaluation event, which resulted in a best rated scenario for each polarity field. For the group wilderness & culture the "Big Bio Business" scenario was the most popular. Based on this output the last phase, the scenario transfer started. On this stage, each polarity field developed convertible projects as a position of points for reaching the scenario-conditions in 2014. To integrate these project ideas into regional planning processes, local key personalities for several projects were identified.

## Discussion and future prospects

The project was a big challenge for all participants and ended successfully after all. A goal from the beginning was, to implement several convertible project ideas. In October 2004 local representatives selected five projects for the prior realisation. Examples are the project "KunstVerjüngung", a land art-project for the afforestration of windbreak areas, that was started in cooperation with the "Österreichische Bundesforste AG" (ÖSTERREICHISCHE BUNDESFORSTE AG, 2005, S69) and the concept for an active regional alliance.

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# Preservation and dynamics – The charge of conservation in national parks in reflexion to autogenous processes

**Wolfgang Scherzinger**

## Abstract

Taking the natural development of woodlands in Bavarian Forest National Park as an example, this contribution points out the role of undisturbed stands of old growth forest, to preserve species of the "forest-interior-climate", which are mostly stenoecic. But on the other hand it also discusses the significant potential of creating habitats by disturbances of ecosystems (like wind throw, insect infestation), which are essential for the diversity of the "forest-exterior-climate" Constancy and catastrophe are positioned at the extreme ends along a scale of natural development, which are represented by the "climax"-phase of mature old-growth-stands and by large clearings, created by destruction of former tree stands respectively. On the one hand, the "preservation" of the typical diversity of whole the system is only conceivable under the influence of the "dynamics" of natural disturbance. On the other hand, characteristic species and even a whole biocenosis could be threatened locally or even eroded regionally by disturbances of catastrophic dimensions! Therefore, preservation requires a balance and a connection between the various phases of development in natural forest, so that locally displaced organism may evade and retreat to alternative patches of suitable habitats within the diverse mosaic of tree stands.- Demonstrating the high importance of large areas, of length of time, and of a compounding network of habitats for preserving the typical biodiversity, the topic is of high relevance for conservational planning, but also opens new fields for ecological monitoring of self-organizing ecosystems.

## Keywords

climax, disturbance, catastrophe, self-organization, biodiversity, preservation.

In accordance with the guidelines of IUCN (1994) national parks as reserves of category II fulfil quite complex charges, as they should preserve – at a level first priority each – a natural development of ecosystems, free of human influences, as well as the biodiversity, typical for the area and in a state as natural as possible. The idea of founding such large-scaled reserves reaches back for 130 years already, when Yellowstone area was designated as a national park in 1872, aiming at the conservation by suffering autogenous development – as "hands off"-management. During the last part of 20$^{th}$ century the "philosophy" became enlarged, and as a consequence secondary habitats got included also, which were altered by human utilization and management, as far as they indicate a potential for "retrogression" to a landscape with secondary naturalness. The new conception of "developmental national parks" made foundations of such reserves possible even in Central Europe, where man partly used and shaped the landscape for 5.000-6.000 years.

As one of the first national parks of this new type the Bavarian Forest National Park was founded in 1970, for preserving a characteristic section of mountainous forests and their local flora and fauna, at the south-western slopes of "Bohemian Massive" Forests in this reserve, covering 130km² for the first time and 240km² after enlargement in 1997, are logged since medieval times at least, but timber harvest of economic value started 150 years ago only. Therefore the woodland stands out for relicts of primary forest as well as for representative parts of mountainous forests in a state near to nature. In the years of establishment the management of national park was according to the "climax-thesis" of classical theory of ecosystems. According to the expectation that any autogenous development of forests teleologically will follow in concern to the conception of the "potential natural vegetation", even man made ecosystems should change to divers and stable systems at the highest level of naturalness, as soon as man retreats from management. Due to this natural determination an additional preservation of endangered species will be superfluous, and therefore the conception of "doing nothing" should be the safest and cheapest way to develop a "primary forest for tomorrow"

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Since 1972 the census of various organism confirm the high value of old growth tree stands, as they are distinguished from commercial forests by special structures and by richness of dead and decaying wood. Their long lasting constancy of development and lifespan is a preposition of high diversity and high abundance in fungi, lichens, mosses, and especially in xylobiontic insects, and in vertebrates dwelling in tree-caves as well (like bats, woodpeckers, small owls).The results seem to be in accordance with the expectation, that even tree stands of formerly used forests possess the ability to develop secondarily to a "primary forest", with a high constancy of growing, a natural age-structure in trees, and a high stability of stands.

Fig. 1: Disturbance by storm and bark beetle infestation destroyed about 80% of old spruce forest in the highland of Bavarian Forest National Park, what not only induced a turnover of bird species composition, but also increased the risk of extinction in some species.- A strong challenge for management in the reserve! (Photo W. Scherzinger)

After 30 years of non-ruled development of forests, the real occurrence turned out to be much more complex, as natural dynamics do not only follow a linear succession from young rejuvenation to old climax forest, but also may release disturbances of ecosystems, which might change habitat conditions drastically – in a chaotic and unforeseen way: Caused by a wind blow on August 2nd 1983 not only 170ha of forest was destroyed, but also the remaining trunks of broken or uprooted trees initiated an insect infestation, resulting in the destruction of far greater parts of the forest. The attack by the bark beetle *Ips typographus* killed about 4.000ha of old spruce stands up to now, mainly in the natural spruce forest at the mountain ridge!

For monitoring the effects of this abrupt change for the fauna, in concern to structures, insolation and nutrition, the turnover of bird species was observed - exemplary – in a control area in highland forest of about 75ha during 12 years (1989-2000, grit-system with 1ha-grit units): For the first time the situation rich on insect prey and dead wood respectively was of profit fore the woodpeckers. Their number of species increased from 2 to 6, the number of individuals from 3 to 30, whereas the Three-toed Woodpecker (with max. 11 individuals), the Great-spotted Woodpecker (max. 8) and the Black Woodpecker (max. 7) used the area regularly. Due to the progressive decay of the canopy and the gradually collapse of the dried trunks the cover was decreasing step by step, what caused the woodpeckers to avoid the catastrophic area after a few years already, although the supply of prey kept quite high! Songbirds living in the canopy were affected especially (like tits and gold crest – as insectivorous species, and crossbill and siskin – as granivor species). This development could increase endanger of Capercaillie, as this grouse species found its gravity of distribution in just this spruce forests of the mountainous highland, where about 80% of its traditional habitat got lost – at least passing by.

Individuendichte 1989-2000

| | Sommer | Winter |
|---|---|---|
| 1989 | 383 | |
| 1990 | 99 | |
| 1991 | 163 | |
| 1992 | 201 | |
| 1993 | 305 | |
| 1994 | 226 | |
| 1995 | 188 | |
| 1996 | 791 | |
| 1997 | 187 | |
| 1998 | 258 | |
| 1999 | 250 | |
| 2000 | 232 | |

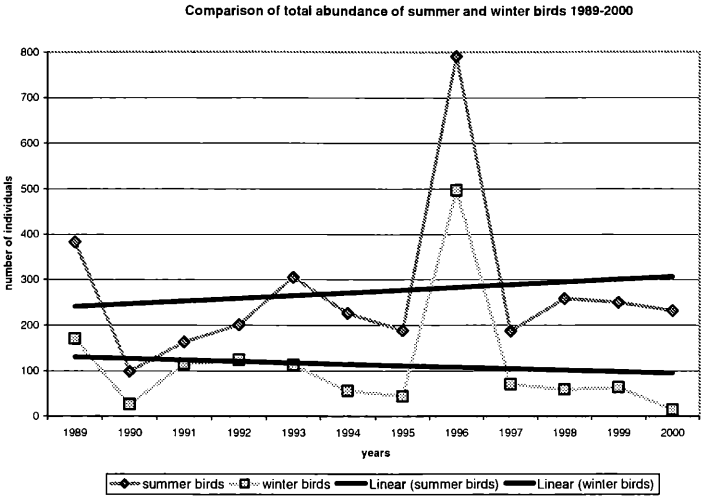


Fig. 2: During the first years after dye back of the spruce stands the bird fauna went through a depression, which continued for the winter situation, when habitat is characterized by great amount of dead wood and high snow cover. But abundance of summer birds is increasing continuously, as soon as herbs, shrubs and tree seedlings get established. The peak in 1996 is caused by an uncommon strong seed mass.

But beside the "losers" of this dramatic development also a number of "winners" within the birds can be recognized, as soon as a new vegetation of pioneer plants, like blueberry brush, tall perennial herbs and sapwood, gets established: species hunting on ground (like thrushes), species using the bush-layer (like warblers), and species of tree steppe (like red start and tree pipit). The chaotic supply of uncommon structures (like broken and laying trunks, uprooted trees) supports wren, robin and dunnock. Due to their higher adaptability euryoecious bird species altogether seem to benefit from this situation, whereas the more stenoecious specialists of old growth (like woodpeckers, Capercaillie) are rather handicapped.- Only 22 years after the storm, and 17 years since the emergency of larger areas of bark beetle infestation in this elevation, the rejuvenation of the succeeding tree generation already is in vital progress, so these new habitats in the young openings will get displaced quite soon by natural succession.

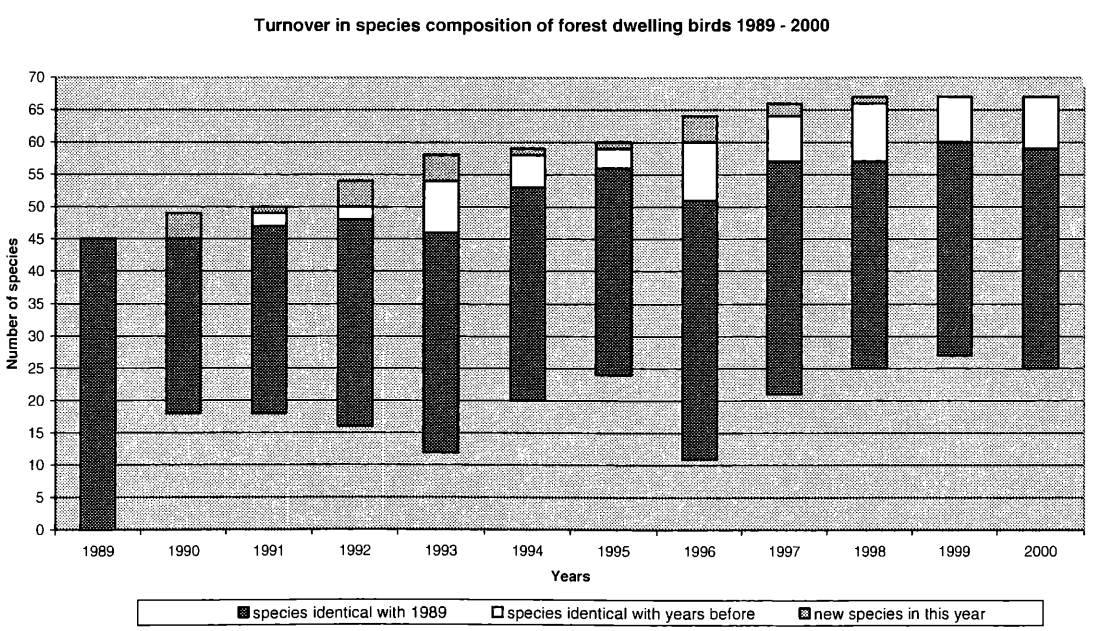


Fig. 3: Within the 12 year period of monitoring, the diversity of species altogether seems to increase from 45 to 67, as each year some species appear, which are new for the mountainous spruce forest. But bird species of the former association get lost every single year also: The result of this turnover is 22 species new, 34 identical with the first year and 11 lost.

When disturbances by storm, fire, flooding or insect infestation were valued negatively and fought – where ever possible even by conservationists till today, present interpretations of natural processes in ecosystems do recognize such events as essential motor for development of a diverse mosaic of habitats and a rich biodiversity. In consequence preservation of "processes" became the main tool of management in national parks. In accordance with the slogan "*allow nature to act naturally*" the expectation arouse, that natural dynamics autogenously will result in a balance between long living stands of old growth and short living patches of disturbance. In such a divers mosaic of habitats all the organism belonging to the local ecosystem should find sufficient areas for retreat and dispersal. But the example of Bavarian Forest National Park demonstrates strikingly, that size of the reserve, duration of interval and intensity of disturbance make the decision, if the succeeding development will have positive, balanced or negative effects for the concerned species. A centennial event, like the bark beetle infestation in the montane forest, does influence the supply of habitats inside and outside the borders of the reserve, what calls for a clear cooperation in management with the surrounding, to preserve plant and animal species, which are affected especially by dynamic changes.

The paper illustrates, that conservational practice reaches a level of socio-politic relevance, as soon as its conceptions allow nature to act within its own dynamic: the mutualism between chaos and order by seif organization requires huge areas, long time and a functional compound with the surrounding environment, and need full acceptance for "wilderness", developing just by chance.

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# Research in Alpine protected areas: importance and issues of international co-operations

**Thomas Scheurer**

## Abstract

Current international projects and co-operations of Alpine protected areas are focusing on three main issues: Visitor information and management, management of biological ressources, and global change issues. Exampels of successful international co-operation are WebPark, Habitalp, WWF-Programme „Biodiversity in the Alps", Glochamore, Gloria, as well as MMV-Conferences and some ALPARC working groups. In future, alpine protected areas should help to build up frameworks favorable for research co-operations such as common monitoring programs, databases publishing current research projects, regular scientific meetings and a new journal specialised on research in mountain protected areas.

## Keywords

research co-operation, protected areas, management, biological resources, tourism, global change, European Alps

Protected areas are part of „learning regions" striving for sustainable development and land management. Scientific research is an important partner for them, to initiate, to promote and to implement knowledge-driven processes. International research co-operation among protected areas can provide access to recent knowledge and to new methods, and tools for information and management.

## Topics of current international research co-operations

Current international projects and co-operations of alpine protected areas are focusing three main issues: (1) Visitor information and management, (2) management of biological resources, and (3) global change. Selected successful examples for international research co-operations are:

(1) Projects with a focus on the development of appropriate tools for visitor management and information: WEBPARK (Geographicallay relevant information for users in protected areas; 2001-2004) is an EU-funded project aiming at the development of software packages to provide information on a given area, place or topic at the visitors disposal by means of GPS and a pager.
The bi-annual Conference MMV (Monitoring and Management of Visitors Flows in Recreational and Protected Areas) – the frist has been held in 2002 in Vienna (Austria) – is aiming to develop methods and practices for visitor management in ecologically sensitive areas.

(2) Projects developing strategies and for biological resource management: Such strategies need to be developed on a methodological rationale and a large scale view (larger than protected areas). Three current projects are progressing is such a direction:

- The Programme „Biodiversity Vision for the Alps", leaded by a consortium of WWF, ALPARC, CIPRA and ISCAR, gathered in 2002 about 70 experts from all relevant disciplines and alpine areas to select priority areas for conservation of biodiversity (WWF, 2004). Finally, 23 areas have been selected all over the Alps, most of them including at least 1 protected area. In a next step an action plan has to be worked out for each priority area, which provides good opportunities for protected areas to integrate their management plans.
- Ecological networks are crucial for preserving the biological integrity of protected areas. ALPARC recently published a study focusing networks among protected areas (ALPARC 2005). To establish ecological network all over the Alps, WWF, and ALPARC are co-ordinating a project to delimit potential connection areas inside the Alps as well as between the Alps and the neighboring lowlands and mountain ranges.

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- With the INTERREG-Project HABITALP 11 alpine protected areas are designing a common typology and methodology for the inventarisation of habitats. This work will enable protected areas to install a common monitoring scheme for land cover and land use change.

(3) In future, most of the mountain protected areas have to deal with the effects of global change. The Mountain Reserach Initative (MRI) and UNESCO initiated a EU-funded project GLOCHAMORE (Global Change in Mountain Regions; 2003-2005), which aims at the development of a research and monitoring strategy regarding the causes and consequences of global change in a selection of 28 UNESCO Mountain Biosphere Reserves (MBRs) around the world. Following GLOCHAMORE, protected areas should take an important role in the survey of the impacts of global change and in designing appropriate managment strategies to enhance the local adaptive capacity. The GLORIA project (Global Observation and Reserach in alpine Environments), a global network including an important number of protected areas aims at monitoring vegetation change on mountain summits that is tiggered by climate change.

Research co-operations among protected areas should pay more attention to topics like regional development integrating protection issues and encouraging the participation of local stakeholders, forest change and forest fires.

## Enhance future research co-operations

For their own profit, alpine protected areas should engage in building up frameworks favorable for research co-operations. Some of suitable strategic orientations are:

1. The development and implementation of joint monitoring programs to generate comparable data sets and tools for data analysis
   - Co-operation in working groups of ALPARC (e.g. predators, springs, etc.) or in global programmes as GLORIA or as proposed by GLOCHAMORE.
   - Add existing monitoring data in the TEMS-Database: http://www.fao.org/gtos/tems/mod_mou.jsp
2. To enable a co-ordinated research planning in each protected area, information on current research and monitoring projects in Alpine protected areas should be made available to everybody.
   - Provide information of current research projects to the database „European Mountain Pool" hosted by ALPARC: http://www.alparc.org/europe/index.html)
3. For better dissemination of scientific findings from protected areas, the creation of a new scientific journal specialised on issues from research in mountain protected areas, as proposed by ALPARC, should be reasoned. An appropriate example could be the American journal „Geology", which is publishing short articels of 4 pages.
4. Scientists which are leading projects in alpine protected areas should meet regularly for international and interdisciplinary exchange, such as at the Symposion for Research in Protected Areas organised by the Hohe Tauern National Park (Austria), at the Young Scientists International Meeting in Trafoi organised by the Stelvio National Park (Italy) or at the ForumAlpinum organised by ISCAR.
5. Alpine protected areas should promote research projects related to the multi-annual working programme 2005-2010 of the Alpine Convention, to profit from research networks throughout the Alps.

Protected areas have to play an active role in promoting international research co-operation. The importance of such co-operations will increase in future, as both, economic development and environmental issues in mountain areas will necessitate common databases and analysis for the development of successful management and protection startegies.

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## Web-Links

WebPark: http://www.webparkservices.info/

MMV3: http://www.wsl.ch/mmv-3

Habitalp: http://www.habitalp.de

Glochamore: http://mri.scnatweb.ch/content/category/3/10/31/

Gloria: http://www.gloria.ac.at

Research: http://www.alparc.org/europe/index.html

## Acronyms of Institutions

WWF: World Wildlife Found

CIPRA: International Commission for the Protection of the Alps

ALPARC: Network of Alpine Protected Areas

ISCAR: International Scientific Committee on Alpine Research

TEMS: Terrestrial Ecosystem Monitoring Sites

GPS: global-positioning system

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# Climate fluctuation in the Alps during the last 250 years

**Wolfgang Schöner, Ingeborg Auer, Reinhard Böhm**

## Abstract

Within EU-project Alp-Imp climate fluctuations in the Alps for the last 500 to 1000 years have been investigated. Beside climate proxy data (tree rings, ice cores) special weight is put on careful analyses of instrumental time series. These data series were quality checked, homogenised and interpolated to a 1°x1° lat/long spatial grid for monthly values (HISTALP data base). Longest series of the data base date back to 1750. However, not only the long time span and data quality makes this data base to a unique example of input data for assessment of both climate change and climate impact but also the vertical extent of climate station from low level sites to high mountain observatories offers the opportunity of three-dimensional evaluations. The high mountain observatory at Sonnblick with its multi-elemental series back to 1886 takes an especially important role for the HISTALP data base and related climate change assessment. On short term (inter-annual) time scale the climate of the Greater Alpine Region (GAR) can be described by five sub-regions (derived from principle component analyses of monthly values) which fits well with a subjective spatial clustering of mean annual course of station series. This sub-regionalisation holds for both air temperature and precipitation. On long term scale GAR air temperature series show a uniform trend for the last 250 years whereas precipitation trends are spatially diverse. Since 1890 GAR annual air temperature has increased by about 2°C. The investigation of changes in temporal variability of both air temperature and precipitation show a decreasing trend which coincide with a decreasing thermal continentality of the GAR.

## Keywords

Climate change, Alps, HISTALP, homogenisation, air temperature, precipitation

## The HISTALP data base

The HISTALP data base (AUER a.o., 2005) stands for high quality (homogenised, outlier-corrected, gap-filled) long-term instrumental time series covering the Greater Alpine Region (GAR), both in a station and gridded mode. The spatial coverage (which covers the transition zone between three most important climate regions of Europe: Mediterranean – Atlantic – Continental) is shown in Figure1 for the example of air temperature and precipitation. HISTALP includes not only air temperature and precipitation but also several other climate elements like air pressure, sunshine duration, humidity and vapour pressure. For the present release of HISTALP temporal resolution is mostly monthly values but increase of temporal density to daily values is planned for the future. Both the long time span back to 1750 as well as the altitudinal coverage from low level sites up to 3500m a.s.l. for the entire GAR make the HISTALP data set to a unique contribution to climate change assessment and impact studies. Whereas the gridded mode of instrumental series is 1°x1° (relative series) reconstruction methods offer spatially high resolution (10 minute lat-long) long term data sets of absolute values for air temperature and precipitation which are also part of HISTALP.

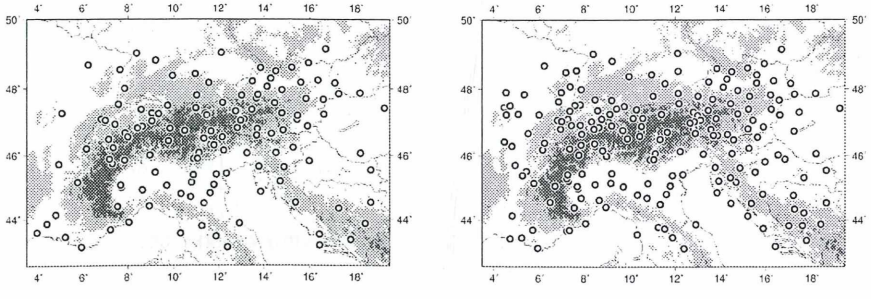

Fig. 1: The HISTALP GAR station network for the climate elements air temperature (left) and precipitation (right)

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## Air temperature trends in the Greater Alpine Region

On short term scale the GAR can be regionalised (rotated principle components of normalised monthly series of air temperature) into five different sub-regions. The long term trends of air temperature for these five sub-regions are spatially homogenous not only for annual values but also for seasonal values (but long term trends are seasonally different). Figure 2 shows the long term trend of air temperature of the GAR for the example of two different sub-regions, GAR low-elevation and GAR high-elevation, respectively. The time series show a common increase of about 2.0°C since about 1890 for annual values which is much higher compared to the global warming of about 0.6°C for the same period (BÖHM a.o., 2004). Beside other effects this difference becomes clearer if one takes into account that 2/3 of the earth surface is covered by ocean water which has a higher capacity of heat compared to continental land masses and therefore results in damped temperature variability on global scale.

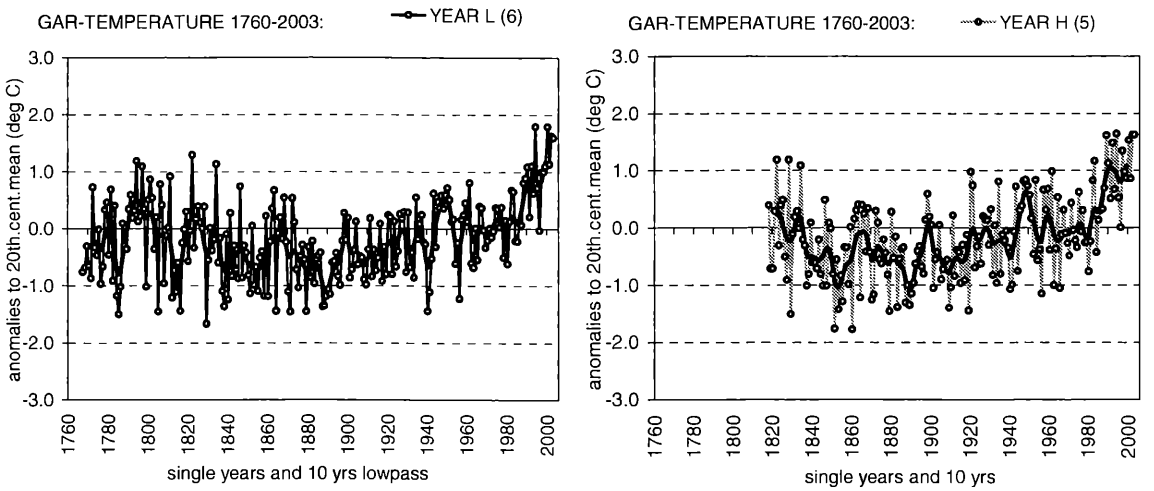


Fig. 2: Long term trends of air temperature for GAR sub-regions low-elevation (left) and high-elevation (right)

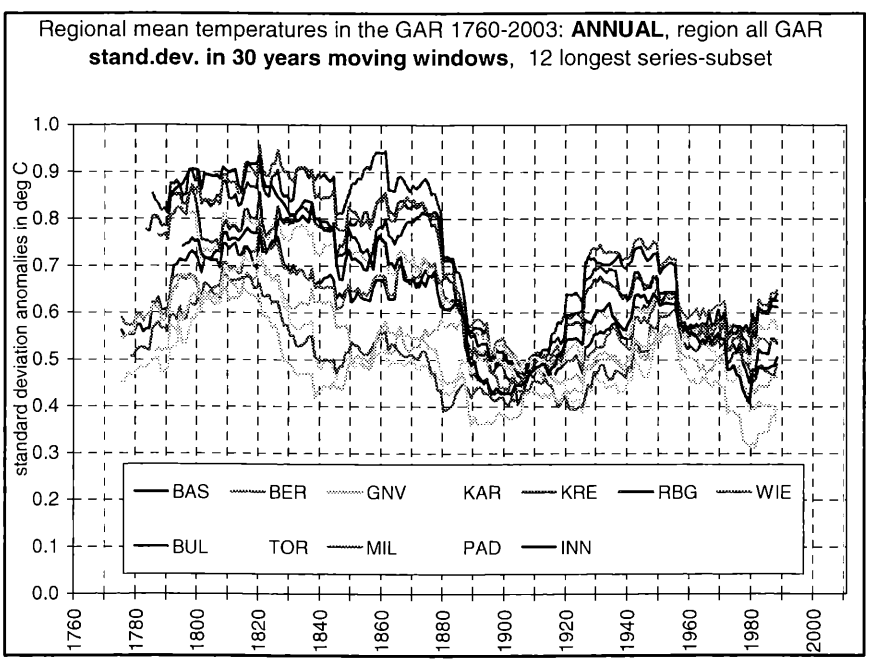


Fig. 3: Time series of annual air temperature variability (30 years moving window technique) for the GAR within the last 200 years for the 12 longest series-subsets

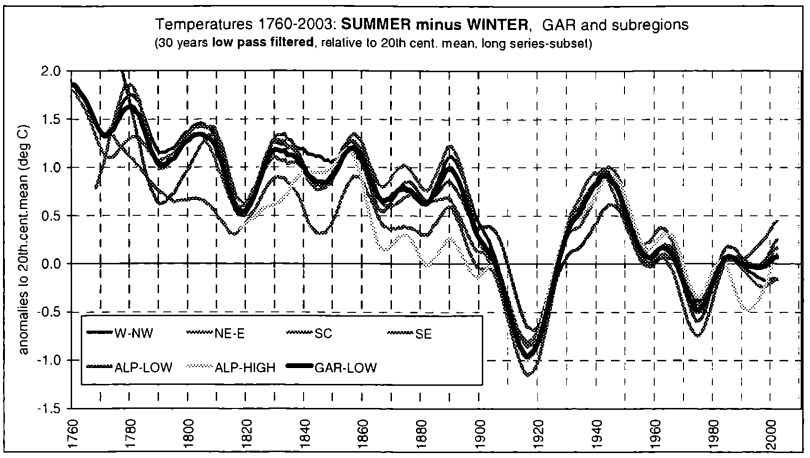


Fig. 4: Low-pass filtered time series of thermal continentality (summer air temperature minus winter air temperature) for different sub-regions of GAR

Another matter of high interest in climate change research is the investigation of changes in variability of climate elements – which could answer the question if the climate has become more variable or not. Figure 3 shows the temporal evolution of the standard deviation of annual values of air temperature for the 12 longest series subsets. It can be seen from the figure that temperature variability is in general decreasing within the 200 years period. This decreasing trend coincides very well with the decreasing thermal continentality within GAR as shown in Figure 4.

## Precipitation trends in the Greater Alpine Region

Whereas on the time scale of inter-annual variability GAR precipitation coincides with the 5 air temperature sub-regions on the long term scale precipitation trends are quite spatially different. Figure 5 shows the example of two different sub-regions (NW and SE) which show in general an opposite trend within the 200 years period (increasing for NW and decreasing in SE for about the last 100 years).

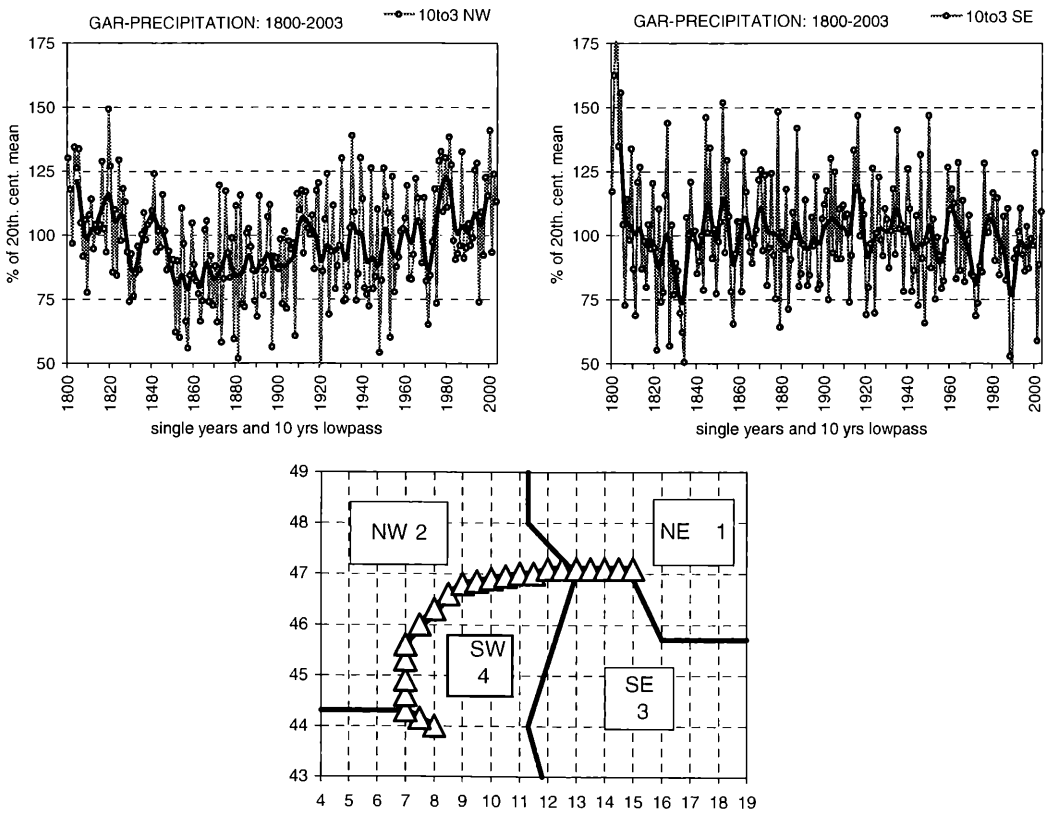


Fig. 5: Example of different long term trends of annual values of precipitation for sub-regions NW (left) and SE (right) of GAR

## Conclusions

- For investigation of short term scale (inter-annual variability) the Greater Alpine Region has to be divided into five sub-regions for both air temperature and precipitation
- Long term trends (decades to centuries) of air temperature and precipitation are different for individual seasons within the Greater Alpine Region
- Spatial differences of long term trends of air temperature are not existent and the computation of a GAR temperature trend is useful and representative for all sub-regions
- For precipitation sub-regional trends show different in some cases even opposite behaviour (the computation of a GAR precipitation trend is not useful and therefore sub-regional trends have to be used for climate trend analyses)
- For monthly values of both air temperature as well as precipitation the temporal trend of variability is rather decreasing than increasing within the last 200 to 250 years and coincide with a decreasing thermal continentality

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# Natura 2000 management plans specifically designed for the Natural Park Trudner Horn and the Natural Park Fanes Sennes Prags
# Conservation measures, issues and future perspectives

**Helga Seeber, Renato Sascor**

The creation of the Natura 2000 network is often referred to as the "cornerstone of Community nature conservation policy". Article 6 of the Habitats Directive (92/43/EEC) plays a crucial role in the management of the sites that make up the Natura 2000 network. With the spirit of integration in mind, it indicates the various tasks involved so that the nature conservation interests of the sites can be safeguarded.

In South Tyrol, located in the alpine area of Northern Italy, 42 sites have been designated in accordance with the Habitats Directive and 17 sites according to the Birds Directive (79/409/EEC), since 2000. The Natura 2000 sites are presently covering 19.9% of South Tyrol's total area, which corresponds to 147.428 hectares. They include the Nature Park Trudner Horn as well as the one of Fanes Sennes Prags. In both parks the types of natural habitats belonging to the Natura 2000 network have been designated and registered on maps.

From 2004 to 2005, the conservation status, the conservation objectives and possible development measures for the natural habitats were defined and the data were summarized in so-called Natura 2000 management plans. The Natura 2000 management plans were realized by two working groups. As it was for the pilot management plan of the Nature Park Schiern, during the implementation period of both plans, the local authorities and population were involved. Several information meetings were organized as well as gatherings between the working group, the responsible of the natural park and the community of interests, in order to discuss possible conservation and implementation measures as well as critical topics.

After the collection of basic data regarding ownership, the actual hydro-geological, touristical, agricultural and forestry land-use along with the legal dispositions for the protected area, the Natura 2000 habitats, flora and fauna were classified on site by use of specialized literature. Moreover, the actual status of the habitats was evaluated in accordance with the Natura 2000 objectives. The collected data were saved in a GIS data base, in order to facilitate the evaluation of information and to be able to follow future developments as well as to guarantee a faster implementation of further measures. The next steps were the definition of the aims of preservation along with the measures of preservation. These tasks required further discussions that have not yet been concluded. It has already been partially possible to determine how and with which financial means the measures will be carried out. Economic interests, high implementation costs and private interests are currently hindering the establishment of a definitive catalogue of measures.

In the future, solutions should thus be found through EU fundings, whereas conservation measures should also be embodied in laws. Since a well structured Natura 2000 management plan facilitates the implementation of an overall concept of a natural park, the drawing up of environmental impact assessments regarding projects in Natura 2000 sites as well as the writing of Natura 2000 interim reports, in the future it would thus be desirable to integrate it into the natural park plan. Development plans like these ones are not only useful tools for the daily management of natural parks or protected areas; they are also important when it comes to obtain more easily and rapidly funds for certain projects through several programmes, to guarantee funding for nature protection and, as a result, to increase the acceptance of protected areas among the population.

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# Weiße Hölle – Hölle Weißsee
# Forced Labor at 2.300 meters above sea level

**Nicole Slupetzky**

## Abstract

Already during the Habsburg monarchy water power plants were an important topic. In 1913 the first plans were developed to build a water power plant in the Stubachtal. On the contrary 11 km² turned into a national park, in 1921 another 90 km² in the region of the Granatspitzgruppe. Parallel the Austrian Railway Company (ÖBB) built the first dam wall at the Taunermoossee which was finished in 1929.

After Austria's "Anschluss" to the German Reich the Stubachtal turned to be a huge construction area of the German Railway Company – Deutsche Reichsbahn. At the beginning many civilian forced laborers from Poland, Ukraine, France for example had to work here. With the beginning of World War II the first Prisoners of War were forced to work here. Through the whole valley wooden huts were built, miserable shelters for the laborers. The working conditions differed extremely depending on the fact where one was assigned for. The worst case was to be assigned to the area of the lake Weißsee in 2300 meters.

The camp Weißsee turned into a concentration camp in 1943 at was officially an auxiliary camp of Dachau. People from different nationalities were forced to work in this area. They had to do heaviest work. Three huts were used for shelter for 450 inmates surrounded by heavy barbed wire, so noone could flee. People suffered without any chance of getting out of hell on earth. In May 1945 American GIs freed the concentration camp Weißsee.

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In Austria, as compared to Germany, the topic "forced labor (Zwangsarbeit) during the Nazi regime" was underrepresented in both scholarly research and in the dialogue taking place in the public sphere for decades. Although an increasing number of historians concentrated on the subject, it is still an unknown chapter of the Austrian past. While research has focused on forced labour in Austrian industry – for example the Hermann Göring Works in Upper Austria – other areas such as the province of Salzburg have been neglected until last year were a three year research project ended and a book was presented.

Though there was no major industry in the province of Salzburg, more than 22 % of all workers were forced laborers during the Nazi-period. In 1943 about 17,000 were foreign civilian forced laborers, concentration camp prisoners and Jews, POWs not included. In Salzburg water for producing energy was very interesting for the Nazis, so two big projects were started. At about 2,300 meters above sea level, dams were to be built to accumulate huge storage reservoirs at the areas of Mooserboden (Kaprun) and Weißsee (Uttendorf). Here the highest labor camp of the Third Reich was set up as an auxiliary camp of Dachau; more than 450 people worked there under terrible conditions.

Agriculture is another sector of economy in which thousands of forces laborers had to work. The drift to the cities of thousands of farm workers during the 1930 's caused huge labor shortage in farming. The situation got worse after the beginning of the Second World War, when young men who had worked as farm hands were drafted. In the province of Salzburg more than 3,500 forced laborers – the majority of whom were Polish and Ukrainian – were forced to work for Austrian farmers.

Soon after the Anschluss the Reichsgau Salzburg created already the first camps. The first victims were Jews and Gypsies who were not only working for big Austrian companies in the city of Salzburg but also in small towns in the middle of nowhere. In 1940 after the first military victories the Nazis added the prisoners of war to the working system and last bun not least brought hundreds of thousands of foreign civilians into the Ostmark. To organise the use of laborers the Nazis created a widespread system of camps and a perfect way of distributing the workers. Although parts of this history are well known the research focused on the big concentration camps, such as Mauthausen, Gusen or Dachau but neglected the small auxiliary camps that existed. Even

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many small villages had more then one hutted camp, the best example is the community Uttendorf in the province of Salzburg. [1]

The history of huge storage reservoirs did not start with the Nazi-period. Already during the Habsburg monarchy water power plants were an important topic. In 1913 the first plans were developed to build power plants in the Stubachtal. On the contrary 11 km² turned into a national park, in 1921 another 90 km² in the region of the Granatspitzgroup were declared protected. Nevertheless the Austrian Railway Company (ÖBB) built the first dam wall at the Tauernmoos lake which was finished in 1929. After Austria's Anschluss in 1938 the ÖBB were integrated into the German Railway Company the Deutsche Reichsbahn. The Stubachtal turned into a huge construction area. Already at that time many different nationalities worked for the construction companies in the Stubachtal. About 29 % of the workers were foreigners. Until 1941, mainly Italians (13%) as well as many workers from Eastern Europe worked here. Not all of them were forced laborers. With the beginning of the Second World War the first prisoners of war from Slovakia and Poland were forced to work for Austrian companies.

On 22 March 1942 more than 150 people from different nations worked to construct the power plants in the Stubachtal and create huge water storage reservoirs. From now on the number of foreign civilians as forced laborers from Poland, Ukraine, Russia, Yugoslavia, Italy, France and other nationalities increased continuously. Throughout the whole valley hutted camps were installed as the following figure shows.

| Lager | Seehöhe | Einsatzort | Baracken | Jahr |
|---|---|---|---|---|
| Enzingerboden | 1525m | Kraftwerk | 1 | Until 1942 |
| Fellern | 976 m | Wasserlauf | 1 | 1939-1945 |
| Scheiderau | 1000 m | Kraftwerk | 1 | 1939-1943 |
| Tauernmoos | 2100m | Wegarbeiten | 3 | 1939-1945 |
| Weißsee | 2300 m | Stollenbau | 3 | 1939-1945 |
| Wiesen | 849 m | Wasserlauf | 1 | From 1939 |
| Wirtenbach | 400 m | Kraftwerk | 1 | From 1939 |

Camps in the Stubachtal (SLA, BH-Zell am See, HB-Akte 1943, 456-1-1943)

Fig. 1: Hutted camps in the Stubachtal from 1938 to 1945

Fig. 2: Transportation of prisoners from Enzingerboden to *Camp Weißsee*

The working conditions for foreign civilian laborers differed extremely depending on the fact which camp they were assigned for. The worst case was to be sent to area of the lake Weißsee in 2,300 meters. In 1939 the first wooden hut was built to shelter about 100 forced laborers. The camp expanded in 1943, from spring on about 450 people had to work here for the Deutsche Reichsbahn. That time the *Camp Weißsee* turned officially into an auxiliary camp of the Dachau. Prisoners from the concentration camp Dachau were sent by train to Uttendorf under strict guarding. From there they nearly had to walk all the way from the train station up to the *Camp Weißsee.* Sometimes prisoners were transported by cableway from Enzingerboden to the top. The cableway had been constructed and allowed to transport material not people.

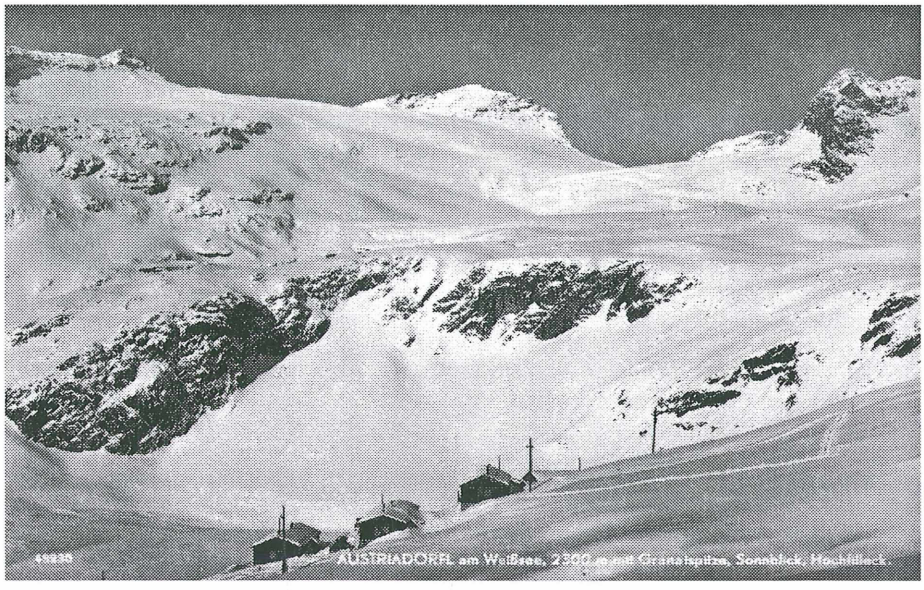

Fig. 2 and 3: Camp Weißsee [2]

People from different nationalities were forced to work as slaves. Three huts were used for shelter surrounded by heavy barbed wire, so no one could flee. The prisoners were closely guarded – though not as strict as in the valley - by members of the SS and the Wehrmacht.

The living conditions were the poorest. Up to 150 people in one building, three people in one bed or lying on the floor, only one heater. The prisoners had to wear the same thin prison clothing used in Dachau much to cold for an area in the mountains. Temperatures below zero were normal in summer and the cold wind let it appear much colder. Sometimes if temperatures were too low the guards allowed the prisoners to put a piece of newspaper underneath their jacket, not more.

Every morning the working day started before sunrise with a roll-call at five o'clock. After "breakfast" – bread and watered coffee – the prisoners marched 30 minutes before they could start working. They had to form groups of 10 to 15 workers lead by a German foreman who was responsible to keep work going and punished workers if they were to slow. Some of them had to build a gallery to the province of Tyrol, others worked in a nearby quarry. Ironically the 754 meter long gallery was finished in time but was never used but shut down in the 1950's. The majority of the prisoners were forced to work in the quarry were they had to carry stones heavier than themselves. At noon they could have an hour break but many times it was that cold that they first dug holes to be protected from the strong winds. The day ended after sunset. Some working days lasted 15 hours. The working conditions brought the prisoners to their physical limits and caused a great strain and distress. An eye witness living in the Rudolfshütte remembered that every day some dead bodies were carried back. [3]

Martin Wolff, a prisoner of *Camp Weißsee* described their situation as follows:
*In the quarry hell is loose. Starvation, ice and snow, many prisoners break down exhausted. Every day we have got some dead because whoever breaks down is too weak to get back up and freezes to death. Others, physically tortured, try to escape. The guarding here in the mountains is not as strong but you have got no chance to find a way into freedom through ice and snow in the mountains. The refugees would die in this desert of ice and snow, that is clear to me.* [4]

How many people died in total could not be clarified but people suffered without any chance to get out of this hell on earth. In May 1945 American GIs freed the concentration camp.

It took until 2005 that the huge amount of work of hundreds of people kept as prisoners and mistreated in the worst way in the *Camp Weißsee* were honoured by the Austrian Railway Company the ÖBB and the by the Government of the province of Salzburg.

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[1] Oskar Dohle/ Nicole Slupetzky: Arbeiter für den Endsieg. Zwangsarbeit im Reichsgau Salzburg 1939-1945. Wien: Böhlau, 2004.

[2] A post card showing the buildings after WW II, used as shelter for hikers and alpinists.

[3] Dohle, Slupetzky, Arbeiter für den Endsieg, S. 212-221. Interview with Klaus Milster.

[4] Martin Wolff: 12 Jahre Nacht – Stationen eines Lebensweges.- o.O., o.J., S. 67-77.


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# Glacial changes, water cycle observations and mass balance development on the Stubacher Sonnblickkees in recent years

**Heinz Slupetzky, Hans Wiesenegger**

## Abstract

Since 1981 the Stubacher Sonnblickkees, a small north-west exposed slope glacier in the Granatspitz group, has lost approx. 26 % of its total mass.

It has been monitored since 1959, which makes it the glacier with the longest observed mass balance series in the Hohe Tauern National Park. The yearly mass balances have been calculated by using semi-direct and direct glaciological methods.

As there are only few glaciers worldwide, which have been observed for more than four decades, these long-term observations are a valuable contribution to the understanding of the glacier climate relationship.

Observing the genesis and the development of "new" lakes around the glacier is also an important part of the monitoring programme, which is sponsored by the Hydrological Service.

In 1990, "Lake Eisrandsee", a small tarn situated at a sea level of 2,500 m between the glacier snout and a rock barrier to the east of the glacier, appeared for the first time and due to constant melting of the Stubacher Sonnblickkees, has continuously grown to an actual length of 203 m and a width of 112 m.

The hydrological system of the recent lake is very complex and in order to understand the ongoing processes, Lake Eisrandsee as well as its two outlets (Keesbach and Eislbach) situated at different altitudes, are being monitored by means of automatic gauging stations.

Daily fluctuations of the lake's water level combined with slightly delayed and different discharge reactions in the two above mentioned streams were also observed as well as the regular water temperature fluctuations which depend on global radiation.

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## Keywords

Alps, Hohe Tauern, Stubacher Sonnblickkees, glacier, mass balance, long-term observations, discharge, runoff from glacier, glacial hydrology, water balance, year 2003

## Introduction and objectives

Snow, a solid form of precipitation, and ice, which is mainly to be found on glaciers, are important components of the water balance. Both are of significant importance for water storage as the water, which has been accumulated in snow and ice, is not immediately effective in runoff.

In 2003 the distinctive influence of glaciated catchments on the summerly runoff was noticeable in almost every stream on the north face of the Hohe Tauern and was even to be registered further downstream in the City of Salzburg, where it had a compensating influence on the low water situation of the River Salzach.

Glaciers need certain climatic conditions, are very sensitive to changes in the environment and react with a certain delay, with smaller glaciers responding more sensitively than the larger ones.

As there are only few glaciers, which have been observed for more than four decades, the long-term observations at the Sonnblickkees are a valuable contribution to the understanding of the glacier - climate relationship and will therefore be carried on into the future.

Observing the genesis and the development of new lakes around the glacier is also an important part of the monitoring programme, which is sponsored by the Hydrological Service of Austria.

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## Study area

The Stubacher Sonnblickkees, situated in Salzburgian Granatspitz group, which is a part of the Hohe Tauern mountain range of the Austrian Alps, is a small north-west exposed slope glacier with a surface area of 1.4 km² (2003) at an altitude ranging between 3050 m and 2500 m above sea level (Fig. 1).

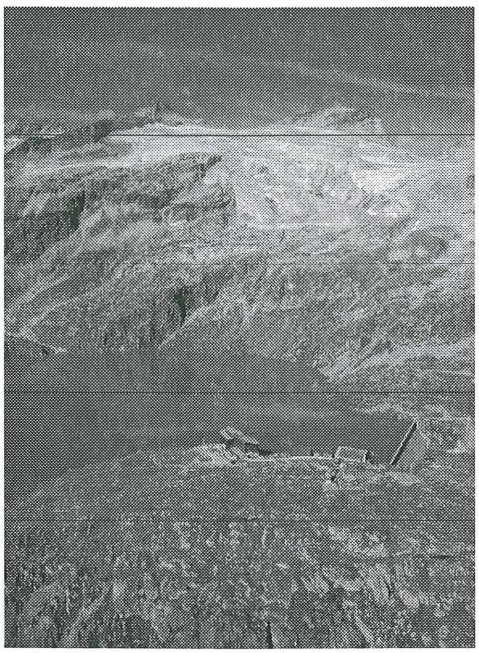

Fig. 1

Due to rough terrain, the Kees (glacier) has a complex shape resulting in an irregular interlocking of accumulation and ablation patterns. Between 1850 and 1860 the glacier terminated in Lake "Weißsee", now a dammed lake used for hydro-electric power production, whose natural catchment area comprises of 5.3 km² At present only a third of the catchment is covered by glaciers whilst in 1850 approx. 70 % was glaciated.

In 1990 "Lake Eisrandsee", a small tarn situated at a sea level of 2500 m between the glacier snout and a rock barrier to the east appeared for the first time. In 1994 it was surveyed using conventional geodetic instruments and a length of 80 m, a width of 30 m and a surface area of 6762 m² as well a maximum depth of 8 m were recorded. Over the years and especially during the extreme summer of 2003 it has increased to a present length of 203 m, a width of 112 m and it is still growing especially at its north-westerly end (Fig.2).

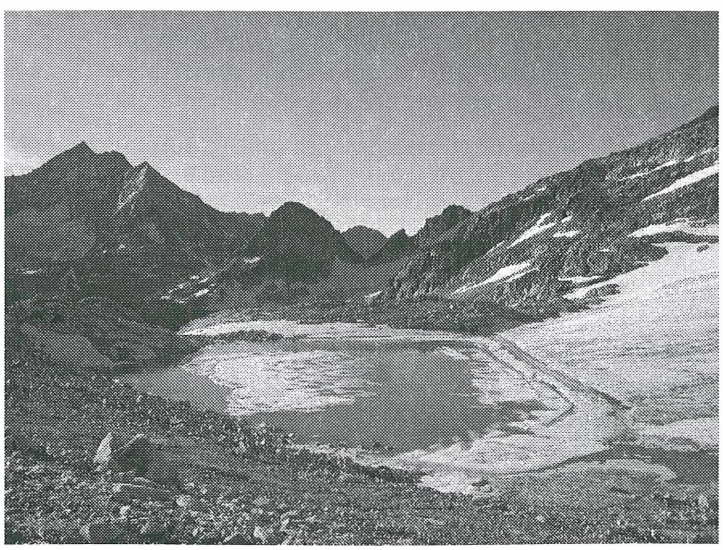

Fig. 2

## Methods

The Stubacher Sonnblickkees has been monitored since 1959 and mass balances have been calculated by using semi direct (AAR) and direct glaciological methods.

From 1964 to 1980 the yearly mass balance has been measured directly. Based on this series of 17 years, a correlation between the net balance and the accumulation area ratio (AAR) was calculated thus enabling an estimation of the net balance 1959 to 1963 and 1981 until now. For this purpose it is necessary to map the accumulation patterns ("firn area") at the end of the balance year (coinciding with the maximum elevation of the equilibrium line). This mapping is done by using either terrestrial or aerial photogrammetry, monoplotting surveys, classical and GPS surveys or by means of amateur photos. Nevertheless, in all cases long time experience is necessary.

Along with these surveys, the development of the new born lakes "Kees See" and "Eisrandsee" has been mapped several times. Preliminary sounding gave an idea of the depth and volume of the temporary stages of the lakes.

The hydrologic system of Eisrandsee is very complex and in order to understand the ongoing processes, the recent lake as well as its two outlets (Keesbach and Eislbach) situated at different altitudes, have been monitored since 2002 by means of automatic gauging stations. Water level and water temperature are registered every 15 min and discharge measurements, using current meters and tracer methods, are carried out in order to achieve accurate discharge rating curves at the outlet gauges.

In order to calculate the main components of the hydrological water balance, climatic data (e.g. temperature, windspeed, precipitation, humidity etc.) are registered at the "Rudolfshütte" meteorological station, operated by the ZAMG (Central Institute for Meteorology and Geodynamics). Several totalizers in the surrounding catchments are used in order to achieve a better areal distribution of precipitation.

## Results

Whilst 1965 was a very positive year with a mass gain of 3.5 Mill. $m^3$, the Stubacher Sonnblickkees lost approx 4.02 Mill. $m^3$ of its mass (representing 2.9 m on average in height) in 2003, when a record mass loss was registered on many alpine glaciers. On the Stubacher Sonnblickkees this record loss was mainly caused by rapid snow melting in May and June, high temperatures and lack of snow fall during summer, as well as by the negative influence of a Sahara sand layer (as a result of a storm in November 2002) on the glacier's albedo.

2003 was certainly an outstanding year but due to global warming the process of mass loss, which started in 1850, will carry on with a high probability in the future. This will result in a distinct shrinking, a decrease in area as well as in glacier retreat.

Since 1981 the Stubacher Sonnblickkees has lost 26.2 Mill. $m^3$ i.e. approx.26 % of its total mass (Fig.3) and a hypothetical extrapolation of the last 20 years shows that the Kees could disappear within the next 50 to 80 years (Fig. 4).

This trend of constant mass loss is also to be found on many Austrian glaciers.

In the Austrian glacier inventory of 1969 (PATZELT, 1981) altogether 925 glaciers with an area of approx. 543 $km^2$ (i.e. 0.6 % of Austria's total area) were registered. In the new inventory which was carried out between 1996 and 1999, but has not yet been completely finished, Austria's glaciated area has been reduced to less than 500 $km^2$. In the same time-span the glaciers of the Granatspitz group (including the Stubacher Sonnblickkees) lost 23 % of their area (KUHN, 2005).

First results of the observations at Lake Eisrandsee show rhythmical daily water level and water temperature oscillations during the melting period as well as slightly delayed and different discharge reactions in the two above mentioned streams. The water level of the lake rises approx. 4 m until it reaches the outlet level of Eislbach, which then functions as an overflow. In late autumn or early winter as the glacier melting rate is reduced due to lower temperatures, all the water is drained towards Keesbach by a sub-glacial flow system and no discharge is to be observed at Eislbach.
A special phenomenon was observed in spring 2004, when heavy rainfall on the frozen and snow covered lake as well as surface discharge from the glacier created a slush-water mixture, which caused a sudden rise of the ("water") level in Lake Eisrandsee and a small glacier flood in Eislbach.

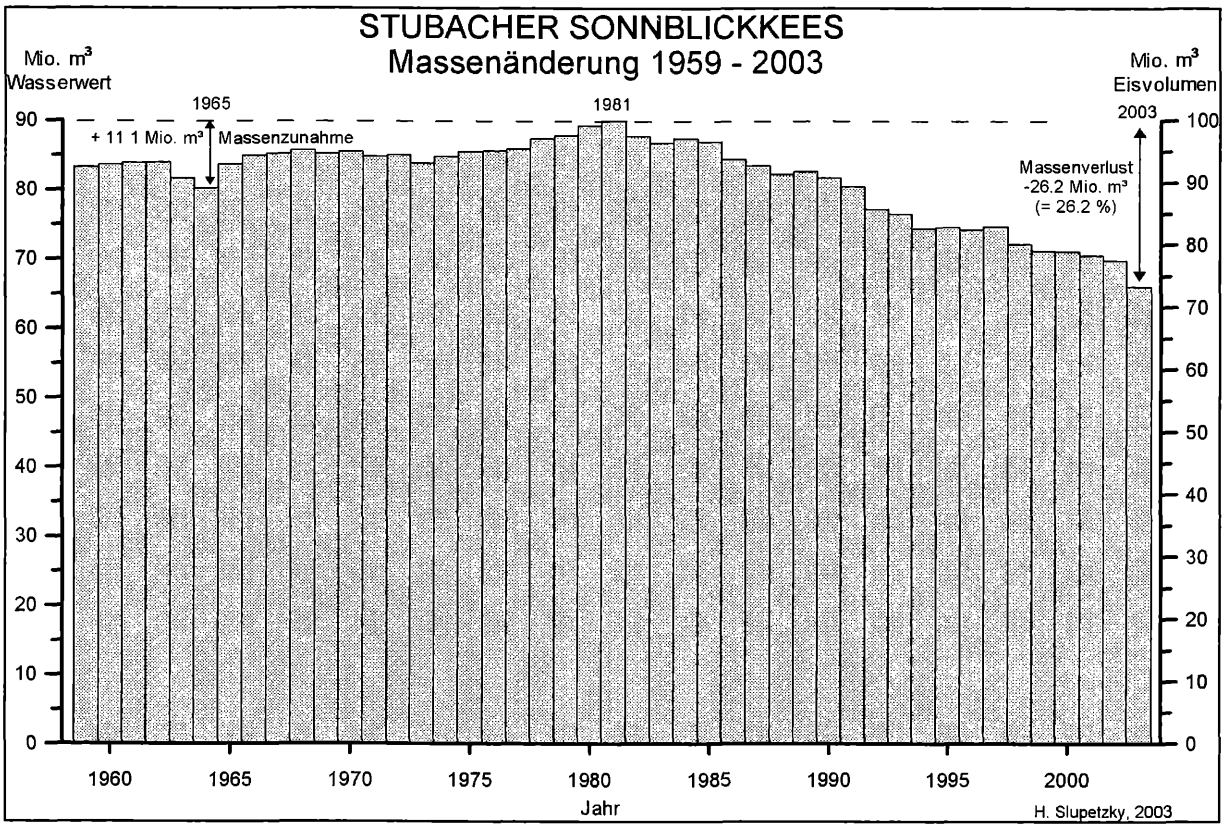
STUBACHER SONNBLICKKEES
Massenänderung 1959 - 2003
Mio. m³ Wasserwert
Mio. m³ Eisvolumen
1965
1981
2003
+ 11 1 Mio. m³ Massenzunahme
Massenverlust -26.2 Mio. m³ (= 26.2 %)
Jahr
H. Slupetzky, 2003

Fig. 3

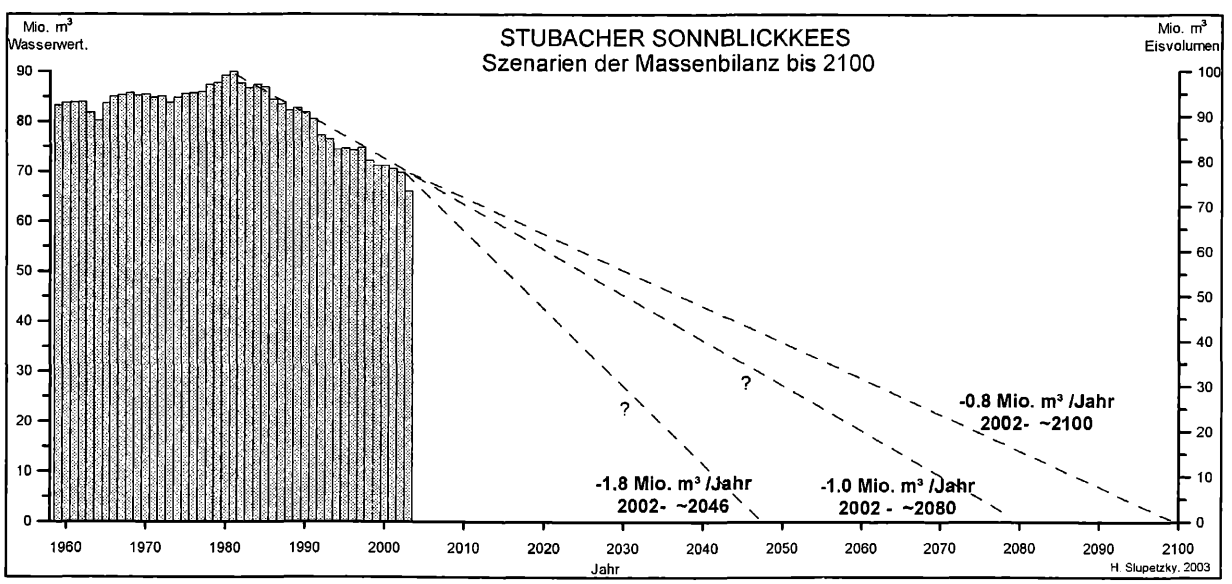
STUBACHER SONNBLICKKEES
Szenarien der Massenbilanz bis 2100
Mio. m³ Wasserwert.
Mio. m³ Eisvolumen
-0.8 Mio. m³ /Jahr 2002- ~2100
-1.8 Mio. m³ /Jahr 2002- ~2046
-1.0 Mio. m³ /Jahr 2002 - ~2080
Jahr
H. Slupetzky, 2003

Fig. 4

## Closing remarks

The public and the media are at present very sensitive about glaciers and their future development. Therefore, the exceptional (by today's terms) year of 2003 was a good chance to present the results of the long-term observations causing a sustainable effect on the awareness of the general public.

Surveying the glacier and the water cycle changes within the Hohe Tauern National Park also offers contributions to applied aspects (e.g. drinking water storage, flood hazards). Besides the main goal, gaining knowledge of the high alpine environment and ongoing natural processes due to the changing climate, it also provides useful information for park authorities concerned with public relations.

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# Research Activities at the Sonnblick Observatory

**Michael Staudinger**

## Abstract

The Sonnblick Observatory at the national park Hohe Tauern developed within the last years in an unique centre of atmospheric research. Conditions at the observatory are undisturbed by any local emissions and the climatic record of the past 120 years gained at unchanged conditions proves to be very valuable in the climate change discussion. Today a number of more than 30 projects are carried out in and around the summit, ranging from aerosols measurements to gamma radiation and permafrost monitoring.

Fig 1: The measurement site on Mt. Sonnblick. Foto Staudinger

## Keywords

Sonnblick Observatory, meteorology, climate change, air chemistry, background measurements

Contribution received at: 28.07.2005

## Introduction

Since 1886 meteorological measurements are performed at the Sonnblick observatory in an altitude of 3106m, creating a continuous series of measurements, which is unique concerning both quality and duration of all meteorological parameters. These measurements were first thought to be mainly important for synoptic forecasting, today they provide a undisturbed climatic record of a mountaintop situation near the Alpine crest. During the 20th century Astrophysics became additionally to meteorology a very important aspect, leading to the Nobel prize for one of its researchers, Viktor Hess in 1936 for his investigation on cosmic radiation. During the 80ties of the past century more and more air chemistry projects started to make use of the fact, that, the mountain summit is not influenced by any nearby local pollution sources and is therefore ideal for background measurements of the atmospheric constituents. So not only the quantity of the climate change in the past 120 years could be assessed, also a few questions concerning the reasons for the change in the past decades were brought closer to an answer.

## Projects at the observatory

Physics of the atmosphere – climate

Day to day meteorological measurements provide the basis for the interpretation of the data of many projects and is at the same time the basis for the longterm climatological studies. The increase in temperature was with 1,8 deg in 120 years nearly twice as much as in the Austrian lowlands. Thos is due to a change in weather patterns with more high pressure systems connected with a significantly higher number of sunshine hours, increase in mean pressure and a higher number of thunderstorms during the summer season. The climatology of the Sonnblick Observatory was assessed first in 1938 for a 50 year period and 2002 for the whole record available till then, by ZAMG.

Glaciers are affected in a spectacular way by the change in temperature, the altered radiation regime and the higher number of days with rainfall during summer, which makes the white, high Albedo surface layer melt much earlier than during the first half of the 20th century. The volume of the Goldberg glacier next to the observatory was reduced on average by more than 5000 kg/m$^2$ in the period 1987 to 2004, the time where continuous mass balance measurement were undertaken. Together with University of Natural Resources and Applied Life Sciences Vienna, Institute of Water Management, Hydrology and Hydraulic Engineering the runoff of the glaciers was both modeled and measured.

The higher number of days with rainfall instead of snow and the general increased temperature average had large consequences in the static of the rock formation underneath the observatory. For this reason extensive geotechnical provisions were made in the last three years to secure the summit with 105 suspended stainless steel anchors and 8 massive concrete reinforcements. A monitoring program will be undertaken from summer 2005 onwards to assess the temperature changes within the rock itself and to monitor the changes in the permafrost distribution.

Offsprings of the meteorological measurements are data which are gathered for warning systems like the Meteorisk project, where 14 European weather services issue daily warnings on Online basis for extreme weather events and at the Sonnblick observatory provides data from an ultra sonic wind measurement system. The Salzburg Avalanche Warning system gathers data in form of snow profiles and daily snow observations from Sonnblick as its highest station.

Radiation in higher mountain regions show a clear trend in the last decades due to the decreasing content of Ozone in higher layers of the atmosphere. This is measured for the total UV by the University of Natural Resources and Applied Life Sciences Vienna, Institute for Meteorology together with the Institute of Physics, University of Innsbruck as part of an Austrian wide network and early warning system. Two other instruments Brewer spectrometer and the Bentham spectral radiometer measure the longterm changes in the UV radiation and can give thereby clues about the vertical distribution of the $O_3$ in the atmosphere.

Cosmic radiation had been monitored for a couple of years with passive Bonner spectrometers in combination with an Extended Sievert Counter. Resulting values showed a threetime higher radiation than in the Austrian lowlands with an equivalent dose rate of 240 nSv per hour.

Nuclear physics are represented with measurements for Tritium, gamma spektroskopy and the Austrian radiation warning system of the Ministry for Agriculture, Forest, Environment and Water management. Gamma Dose rate are available back to 1986 where the accident in Tschernobyl produced with 1040 nSv/h a daily value 5 times higher than the average. CTBTO the Comprehensive Test Ban Treaty Organisation test at Sonnblick their sampler types for polar measurements.

The link between physics of the atmosphere and air chemistry is perfectly closed by the work done in the GAW (Global Atmospheric Watch) of the WMO, where Sonnblick is together with Zugspitze and Jungfraujoch a background station for central European atmospheric conditions and where various filter functions for the determination of the origin of the air masses at the measuring sites had been developed.

Airchemistry

Air chemistry is presented in various projects ranging from aerosols to POP (persistant organic pollutants) and VOC´s (Volatile organic constituents)

Within the project "Backgroundmeasurements Sonnblick" major inorganic aerosol compounds as well as the trace gases sulphur dioxide, nitric acid and ammonia were collected with filterpacks at the Sonnblick Observatory (SBO). The major inorganic aerosol compounds nitrate, sulphate and ammonia showed average concentrations ranging from 5,5 to 15 nmol/m³, while the trace gases nitric acid, sulphur dioxide and ammonia range from 2,9 to 19 nmol/m³. The calculations of summer to winter ratio represent the seasonal changes of the concentration values of the individual compounds. The highest ratio is found for ammonia, where differences between summer and winter concentrations are very pronounced. Sulphur dioxide, on the contrary does not present a marked seasonal cycle. Scavenging ratios were calculated to compare aerosol data with precipiation samples. (See poster SANCHEZ-OCHOA et. al.)

A discontinuous method for measuring nitrogen dioxide (NO2) on a daily average basis hzad been adapted to the background ambient at the Sonnblick Observatory also by the Institute for Chemical Technologies and Analytics; Vienna University of Technology. Originating from the basic Saltzmann method (SALTZMANN 1954) it uses a solid sorbent, based on the findings of FERM et al. (1984) consisting out of sodium iodide (NaI) and sodium hydroxide (NaOH) (see poster of KOLLER et. al).

The components O3, CO and CO2 are continuously recorded with a TE 49C (O3), Horiba Apma 360 (CO) and an Infrared two chamber system with calibration gases for CO2 developed by the Federal Enironment Agency Austria. All instruments had been modified for the 700 hPa level with special adaptations to compensate the pressure change.

Volatile Organic Components (VOC) are precursors of the Ozon in higher layers of the atmosphere and stem partly from natural, partly from anthropogenic processes. University of Innsbruck, Institute for Ion Physics and Max-Planck-Institute Mainz employed a proton transfer reaction mass spectrometry (PTR-MS) to measure very short term fluctuation of benzol, toluol, isoprens and other volatile components, showing clear transport mechanisms with the circulation of the alpine valleys surrounding the observatory.

The group around Vienna Environmental Research Accelerator and the Max-Planck Institute for atmospheric chemistry determined OH indirectly with the measurements of $^{14}C$ and $^{14}CO$, concluding from the speed of the oxidation process the very low concentrations of the aggressive OH radicals. Very high volumes of air sampled at Sonnblick and analyzed in Vienna.

Persistant Organic Pollutants (POP) are constituents which persist for long periods of time like DDT and Dioxins. In higher layers of the atmosphere with cooler temperatures the concentrations accumulate over longer periods as the reduction mechanisms are reduced here. The filter samplings taken at Sonnblick are focused on very small concentrations and have to integrate longer periods of time, characteristically more than 10 days. Meteorological forecast for trajectories are used to sample data coherent for one source region, like northern Europe or pure maritime Atlantic air masses.

Precipitation in Europe contains considerable quantities of acidic components like SO2, $NO_x$ and $NH_3$ which lead to consequences features summarized as "acidic rain" To assess in details the quantities of the acidic components a device in employed at Sonnblick since 1984 called WADOS (wet and dry only sampler) which differs between acidic components in the precipitation and dry deposition, which can be considerable if a sampler is exposed all the time to catch the rainfall. The resulting trends for this rare 20-year period of a mountaintop site show a decreasing trend for the sulphur components attributable to the reduction of sulphur in the oil and rather steady conditions on the nitrate part, which is due to constant emissions from the traffic.

The pH values of precipitation are not only measured in the falling rain, but also in the snow cover, where dry deposition on the snow surface is also part the integrated consideration of the acidic input to the water cycle. Results and trends here are similar and can be considered to be representative for larger areas.

Biology

Bacteria in Clouds was a project of the Institute for Limnology at the University of Innsbruck, where the cleanm air conditions of the Sonnblick site allowed to trace carbonyls in aerosols which gave clear indiciaton for bacteria as condensation nucleus.

On the ground little vegetations can be found, but lichen as the most durable and primitive form of vegetation survive directly on stones, having metabolism even directly under the snow cover, if the light and radiation conditions are favourable. The measurements of the CO2 metabolism of the lichen species by the Institute for Botanics of the University of Salzburg on Sonnblick are unique in this form in Europe.

Above ground insects traverse the alpine crest in considerable numbers and use different systems for their orientation. The University of Graz, Institute for Nature Protection and Ecology of the Environment investigated these mechanisms by tracking the animals at various sites.

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# The importance of National Parks and other protected areas for the surviving of lichens and lichen communities

**Roman Türk**

## Abstract

In the densely populated areas of Central Europe National Parks and protected areas like Natura-2000-Habitats play an important role for the growth and the surviving of lichens. These slowly growing, symbiotic organisms of mycobionts and photobionts need for the colonization, development and growth in most cases undisturbed areas with only slight anthropogenic influences. Thus National Parks and protected areas with a high amount of natural or near natural areas provide many different habitats which are the prerequisite for a high diversity of lichens with special demands on microclimate and substrates. Also for long-term research and monitoring studies on succession of biological soil crusts, succession on decaying wood and the development of vegetation natural habitats are very important. As the results of lichen diversity in various National Parks and other protected areas show, there is a great demand of research in the next century.

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National parks and other wide protected areas have a high status for the preservation of lichens and for the lichenological research. Lichens are in common long-lived symbiotic organisms which are a considerable component of the vegetation in some regions with natural and near-natural landscapes.

Lichens consist of a fungus (mycobiont) and one ore more species of green algae or Cyanobacteria (photobiont). The hyphae of the mycobiont are closely interlinked with the cells of the photobiont and they form a so called symbiosis. The interaction between the two partners is very well balanced so that they are very resistant to natural stresses like cold, heat and drought. The symbiotic organisation of the lichens enables them to settle habitats in extreme environments like cold deserts, hot deserts and rocks at the seaside. But they are very sensitive to anthropogenic influences like air pollution and short-term microclimatic changes caused by exploitation of forests (TÜRK & WUNDER 1992).

Lichens live extremely frugally. They are poikilohydric organisms, the water status of their thalli depends immediately on the water supply of their environment. Their metabolism is only active when the humidity in form of liquid water, dew, fog or vapour is sufficiently available. When the thalli dry out, they turn into dormancy. The physiological functions of most of our native lichens are dependent on the permanent change of imbibition and dehydration of the thalli. Generally they grow very slowly and they are at a disadvantage against the competition by higher plants. Thus their habitats are in areas with only a weak competition by the fast growing herbaceous plants or shrubs. This is the reason why lichens prefer sites in extreme environments as habitats. In mountainous regions they play an eminent role as pioneer organisms on eroded surfaces on soil, on rocks in the outwash plains of glaciers and on boulders or on slowly moving screes. Also living and dead trees, wooden roofs, fences and others are extreme sites with regard to microclimate and substrate. In near-natural landscapes lichens form a conspicuous vegetation on free standing trees or on trees in humid, closed forests.

Anthropogenic influences like air pollution, the sudden or gradual destruction of micro- and macrohabitats following the different forms of cultivation, exploitation and utilization reduce the vitality and the possibilities for surviving of lichens in many cases severely. The construction of forest roads, of lifts in forestry areas, of golf courses causes e.g. changes of the environmental conditions which can lead to the complete extinction of sensitive lichen species (TÜRK & WITTMANN 1986, TÜRK & HAFELLNER 1999).

Thus national parks and other wide protected areas are important habitats under the aspects of nature and species conservation for the threatened lichens and also of great interest from the point of scientific view. In Europe most of the national parks and of conservation areas are situated in regions with almost naturally or near-naturally structured biotopes and ecosystems.

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Many questions on the function of the single organisms in natural ecosystems, on their interaction and the dependence on the structure of ecosystems can be solved only in national parks and wide protected areas. This is valid all the more so for lichens, since they are organisms with a long term live cycle, which need long phases of undisturbed development.

A high amount of dead trees and woody litter is a feature of high quality in national parks in woodlands. The woody litter and the erect stems of dead trees are of great interest for lichenologists. The various phases of decomposition of wood are the substrates for a high diversity of lichens (TÜRK & WUNDER 1999; GLOßNER & TÜRK 1999).

The high number of lichens species occurring in national parks can be explained by the presence and the preservation of biotopes with natural and near-natural structures. These structures exist in old forests from the colline to the montane step outside the Alps and in the montane to subalpine zone in the Alps and also in near-naturally managed fields and pastures. In regions with a high amount of these structures the diversity and abundance of lichens is high, also of birds, reptiles, amphibia, insects and other invertebrates. In the following table 1 the number of lichen species in some national parks and Natura-2000-areas is shown.

| National Park or Natura 2000-area | Province | Altitudinal zone | Number of lichen species | Authors |
|---|---|---|---|---|
| | | | | |
| Berchtesgaden | Bayern | montane to alpine | 716 | Türk & Wunder 1999 |
| Nockberge | Kärnten | montane to alpine | 580 | Wittmann & Türk 1990 |
| Hohe Tauern | Kärnten | montane to nival | 650 | Türk & Hafellner 1993<br>Hafellner & Türk 1995 |
| Ranna-Tal | Oberösterreich | colline to montane | 420 | Berger & Türk 1995<br>Berger 1999 |
| Hochschab-Massiv | Steiermark | montane to alpine | 640 | Hafellner et al. 2005 |
| Thaya-Tal | Niederösterreich | colline | 436 | Hasler 2005 |
| Hainich | Thüringen | colline | 125 | http://www.nationalpark-hainich.de/index.php?page=3_14 |
| Bayerischer Wald | Bayern | Colline to montane | 218 (nur Epiphyten) | Macher 1992 |

Tab. 1: Number of lichen species in some selected National Parks and Natura-2000-areas in Austria and Germany

Important prerequisites for the diversity of habitats and lichens are the altitude zonation, the relief of the landscapes, the diversity of outcrops and the number of microhabitats. The knowledge of the diversity of lichens is dependent on the willingness of the administration of national parks to support projects for the research into diversity of the plants, fungi and animals. The number of lichens in the National Parks Hohe Tauern, Kalkalpen and Bayerischer Wald could be much higher, if the research would be intensified.

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# IPAM Toolbox. Tools and Pilot Actions for Management Plans. Management plans for 7 Natura 2000 Sites in Carinthia

**Robert Unglaub**

## Abstract

The project „Management Plans for 7 Natura 2000-Sites in Carinthia (Austria)" focuses on two focal points. The theoretical part presents and illustrates methods and tools to best management plans. In part 2 these tools and methods are tested in management plans for 7 Natura 2000 sites in Carinthia.

The most important tools of part 1 - according to the main steps of the working process - are:

*for data-collection, inventory and assessment:*
- a form for collection of data about the habitats and species of the site including the evaluation of their conservation status
- the structure and contents of a data bank documenting these data

*for planning:*
- a standard map symbols key
- a list of standard measures
- a method to find out the ranking of the urgency to implement the different measures

*for the report:*
- a standard list of contents

Experience in implementing the tools was in general positive. They were able to raise the quality of the management plans concerning transparency and the "transmission" of legal regulations of the Habitat directive on a technical and practical level.

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## Keywords

Natura 2000; management plan; standards; methods; best practise; legal security; conservation status; map symbols key; data bank; tools; standard list of contents

## Objectives

A key issue of managing Natura 2000-sites is the "transmission" of legal provisions of the Habitat and Bird-directive on a technical and practical level. The centre of interest of the Natura 2000 network is the "favourable conservation status" of all species and habitats listed in the annexes of the Bird and Habitat directive. All member states have to ensure the favourable conservation status of these species and habitats on their whole territory and especially in their registered Natura 2000 sites. The overall objective of this IPAM-project was to develop and test standards and tools for best practise managing Natura 2000 sites regarding to

- transparency and objectivity of the planning process
- legal security for the technical statements.

The standards should be kept as simple as possible but as complicated as needed.

## Methods

As a first step the development of tools required an overview on the technical literature about standards and best practise in managing Natura 2000 sites. Secondly, the legal background especially the Bird and Habitat directive was examined to identify the minimum standards, what the management plans are about, what goals have to be achieved and how detailed they should be. The analysis of the technical and legal aspects leads to basic requirements for inventory (need for data), evaluation and planning. Finally these requirements were discussed with other experts.

Following the tools for the main steps of the working process were developed. The standards and methods were obligatory for the whole team working on the different subjects of the management plans. As a result there are first experiences in working with these tools in 7 management plans.

## Results

The following chapters give a survey about the technical and practical requirements for Natura 2000 management plans as a result from the legal provisions of the EC-directives and present the most important tools according to the main steps of the working process.

The main working steps

The following figure presents the working steps of a management plan and the main contents according to each step.

| Working Step | Contents |
|---|---|
| 1. Inventory and evaluation | Inventory (covering the whole area)<br>♦ natural habitat-types and species of the Bird and Habitat directive<br>♦ all other areas of the site (biotops and land use types)<br>♦ analysis of the land-use system covering the whole site with consideration of outside influence |
| | Evaluation:<br>♦ conservation status of the habitat types and species<br>♦ threats, constrains and their causes |
| 2. Draft of goals and management measures | Goals:<br>♦ conservation goals concerning the particular habitat types and species of the site<br>♦ integrated target system for the whole site |
| | measures:<br>♦ measures concerning the particular habitat types and species of the site<br>♦ integrated measures for the whole site |
| | Priorities for action:<br>♦ order of implementing |
| | costs:<br>♦ estimation of costs |
| 3. Discussion of the draft* | Discussion of the draft with all stakeholders |
| 4. Finishing the management plan | Revision of the draft considering the technical and legal integrity of the plan |

* The participation of the stakeholders as an „open planning process" starts with the first working steps, but the most important discussion is about the draft of the plan

Fig. 1: Working Steps of the management plan

Objekt Nr.: ☐ EU-Code: Date:
Name of the site: Name:

Category: ☐ Habitat directive ☐ Bird-directive

Source of data: ☐ mapping for Natura 2000 ☐ existing data ☐ Remote sensing

○ ***7110 Active Raised Bog***

Characteristic species

☐ Andromeda polifolia ☐ Calypogaia sphagnicola ☐ Drosera rotundifolia ☐ Drosera longifolia ☐ Carex pauciflora ☐ Sphagnum sp. ☐ Trichophorum cespitosum s.str. ☐ Vaccinium uliginosum agg. ☐ Polytrichum strictum ☐

Associations

☐ Oxycocco-Sphagnetea Br.-Bl. Et. R. Tx., ex. Westhoff et al. 1946 ☐ Scirpetum austriaci Osvald 1923 em. Steiner 1992 ☐ Rynchosporion albae Koch 1926 ☐

○ ***Other parts of the area (percentage of other habitat types/biotops/land use types)***

| Code | Name | % | Code | Bezeichnung | % |
|---|---|---|---|---|---|
| | | | | | |

## Features of the Area

***Relief:*** ☐ ☐

***Exposition:*** ☐ N ☐ S Gradient: ☐ ☐

***Landuse:*** ☐ Pasture ☐ Forest ☐

***Damages***: ☐ Hydrologial balance ☐ Nutrient intake ☐

***Management:*** ☐ Maintenance of biotops ☐ Fishery / hunting ☐

## Conservation Status

Hydrologie

☐ 1 No draining; groundwater table not below 25 cm
☐ 2 Nearly not drained; groundwater table not below 40 cm
☐ 3 Drained; hydrological balance seriously damaged and/or peat extraction; groundwater table below 40 cm
☐ X Not assessable

Damages

☐ 1 No damages
☐ 2 Moderate: small afforestation areas, soil loading caused by trails
☐ 3 Heavy damages: massive afforestation: significant soil loading caused by trails
☐ X Not assessable

Indicators for Negative Impacts

☐ 1 Nutrient indicators or species of contact-biotops <5 %
☐ 2 Nutrient indicators or species of contact-biotops <20 %
☐ 3 Nutrient indicators or species of contact-biotops >20 %
☐ X Not assessable

Fig. 2: Habitat types inventory form

Selected Tools

*Inventory, Data-collection and evaluation*

- A form for data of habitats and species of the site including the evaluation of their conservation status

  The documentation should focus on the data that are really useful. From a practical point of view not only basic data should be documented but also the results of the interpretation of data essential for managing Natura 2000 sites. Especially the assessment of the current conservation status should be documented. The method to judge the conservation status of the species and habitats mentioned in the annex of the Bird and Habitat directory is based on a system of indicators developed by the Austrian Environmental Office [1]. In addition to that it is very important to document these data separated for each identified area of habitat type or habitat of species situated in the Natura 2000 sites. The next page presents the documentation form for Natura 2000 illustrated by the habitat type "active raised bog"

- The structure and contents of a data bank documenting these data

  A data bank holding the knowledge about the Natura 2000 sites should not only document data concerning the conservation status of the relevant species and habitats. Due to efficiency all required data concerning management, reports according to Art. 17 Habitat directives and monitoring should be included.

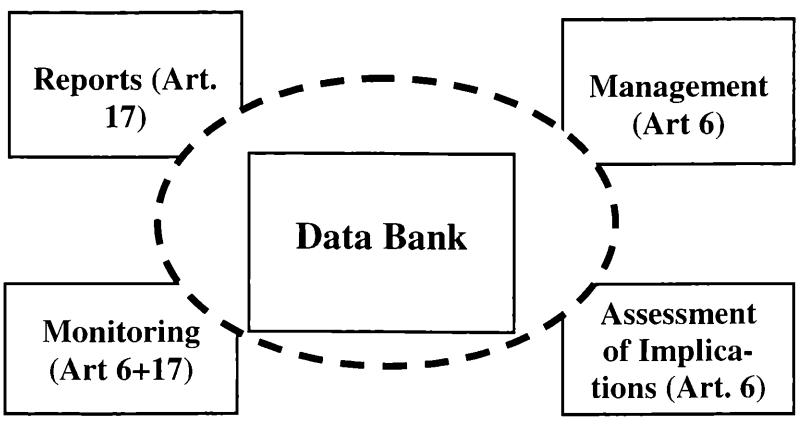


Fig. 3: Tasks of the Natura 2000-data bank

For most of the data it is important that it is connected to the area where it is situated (e.g. the exact area of a habitat type of annex I Habitat directive). The date of registration of the data is also essential. Hence the data bank should be linked to GIS and allow to compile time series (e.g. monitoring the conservation status of species in a certain period).

Before implementing the data bank it is very important to clarify which primarily data to feed into the computer and which data or necessary information can be generated by computer aided interpretation of data.

Figure 4 presents the structure and contents of the data bank and its link to GIS.

*Planning*

- A standard map symbols key for conservation measures

  The "heart" of the management plan is the map presenting the conservation measures. This map is of great importance for the experts but also for land owners or land users. On their land the measures will be implemented. Also non-experts should be able to understand the statements of the map easily. For that reason it is recommended to follow the structure of maps everybody is used to. The land use plan is known by most of the people. According to this plan all measures should as far as possible refer to areas of the same type of land use. The main zones are

  - agriculture
  - forest
  - other areas

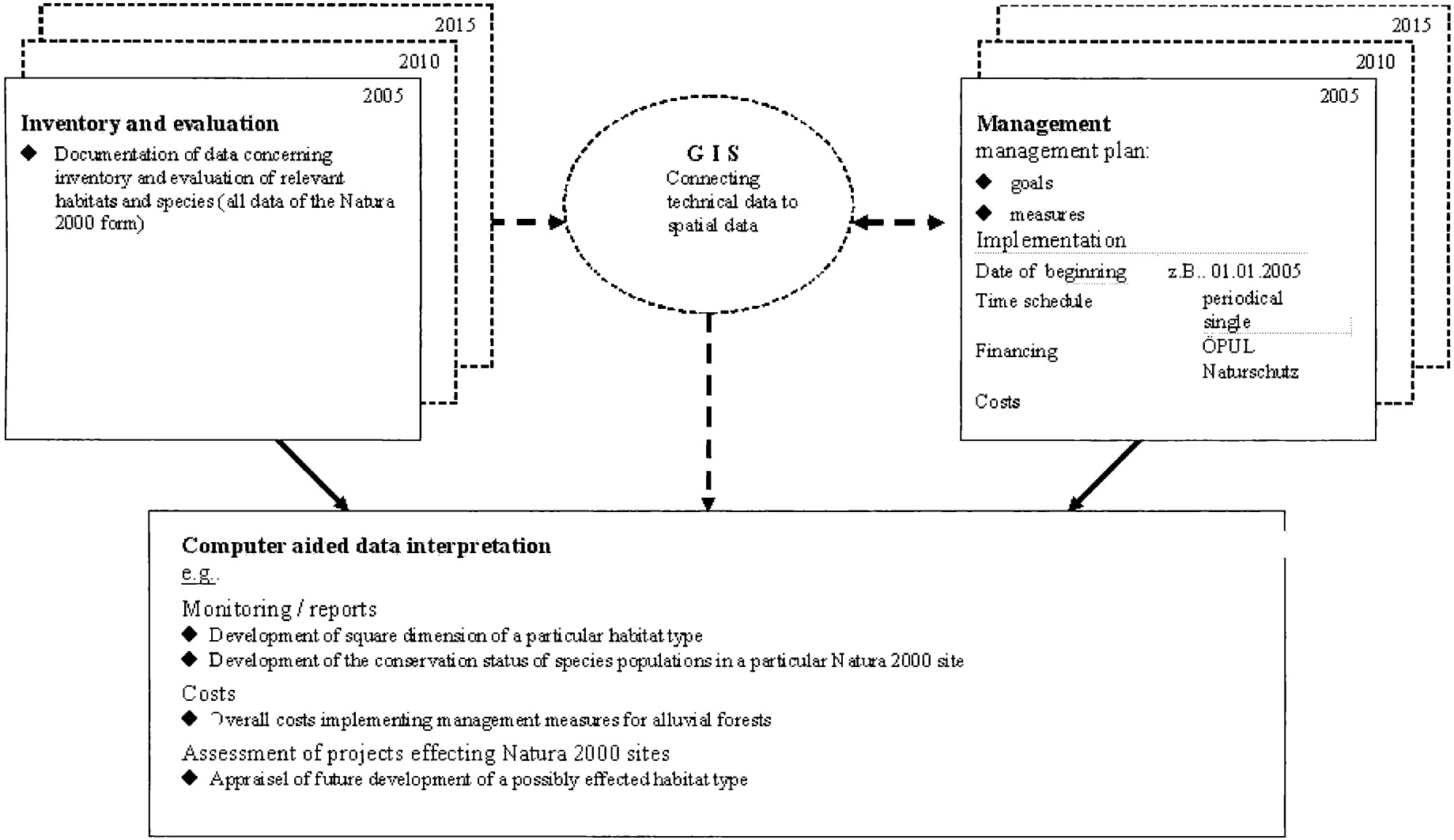


Fig 4 Concept and structure of the data bank

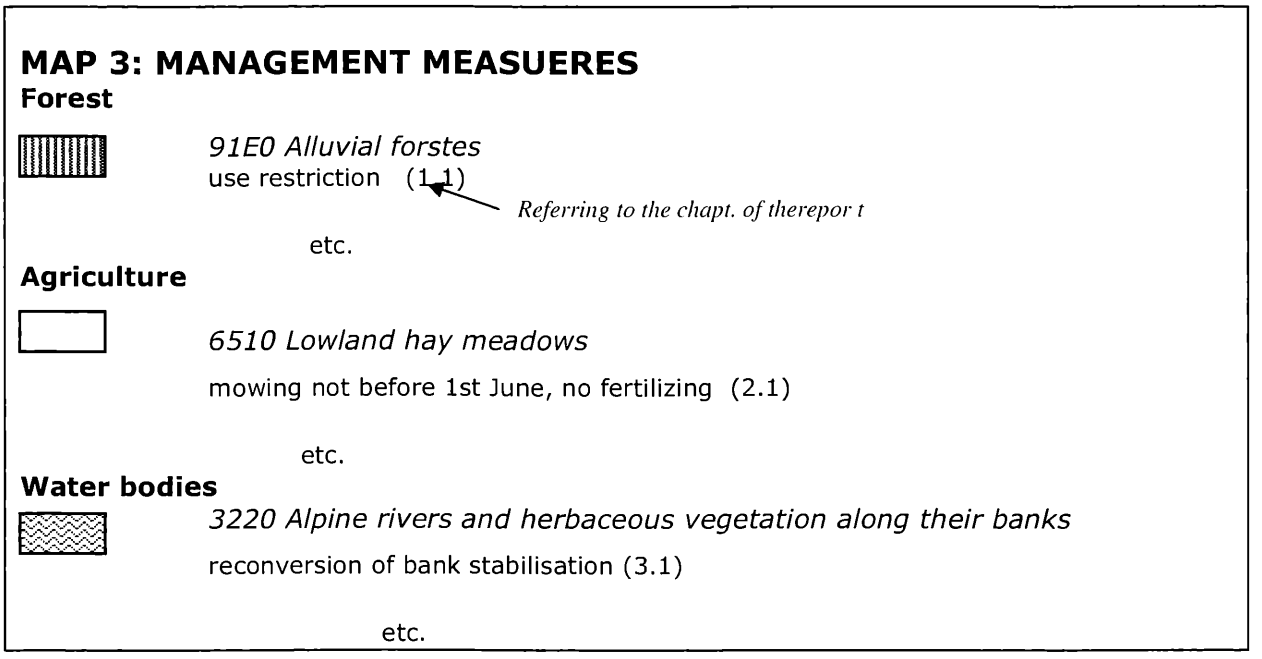


Fig. 5: Example of the standard map symbols key

## Discussion

The methods, standards and tools have been tested in 7 management plans. These 7 Natura 2000 sites represent the variety of Carinthian sites of the alpine valleys and the basin of Lower-Carinthia. They do not only represent different natural habitats but also a wide variety of land-use and land property. The only thing they all have in common is that they are small areas compared to the average Natura 2000 sites. This leads to problems in applying some tools especially the standard map symbols key. It was devised for complex planning-tasks. For the small sites other practical and more simple solutions had to be found. Experience in implementing the other tools turned out to be mostly positive. It was possible with the tools to raise the quality of the management plans concerning transparency and the "transmission" of legal regulations of the habitat directive on a technical and practical level.

Managing protected areas and especially Natura 2000 sites means firstly ensuring the favourable conservation status of ecosystem and all the endangered species and habitats as provided in the legal previsions. This is the overall goal of all management plans. On a technical level a spectrum of measures has to be identified to achieve this goal. After clarifying the factual issues the real "management part" can be started. Therefore local conditions and communication with the stakeholders becomes a key issue. Synergisms should be taken advantage of. In many protected areas the traditional land use system goes together with conservation issues. That is the reason why rare species or biodiversity could sustain untill now. This should be a part of the strategy for implementing conservation measures and activities for the future. Protected area management as cross cutting issue always needs a holistic approach. The basic issues that should come together are

- legal provisions for protection
- technical know how about the needs of protection
- economic aspects especially the costs and benefits of necessary conservation measures
- communication (stakeholders, administration, politicians)

## Does the flood of data, as well as the current methods and standards really help the practitioners and those who are responsible?

## What results does research in Protected Areas need to achieve to be useful for Protected Area Management at the best?

The history of Science is a history of specialization. Research activities on nature conservation should always be aware that protection of nature cannot be achieved only by improving the knowledge in natural science. More data does not mean more success in conservation activities automatically. First of all nature conservation and ulimately the protection of natural resources is a question of basic rules and value and how society as a whole and every single person treats his environment. The knowledge about future consequences (especially long term effects) of new technical development or change in land use concerning environment, health and society is always behind the use of the new technologies and the new developments as a whole.

So the challenge of managing protected areas and also of managing sustainable development is to establish rules of protection beyond classical scientific proof. Classical scientific knowledge does not give advice for decision making. For example the decision how many protected areas and what measures for protection are in need primarily is a question of basic values and common sense (e.g. the precautionary principle). These values are written down as goals and rules in legal regulations like the constitution or the environmental laws. In a constitutional state the legal norms of environmental laws represent the agreements of society on how to treat and how to protect natural resources .The Nature conservation law, Water directive or Regional planning law as well as national and international conventions (e.g. Alp Convention) and programs are full of rules how to protect biodiversity or to achieve sustainable land use.

The missing link primarily is not the knowledge about the best practise from a technical point of view. There is an enormous gap between what we know is right and what every day politics decide and what everybody is doing every day. Obviously the principles of nature conservation, environmental protection and sustainable development are not embodied in people`s minds, especially when they might be in conflict with their personal interests. Primarily we do not need more data about the damage to our environment or how to protect a particular specie but we need people (scientists, politicians, public servants) who have the courage to take the environmental laws serious and bring the abstract goals and rules into action in every days decision making. For that reason scientific knowledge and the legal regulations and ethic value of conservation have to be integrated and should not be handled as two separated issues.

An important instrument for bringing scientific knowledge and abstract legal goals and rules together and operable for local action are standards, methods and tools. They try to bring abstract legal provisions and complex scientific knowledge on a practical level, transparently for everyone. So the tools connect abstract social agreements about protection (e.g. Habitat directive) with the particular local questions, problems and conflicts. The result of working with these tools and standards are detailed and specific goals and rules of conservation adapted to the particular needs of the protected area. These specific goals and rules grounded in the legal regulations and the technical data of the protected area not only ensure legal security but also improve the conditions for the communication process. They should be the legal and technical basis and frame work for all negotiation with the stakeholders about the management measures and long term perspectives of protection. Consequently used they can help to shorten discussions with the stakeholders and make them more effective and therefore fundamental needs of conservation in a protected area would not be an issue of discussion. Based on this agreement the negotiations could be focused on possible measures to achieve the practical goals.

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# The Dolomiti Bellunesi National Park "Fauna" special project

**Enrico Vettorazzo**

## Abstract

The special project "Fauna" is the instrument of fauna planning of the Dolomiti Bellunesi National Park. It concerns: knowledge, detailed check list with commentary about Vertebrates and Invertebrates; the effective proposals of management and preservation of the zoocoenosis; planning of future scientific research; priorities of intervention. All the information about the plan have been georefered and implemented in a GIS.

## Keywords

Dolomiti Bellunesi National Park, fauna management, fauna preservation

## Introduction

The Dolomiti Bellunesi National Park (DBNP) is situated in the most southerly part of the Dolomites, between the Cismon stream and the Piave river. With its 31.512 hectares, it is one of the most preserved mountain areas in the east alpine arc, with a very high floral and vegetational biodiversity; with the sole exception of the ibex, it has all the items that represent the alpin vertebrate fauna.

The Plan of the Park (published in the Supplement of the Official Journal of 26.01.2001) defines guide lines and criteria for the management and the preservation of ecosystems and biocoenosis, but gives the detailed explanation of all the actions, carried out, in the different sectors of the Park, to a series of special projects, like the Fauna project.

## Materials and methods

The Fauna Special Project (FSP) is a "preservation plan", that has the purpose of analizing interactions between fauna and its environment, discovering the correct measures to preserve the "Zoocoenosis" For this reason, the FSP is a useful help for the Park Authority to plan future strategies for the fauna.

The goals of the FSP are:

1. critical valutation of faunal knowledge available for the area of the Park;
2. implementation of all the information available in a GIS;
3. presentation of proposals of preservation, study and research;
4. definition of the priorities of the actions

The preservation proposals have been created with the purpose of maximising the ensemble of the advantages from the presence of the fauna and have been chosen, besides their ecological validity, for their compatibility with the environmental and social situation of the area.

The advantages from the fauna in a protected area can be looked for in three different situations: ecological (connected to the stability of natural ecosystems), economic (connected to positive economic consequences from the fauna's activity) and aesthetic (connected to the importance that man gives to the simple presence of the animals, even if he does not use them directly)

Effective and planning stages have considered that the park is a reality that has to be analized in a wider territorial sense, with important ecological , environmental, and human relations.

This guideline has been requested, knowing that every planning action has to take consider all the points even if they are not scientific.

Especially for faunal planning, we have to consider not only priority law lines and wright hopes of the local inhabitants, without forgetting that in a national park the management of the fauna have necessary to privilege cultural and preservation aspects, connected to and indirect using of animal species.

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Also for this reason, the FSP has been realized by a "holistic approach"with the intention of considering not only the species important for social aspects like Ungulates and Galliformes, but also for the whole zoocoenosis.

The *Taxa* that have been considered are as follows: Invertebrates, only for a few systematic groups; Ostitis, Amphibia, Reptiles, Nesting Birds (especially alpine Galliformes), Mammals, especially Ungulates.

All this makes it possible to characterize the area of the Park with respect to outside areas.

A numerous work team has been set up to satisfy the complexity of the project: Marco Apollonio (Sassari University), Andrea Mustoni, Barbara Chiarenzi, Sandro Ruffo, Beatrice Sambugar, Enrico Marconato, Andrea Dall'Asta, Michele Cassol, Paolo and Giacomo De Franceschi, Maurizio Ramanzin (University of Padua), Marco Catello, Pier Giuseppe Meneguz and Luca Rossi (University of Turin), Simonetta Fuser, Mara Maffei (†), Gianpiero Andreatta (State Forest Department)

## Results

Analysis of the faunal context

Different research done in the past years by the Park give a clear context of all the species present in the area. More research is necessary, especially for the Invertebrates. Nowadays only 446 species have been counted in a census. What is very important is the presence of endemic species in the hypogeal fauna and *Rosalia alpine* (in the Appendix II European Directive 92/43 CEE Habitat).

204 species of Vertebrates have been counted in a census, but different systematic groups have been studied with different levels of research.

For Mammals, Ungulates, Carnivores, Birds and Ostitis Fish all the species present in the area have been found. More research is needed for Insectivora, Rodentia and Chiroptera.

Some important faunal species are present in the Park:

a) Fish: *Alburnus alburnus alborrella*, *salmo (trutta) marmoratus*, *Cottus gobio* (in the Appendix II of Habitat Directive);
b) The Amphibia, represented by the most typical species of the mountain area, such as the *Triturus carnifex*, present together with the *Bombina variegata*, in the Appendix II of Habitat Directive;
c) Reptiles (13 species) including *Zooteca vivipara*, *Archeolacerta horvatie*, *Vipera berus*, *Vipera ammodytes*, included in the IV Appendix of the Habitat Directive.
d) The most important presence in the Birds species, is the *Gypaetus barbatus* and *Gyps fulvus* (irregular presence within the Park), included in the Appendix I Directive 79/409 CEE Birds; however some species, like *Aquila chrysaetos*, *Crex crex* (included in the Appendix I Directive Birds and *Tetrao urogallus*, are present in the area of the Park in large numbers.

Proposals of management and preservation

The actions suggested can be classified in 4 types:

- Action of Environmental Improvement:
  Includes actions on the habitat like mowing and thinning out, in places that have been identified as fundamental for the species studied.
- Actions of Elementary Monitoring:
  Actions carried out periodically to keep the populations monitored (health monitoring, census, etc);
- Actions of active management of the specie:
  Reintroductions and exterminations, etc;
- Research Actions:
  Research projects and actions necessary to obtain further faunal knowledge of the Park.

For every action a level of priority has been defined (maximum, high and medium) to allow the Park to also plan also the division of financial resources available. The difficulty in defining an "Emergency Index" given to the different species, considering ecological and social aspects, is well known in the Faunal Planning.

84 proposals have been created, and are as follows: 15 actions of environmental improvement; 27 of elementary monitoring; 20 active management of the species and 22 of research: Most of them are being carried out or in advanced planning.

All the data of the fauna of the park have been put in a database integrated in a GIS, that allows the production of maps of the distribution of the different species and will let, thanks to the information already available about forestry types and herbaceous consortiums, future elaborations obtained through models of environmental qualification.

## Conclusions

The FSP has been created with the purpose of reaching two main goals: to check the knowledge of the species present in the Dolomiti Bellunesi national Park and identify a series of future actions to support the preservation of the faunal heritage.

The whole work has been created with the intention of considering the whole actual zoocoenosis, in the best way, with the knowledge that social interest favours those types of *Taxa* that are easy to understand and of direct use.

The FSP has for this reason tried to resolve all the questions connected to faunal groups often forgotten in the planning (little Mammals, Chiroptera and Carnivores), species that in a protected area should have the same dignity with respect to other species usually studied.

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# The Implementation of the National Park Idea in Society – The Role of Agenda 21 Processes

**Ulli Vilsmaier, Ingo Mose**

## Abstract

Due to continuous debate, a significant paradigm shift in protected areas research and implementation can be observed, being characterized by a shift from the dominance of protection to an integration of protection and development. As a result, the idea of area protection has been extended to the idea of general protection of nature and the environment. This approach requires a continuous participation of inhabitants and civil society at large. If protection should take place *with* people and not *against* them, it is necessary to promote acceptance, initiate continuous discussion and reflection about the functions of protected areas and organize active participation in their development. Especially during the implementation of protected areas there is a high need of explanation for the necessity of borders and zones to meet the aims of nature protection. Many different models and examples of participatory processes of protected areas, especially national parks, show how successful the integration of regional actors can be. To reach a continuous discussion and contribution of the population, it is necessary to examine the meaning of borders and develop a new understanding of their functions between protected and non-protected areas. Although the border has the role to delimitate, it should contribute to overcome itself and finally make itself unnecessary. Decoding borders of protected areas as restrictions, impulses and measures for man-biosphere-relations, can only happen throughout dialogue. Not simply teaching and studying, but common experiencing and understanding offers a chance for an area protection, that goes beyond national parks and other protected areas and makes room for sustainable development of regions. Local and regional Agenda 21 processes offer an appropriate political and organizational framework to cope with this challenge. By several examples of national parks in Europe the authors will illustrate experiences, possibilities and limitations linked with Agenda 21 models of regional learning processes under the umbrella of nature protection. Their fruitful implementation has only just begun.

## Keywords

Participation; Borders; National Park Idea; Implementation Process; Agenda21;

## Goals of the presentation

This presentation describes the possible and necessary conditions for continuous examination and discussion of protected areas, especially national parks, by regional actors and their active participation in the development. Its main focus is on local-regional Agenda 21 processes in national park regions.

## The necessity of continuous participation

The systematic participation of inhabitants and representatives of civil society, economy and local politics has turned out as an absolute prerequisite for the establishment of protected areas (BARBER 2004, p. 117). Similar to other fields of planning, participatory elements are being institutionalized as parts of the implementation process of protected areas. Many examples underline the importance and value of participation processes for establishing national parks and creating the necessary acceptance.

It also has become clear, that models of participation are required, that go beyond the creation of pure acceptance for conserving biodiversity among landowners, adjoining owners or local decision makers/politicians. If a broad participation takes place continuously, not only identification with the idea, acceptance and respect of the protected area will be established. At the same time, also an important contribution to the idea of general protection of nature and the environment can be made. Protected areas "can serve as a model of comprehensive, integrated land management, aimed at serving a variety of human purposes within the context of ecological sustainability" (MUNRO 1995). General protection of nature and the environment are realized, when this idea is embodied in people and sustainable acting has become part of their daily lives.

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## Examining borders

The borders of protected areas are a necessity, but they are also a handicap. As a matter of fact, the design of protected areas is based on special characteristics and qualities, which are not present or visible outside the protected area. At the same time borders can lead to the perception, that the idea of protection is primarily or even exclusively limited to the park itself. This goes along with another paradox: On the one hand the border is necessary to protect nature from human activities, on the other hand it should be overcome, to allow for a general protection of nature and the environment. What is made visible and can be realized inside the border should be applied beyond the border, too. This requires acceptance and crossing of the border at the same time. The border is creating a tension that can lead to conflicts but also to examinations and therefore create confidence at the same time (WEIZSÄCKER 1997). To experience and understand this differentiated meaning of borders, it is necessary to establish appropriate spaces for dialogues.

## Dialogue-framework

Forms of participation in national park development processes can differ significantly, depending on the phase of implementation. Different levels and methods of participation (from passive forms of participation to interactive forms) are appropriate for different situations and aims (BARBER 2004, p. 117ff). During the initial establishment phase it is usual, that participation possibilities are offered by the representatives of the national parks top down (ministry, administration). Information is offered from above, workshops held – structured, organized and thematically designed by the representatives of the park. For continuous development and implementation of the national park, it is necessary to develop forms of participation that are characterized by openness, self-determination and flexibility. These participation models do not necessarily have to be implemented by the representatives of the park. If the framework is created bottom up by inhabitants of a national park region as a self-initiated mobilization, a more open process of examination and dialogue may be possible. It requires a vision for partnership of representatives of protected areas and the openness to accept and follow dialogues on subjects others introduce.

## Local Agenda 21

The local Agenda 21 (proposed at the Conference of Rio de Janeiro 1992) was established in many municipalities and regions as a framework for the implementation of sustainable development aims on local level, during the last years (for Austrian Agenda 21 processes see: www.nachhaltigkeit.at). Local/regional Agenda 21 processes are open development processes being based on the understanding that autonomous and self-responsible citizens can contribute to the improvement of local/regional living conditions, according to their actual understanding and perception of reality. `Openness´ is given in a thematic sense as well as in a participatory sense. An Agenda 21 process does not have to be founded or installed formally. Therefore there can be more liberty in thinking-, discussing- and learning-processes. Agenda 21 processes are primarily self-organized, but frequently moderated by external persons.

## Examples

Actual examples of local/regional Agenda 21 processes show that this model of self-organization of citizens and participation of civil society is appropriate to deal with various subjects of interest. Therefore they can also form a useful discussion platform between national park administrations and the interested public. This presentation will refer to two European case studies showing possibilities and limitations of Agenda 21 processes in national park areas: the `Peak National Park´ region, Great Britain (see MOSE, WEIXLBAUMER 2003) and the `Kalkalpen National Park´ region, Austria.

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# What happened in the Šumava National Park?

## Mojmir Vlašin

Šumava is largest National Park in the Czech Republic. It is 69 thousands hectares large, majority of its area is cowered by forest. Only about ten percent of forests are ancient ("virgin") stands. The rest is "man made" i.e., it had been felled and replanted by humans. However, it does not necessarily imply unnatural species composition.

Activity of bark beetles is a natural process in old Norwegian spruce forests. These beetles (in Central Europe mainly *Ips typographus*) attack old trees, lay eggs into bark, and their larvae feed on underlying phloem tissue. Majority of thus attacked tree dies out. Now, after an outbreak of bark beetles that lasts for 15 years, about 14% of forest cover of Šumava National Park are damaged. There are two hypotheses among the concerned circles:

1. The bark beetle outbreak is a natural disturbing process in habitats of mountainous "taiga" forests. As every natural process, it had begun naturally, and would naturally end up even without interference of humans.
2. The outbreak is a horrible catastrophe, which might last for ever, or at least until the "pests" has eaten whole forest cover of the Šumava NP.

Before establishing NP, area of present NP Šumava was proclaimed as a Biosphere reserve(1990). Core zone (natural zone) included approximately 40 % and formed from 14 pieces. In the beginning (NP was established in the year 1991) the park was divided to three zones (according Nature Protection Act) i.e. natural, managed and recreational zone. First zone (natural) had about 22% of whole area and was divided to 50 separate pieces.

Because in central Europe there is not an example - except the Bavarian forest NP how to solve bark beetle problem in such type of NP, headquarters of the Šumava NP and Ministry of Environment decided (1995) to divide NP differently into zones. However, only 13 % of the NP area was included into the new natural zone, which was moreover fragmented into 135 separate pieces. That such policy was nonsensical is clearly seen from Table 1, which compares state of zonation in selected national parks in mountains and highland of Central Europe.

Furthermore, there was an agreement that except the natural zones administration of the Šumava NP will implement strict anti- bark beetle management which means clear felling of all attacked stands. Natural zone was declared as inviolable. It is of interest that all income from logging flows to headquarters of the NP.

In the year 1999, director of Šumava NP asked Ministry of Environment for permission to "manage bark beetle" (i.e. to cut trees) also in natural zone. The crux of the problem is that the administration of the NP was wholly controlled by technocratic-minded foresters. They believe that they are able to rule the development of ecosystems better than nature.

The fragile balance of these ecosystems was constantly threatened under the Park administration's present clearcutting policy. Thanks of the intensive campaign, which included tens of specialists and scientists from the Czech Academy of Science, universities, and the WWF, and thanks particularly to two blockades of clearcutimg by Czech NGOs minister of Environment recall previous director an established new director. He has entomological backgrounds and Šumava start changing step by step to the real national park

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| Name of NP | Country | Founded in | IUCN Category | Area of NP (ha) | Area of buffer zone (ha) | Percentage of natural zone | Number of fragments of the natural zone |
|---|---|---|---|---|---|---|---|
| Bayerischer Wald | D | 1970 | II. | 24. 250 | 0 | 40 | 4 |
| Bialowieski PN | PL | 1921 | II. | 10.502 | 0 | 45 | 1 |
| Kalkalpen | A | 1997 | II. | 16.500 | ? | 82 | 1 |
| Donau - Auen NP | A | 1997 | II. | 9.300 | 0 | 85 | 1 |
| Berchtesgaden | D | 1978 | II. | 21.000 | 0 | 67 | 1 |
| Triglav NP | SLO | 1961 | II. | 83.807 | 0 | 66 | 1 |
| Tatranský NP | SK | 1948 | II. | 74.111 | 36.574 | 67 | 7 |
| **Šumava NP** | **CZ** | **1991** | **II.** | **69.030** | **0** | **13** | **135** |
| Krkonoše NP | CZ | 1963 | II. | 36.300 | 18.400 | 12 | 13 |
| Karkonoski PN | PL | 1959 | II. | 5.578,5 | 11.226 | 30,78 | 1 |
| Podyjí NP | CZ | 1991 | II. | 6.260 | 3.000 | 34 | 1 |
| Kampinoski PN | PL | 1959 | II. | 36.562 | 1 km from borders | 13 | 23 |
| Šwiss NP | CH | 1914 | I. | 16.887 | 0 | 100 | 1 |

Tab. 1: Selected European National Parks

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# The origin of hollow tubes in Alpine quartz crystals

**Franz Walter, Karl Ettinger**

## Abstract

Needle-like hollow tubes penetrating quartz crystals are a particular inclusion phenomenon of Alpine mineral parageneses. From several locations of the Eastern Alps samples of quartz crystals with hollow tubes were investigated to find the previous mineral forming the tubes. In four samples solid inclusions showing the same crystal morphology like the hollow tubes were identified by X-ray and microprobe as anhydrite, $CaSO_4$. The formation and dissolution of anhydrite in the hydrothermal system of Alpine clefts is discussed.

## Keywords

Hollow tubes, quartz, Alpine clefts, anhydrite, Carinthia, Salzburg.

Projects: „Mineral documentation of the National Park Hohe Tauern":
Nr. 21303-68/112-2003; areas Rauris and Stubachtal, Salzburg: duration 2003-2008.
Nr. 3Ro-ALLG-231/2-2003 area Ankogelgruppe, Zirknitztäler, Carinthia: duration 2003-2008.
Project aims: Mineralogical investigations of Alpine mineral parageneses.

## Introduction

The study of inclusions in minerals may reveal important informations about the history of mineral formation. Fluid inclusions are by far the most frequent in quartz and may contain liquids ($H_2O$, $CO_2$, heavy hydrocarbons), gas phases ($H_2O$, $CO_2$, $CH_4$ and $N_2$) and in saturated saline solutions also solids as for example NaCl and KCl. Their analyses point to the composition of the original liquid from which the quartz crystal was formed. Solid inclusions (minerals) in quartz are characterised as protogenetic (formed before the host quartz), syngenetic (formed at the same time) and epigenetic (formed after deposition of the host crystal).

A particular inclusion phenomenon of tubular voids in quartz is widely distributed in Alpine type mineral parageneses. The needle-like hollow tubes penetrating the Alpine quartz crystals are formed protogenetically relative to quartz and can only be observed in quartz and not in any other mineral of the same paragenesis. These hollow tubes with a rectangular shape in cross-section are usually designated "anhydrite tubes" in the literature. This assumption is due to a communication by KENNGOTT (1866), who described anhydrite as solid inclusion completely encapsulated by a quartz crystal from the Swiss Alps. Anhydrite has the same morphology like the hollow tubes penetrating the surface of the quartz crystal. In the Swiss Alps several locations of "anhydrite cavities" in quartz were described but only in a few cases, anhydrite has been verified by analytical methods (STALDER et al. 1998). In the Eastern Alps the characteristic tubular voids in quartz are found especially in Alpine clefts of the Tauern Window. From this area NIEDERMAYR (1997) and HYRSL & NIEDERMAYR (2003) reported several locations of hollow tubes in quartz, but anhydrite could not be detected in any specimen of the samples. To find the previous needle-like mineral which was transformed to hollow tubes was a main project aim of the mineralogical National Park projects during 2003 and 2004.

## Samples and description

Selected mineral collectors which are named in the specific projects sampled quartz crystals from following locations:

A) Schleierfall, Seebachtal by Mallnitz, Ankogel group, Carinthia: quartz-cleft in migmatite.
B) Lassacherkees, Ankogel group, Carinthia: quartz-cleft in migmatite.
C) Romate by Mallnitz, Carinthia: smoky quartz-cleft in syenite gneiss.
D) Romate by Mallnitz, Carinthia: quartz-vein with beryl (aquamarine) in syenite gneiss.
E) Großer Stapnik, Reißeck group, Carinthia: quartz-cleft in banded gneiss.

Contribution received at: 14.07.2005

F) Hochkedl-Staffenhöhe, Reißeck group, Carinthia: quartz-cleft in amphibolite.
G) Nussing by Matrei, Eastern Tyrol: quartz-cleft in amphibolite.
H) Ritterkopf, Rauris, Salzburg: quartz-cleft in amphibolite.

All quartz samples include predominately needle-like hollow tubes up to 6 cm in length with rectangular cross-sections beyond 1 mm. Only a few hollow tubes are crossing the quartz crystals in the samples A, B, C, F and G; whereas in the samples D, E and H the tubes are very abundant (Fig. 1). Frequently the needle-like voids penetrate the quartz complete and are partly filled by clay minerals. Often one end of the hollow tube is encapsulated by quartz and the other end penetrates the quartz at the contact to the cleft wall. These tubes are filled only by air and show their morphology with contrast to quartz by total reflection (Fig. 2). From all samples polished sections were made for light microscope investigations. In the samples A, B, C and E also fully encapsulated needles in quartz could be found. The optical contrast is much lower than by the hollow tubes and cleavage planes indicate these inclusions to be solid (Fig. 1 and 3).

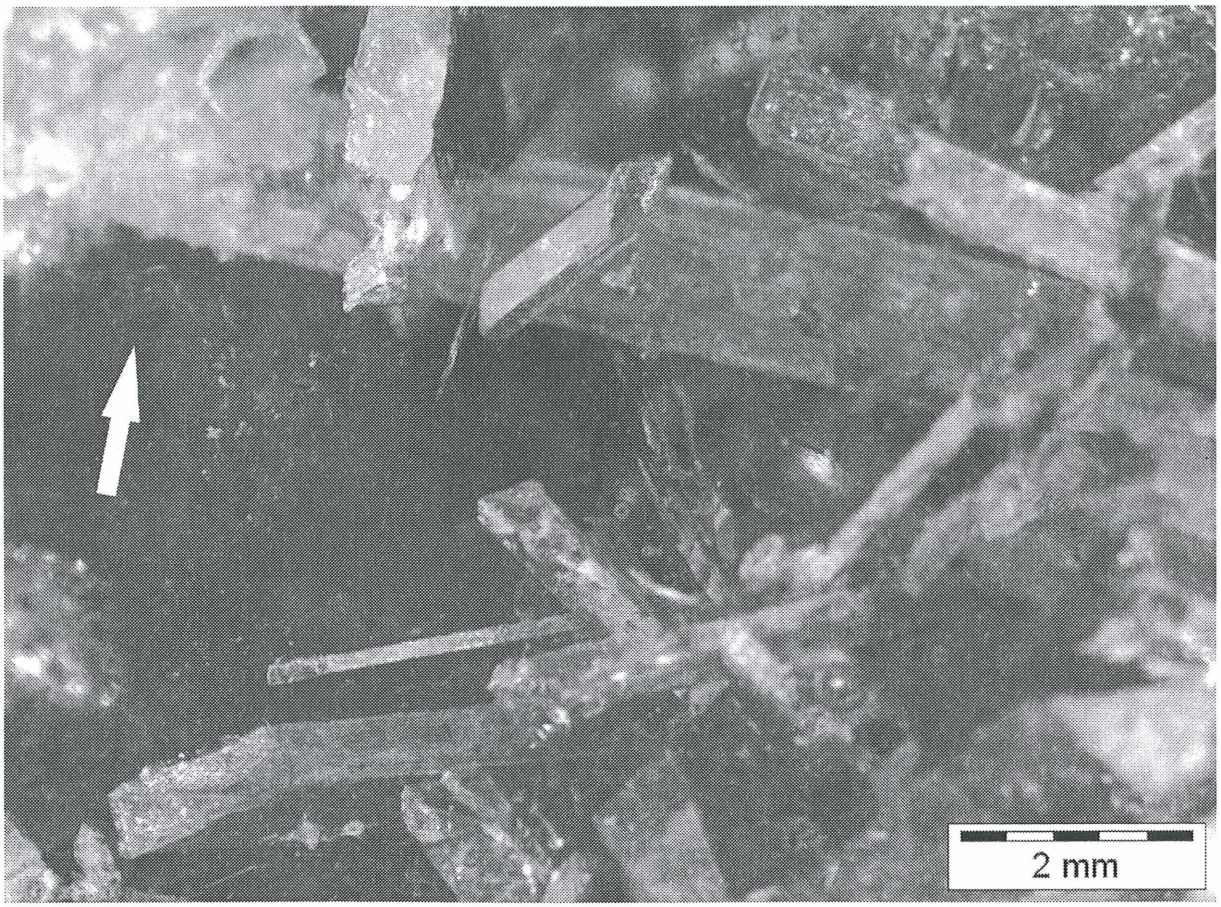


Fig. 1: Polished section of hollow tubes in quartz (dark grey) from Großer Stapnik, Reißeck group, Carinthia. The white arrow signs a nearly invisible solid inclusion (anhydrite) with the same shape like the hollow tubes (reflected light photo).

## Analytical methods and results

The microprobe analyses (Jeol JSM-6310, with ED- and WD-spectrometer) of the solid needles included in quartz yielded oxygen, sulphur and calcium. The analytical sum indicated a water free calcium-sulphate mineral. This was also confirmed by the X-ray powder pattern (Siemens D5000, CuK$\alpha$) that could identify this mineral as anhydrite, $CaSO_4$. To determine the crystal morphology of the needle-like anhydrite, a small part of the needle was broken from the polished cross-section. Oriented X-ray diffraction analyses (Bruker-axs, system GADDS) indicated the needle is an anhydrite single crystal with needle axis [100] (= a-axis). The crystallographic forms were measured by optical goniometry and resulted in {100}, {011}, {001} and {010} (Fig. 4).

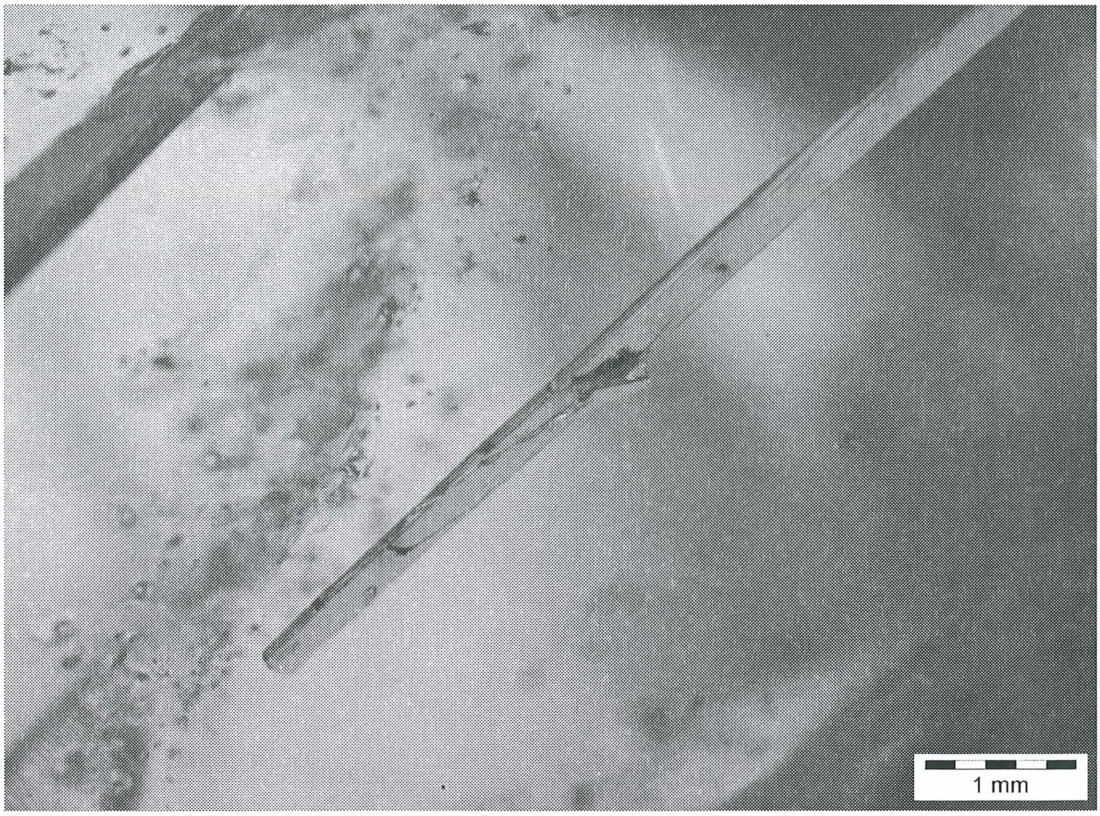


Fig. 2: Hollow tube in quartz in contrast to quartz by total reflection; from Schleierfall, Seebachtal by Mallnitz, Ankogel group, Carinthia (reflected light photo).

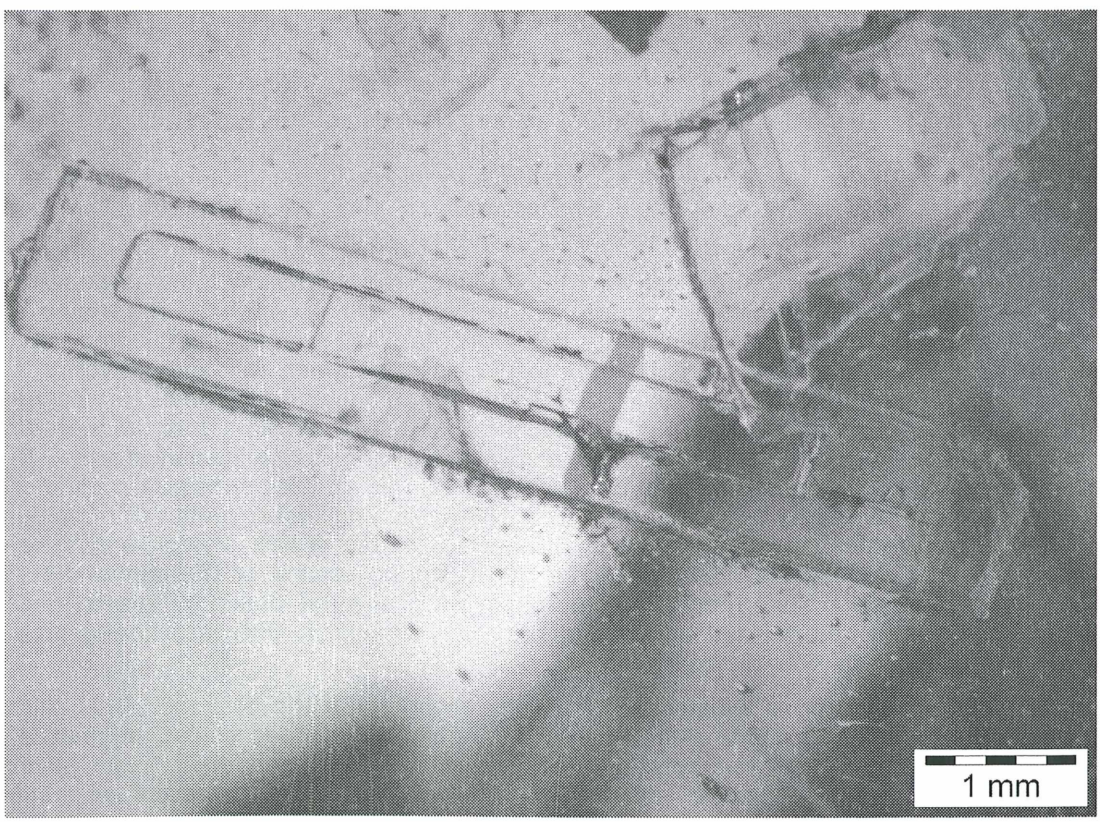


Fig. 3: Solid inclusion of anhydrite in quartz from Lassacherkees, Ankogel group, Carinthia. The cleavage plane of anhydrite is visible (dark grey) in the prismatic crystal (reflected light photo).

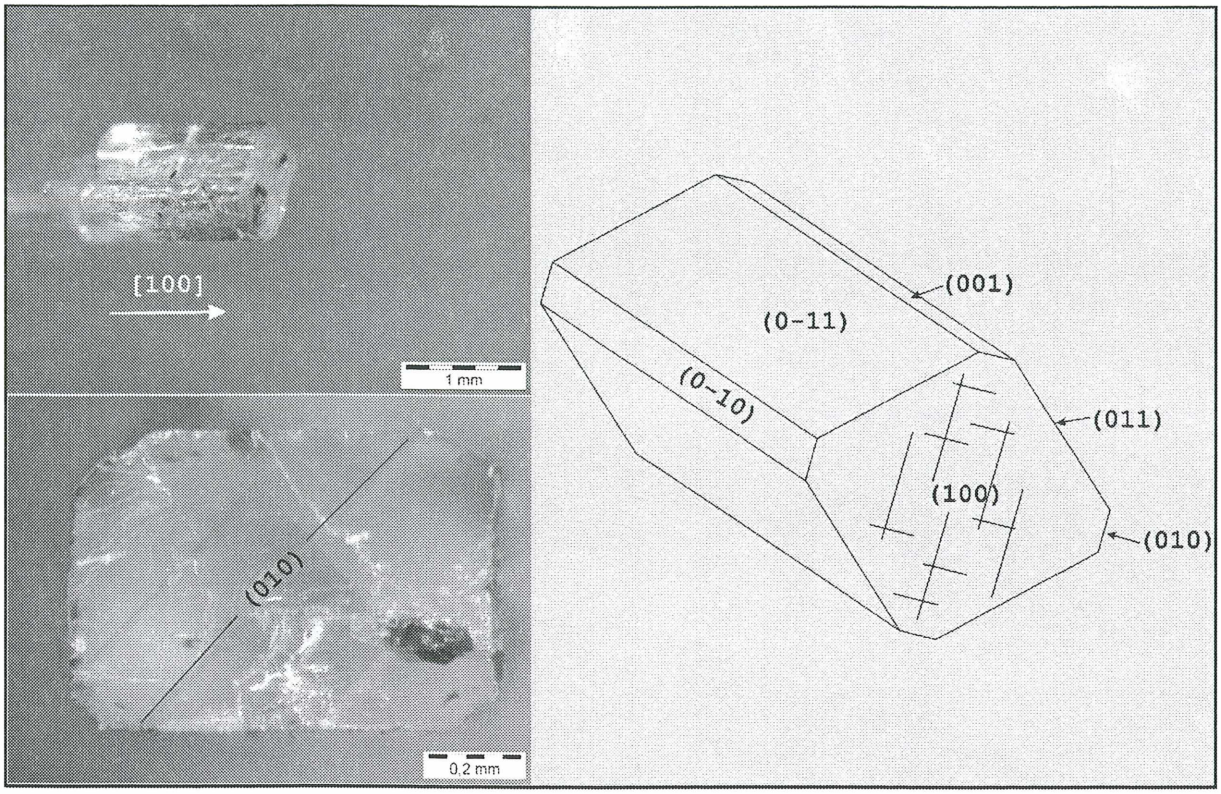


Fig. 4: Single crystal of anhydrite broken from the solid inclusion of the polished section (sample Schleierfall, Seebachtal by Mallnitz, Ankogel group, Carinthia). The needle axis is the crystallographic a-axis [100] (top-photo) and the cleavage planes are rectangular (down-photo). The faces of the anhydrite crystal are signed with Miller Indices in the idealized drawing.

## Discussion

From eight localities (A-H) of the Tauern Window quartz crystals with included hollow tubes are described. In quartz crystals of the samples A, B, C and E fully encapsulated needles could be identified as anhydrite. From the Eastern Alps anhydrite inclusions in Alpine quartz crystals were reported for the first time by WALTER (2005). The assumption, that the hollow tubes are due to anhydrite, that was later dissolved, could base on following facts:

The anhydrite inclusions in quartz show the same morphology like the hollow tubes in all samples. Anhydrite is the stable calcium-sulphate mineral in the hydrothermal system of the Alpine clefts under oxidizing conditions. The solubility of anhydrite in the system $CaSO_4$ and $H_2O$ at temperatures of 300° C and pressures of 1000 atmospheres is extremely low and anhydrite is the stable phase. At temperatures below 70° C the solubility of anhydrite reaches its maximum, anhydrite will be dissolved or transformed to gypsum, $CaSO_4 \cdot 2H_2O$. Anhydrite is therefore a protogenetic inclusion in quartz; it was formed before the quartz crystallization started. If the anhydrite needles were fully encapsulated in the later growing quartz, the permanent cooling of the hydrothermal system, caused by uplift and erosion of the overlaying rocks, could not dissolve this mineral. Are the anhydrite needles penetrating the surface of the quartz crystal, anhydrite has contact with the fluid and will be dissolved under 70° C during cooling of the alpine cleft. The anhydrite needles are now transformed to hollow tubes, which are not closed by quartz, because the quartz crystallization had finished before anhydrite was dissolved. Only weathering products (e.g. clay minerals) could fill now the hollow tubes.

The crystallization of anhydrite is independent from the chemistry of the host rock. This calcium-sulphate mineral was found in Alpine clefts located in amphibolite, banded gneiss, migmatite and syenite. The fluid composition was rich in sulphur and produced anhydrite under oxidizing conditions at an early stage of the cleft mineralization. Anhydrite is only protected by minerals, which are stable in the fluid of the hydrothermal system until weathering conditions, if it is fully encapsulated. Quartz is a very stable and frequent mineral of the Alpine clefts and often rich in solid inclusions of protogenetic and epigenetic crystallized minerals.

In Austria alpine mineral parageneses are predominately located in the Tauern Window, a protected area in great parts. For investigations earth scientists need samples of minerals and rocks which could not be found outside of this area. The scientific achievements are also presented for general public in meetings of societies for natural sciences.

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# AQUILALP.NET – The Golden Eagle in the Eastern Alps A trans-border monitoring project in the Austrian-Italian Alps

**Norbert Winding, Robert Lindner**

## Abstract

The Golden Eagle is one of the most prominent symbols of the Alps. Yet, excessive hunting and environmental changes caused eagle numbers to decrease dramatically at the end of the 19th century. Today populations are thought to be stable; they are no longer under immediate threat. However human influence still causes a potential threat, thus Golden Eagles are protected under the European Birds Directive. AQUILALP.NET aims to identify and document eagle populations in five protected areas in the Austrian-Italian Alps and to use this information to develop a coordinated trans-border protection strategy.

The project encompasses the national parks Hohe Tauern, Stelvio, Dolomiti Bellunesi, and the nature parks Rieserferner-Ahrn and Fanes-Sennes-Prags. All are part of the European NATURA 2000 network and recognised as core eagle habitats in the Eastern Alps. A co-ordinated recording scheme, regular controls of nesting sites and a standardised methodology allow scientifically exact documentation of populations and comparison of reproduction rates. Additionally, location characteristics of nesting sites were recorded, paying particular attention to present or potential disturbance parameters.

Within the project, a total of more than 70 breeding pairs are monitored and more than 230 nest sites have been documented. The co-ordinated monitoring over an area of 3,200 km² allows us to review the efficiency of the NATURA 2000 Network in the Alps for the protection of this prominent bird of prey.

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## Keywords

Golden eagle, Eastern Alps, Nationalpark Hohe Tauern, National Park Stelvio, National Park Dolomiti Bellunesi, Nature Park Rieserferner-Ahrn, Nature Park Fanes-Sennes-Prags, Natura 2000, population monitoring, breeding success.

## Aims, study area and methods

International collaboration and the development of efficient protection strategies are particularly relevant for the protection of species such as the Golden Eagle that uses its environment at large scales. One aim of the AQUILALP.NET is to intensify cooperation between Protected Area administrations in the partner regions. The coordinated and standardised quantification of Golden Eagle numbers in five spatially significant protected areas of the Eastern Alps will allow a quality control of the effectiveness of an interregional protection strategy for a protected species under Appendix 1 of the Birds Directive of the European Union. Further, the ALQUILALP.NET Project should provide a stimulus to promote general public awareness of efforts to protect the alpine flora and fauna.

The project was scheduled from 2003 to 2005. It aimed to identify and document populations of Golden Eagles within selected protected areas in the Eastern Alps and to use the information obtained to develop a coordinated strategy for the protection of the species in this trans-border region. The project encompasses 5 protected areas within the INTERREG Project region. All of these areas are included within the European NATURA 2000 network of Protected Areas. They are all recognised as core areas of habitat for the golden eagle in the Eastern Alps. Together, they cover an area of about 3 200 km².

Co-ordinated recording, regular controls of the eyrie (nesting) sites and standardised methods allowed scientifically exact documentation and comparisons of the reproduction rates of this bird of prey. Breeding pairs and nest sites were documented and mapped. As a supplement to the reproduction data, all important location characteristics of nesting sites have been recorded within a standardised scheme. To get an idea of the variety of prey taken by the eagles within the project area, diet analyses from remains found within selected nests has been carried out.

Contribution received at: 18.07.2005

## Results and discussion

A total of more than 70 breeding pairs of Golden Eagles could be monitored in all partner-parks and about 250 nest sites have been mapped. The breeding success varied between parks and years from 0.25 to 0.82 fledged birds per breeding pair. Golden Eagles are generalists in their diet. This means that their prey spectrum varies greatly between the investigated regions, consisting mainly of marmots in the central alps, with large open grasslands, and being much more varied in the southern alps, where limestone and dolomite rocks dominate the landscape.

Within the project a very effective cooperation between the nature reserves could be established and a standardised monitoring scheme was set up. The results clearly highlight the importance of the investigated areas for the protection of the Golden eagle, yet it is also obvious that only a network of protected areas can maintain healthy populations of wide ranging species like this bird of prey. Long term monitoring schemes are essential to get knowledge of the natural variation in breeding success between years and regions. Only with such background data it is possible to identify long term trends and to establish critical thresholds for conservation.

The strong public image of the Golden Eagle together with the results from this project, were used for the promotion of the participating national parks and nature parks.

The project website (www.aquilalp.net), the yearly newsletter, an extensive exhibition, and the final booklet are aimed to gain further support for the general idea of large scale protected areas in the Alps.

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# Types of Conflicts between Recreational Use and Nature Conservation – a contribution to Conflict Analysis, Resolution and Prevention in National Parks and Biosphere Reserves

**Karen Ziener**

## Abstract

Conflict types provide the possibility of structuring the extremely complex conflict area recreational use – nature conservation in national park and biosphere reserve regions. This conflict typification is based on the findings of spatial and social-science conflict research as well as on extensive conflict analysis carried out in the six areas which were investigated. In this process, both general tendencies in conflict development and resolution as well as specific regional features became evident. In this lecture, the typification will not be dealt with as the result of, but as the starting point for, the analysis of conflicts and the development of strategies for solving and avoiding conflicts. Using several conflict types as examples, the differences between the conflict situations and their resolution will be described and the varying roles of national park and biosphere reserve managements in the conflict process demonstrated. Even though each conflict situation demands an individual, conclusive analysis, they can provide the basis for the discussion of fundamental procedures and generalization of experience.

## Keywords

Conflict, Types of Conflicts, National Parke, Biosphere Resere, Tourism, Recreational Use, Nature Conservation, Conflict Analysis, Conflict Resolution, Conflict Prevention.

## Project

Habilitation Thesis, 1996–2002 (cf. ZIENER 2003).

## Regions

Spreewald, District of Rügen, Harz and Rhön in Germany, Lake Neusiedl and Danube floodplains in Austria.

A wide range of differing conflicts concerning spatial use, interests and goals arises during the establishment and development of national parks and biosphere reserves. These influence the implementation of protection goals, hinder and block the activities of the management of the conservation area. However, conflicts can also lead to development (e.g., changing ideas in tourism and leisure-time sport towards sustainable tourism and the environmentally-friendly performing of leisure-time activities). Unlike problems, conflicts cannot be solved unilaterally but require the reciprocal action of both (all) parties.

The modelling of the conflict area recreational use – nature conservation demonstrates the variety and complexity of the spatial-use conflicts and goal conflicts in the field of tension of ecology, economy (tourist industry) and social aspects (recreation and leisure-time use) as well as the interaction between them and, at the same time, serves as an example for other fields of conflict. The core of the modelling is the establishment of conflict types. The fundamentals of the methodology: Due to the complexity of the data structure – varied individual conflicts and a wide range of conflict properties – deductive and inductive procedures were linked. The conflict structure – the (objective) conflict subject, conflict parties, (subjective) points of contention, form, connection with space and time, conflict result and long-term effects – provided the analysis raster for real conflicts. And, the systemisation of the registered conflicts permitted the identification of typical conflict situations, development, and approaches to solution, their concretisation and characterisation. Three sources were used for the conflict analysis in the regions being investigated: scientific studies, concepts and plans dealing with conflicts, the regional press as well as interviews with regional decision makers.

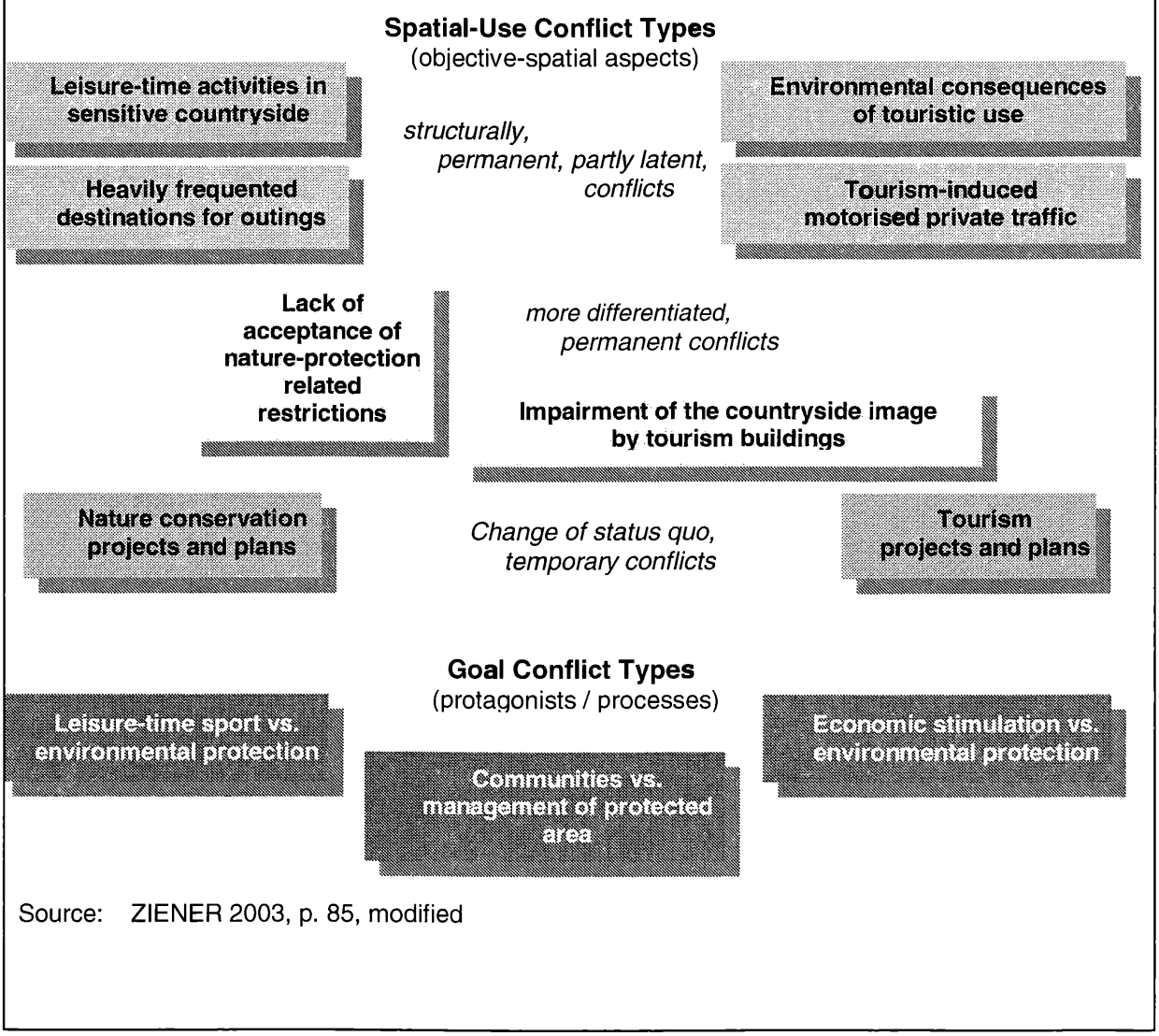
Contribution received at: 19.07.2005

As a result of the typification, eight types of conflicts concerning spatial use and three concerning goal conflicts could be formulated and described. Whereas conflicts over spatial use could be typified according to objective-spatial aspects, in those dealing with goals, the aspects dealing with the protagonists and processes were in the foreground. Two examples of the (qualitative) description of the spatial-use conflict types are shown in table 1. The characterization of the goal conflict types was carried out according to the three distinctive groups: conflict parties / issue / points of contention, spatial relationship, outward form / time relationship / conflict result / conflict effect. The application of the spatial-use conflict types on the six regions being investigated showed that almost all recorded conflicts could be assigned to the eight types and the typification was confirmed.

## Conflict analysis

The conflict types can support the structure of the field of conflict recreational use – nature conservation in a region and the analysis of individual conflicts. The point of departure is formed by questions such as: Which conflict types exist, and/or existed, in the region and what are the characteristics of the individual conflicts? Are there dominating conflict types and specific regional features? The conflict types can be processed as a checklist. The confrontation concerning heli-skiing in the Grosses Walsertal can be categorized under the conflict type leisure-time activities in sensitive areas. Its analysis and characterization can follow the type description and substantiate or modify the individual points.

**Fig. 1 Types of conflicts**




Source: ZIENER 2003, p. 85, modified

Fig. 1: Types of conflicts

**Table 1 Examples of the Description of the Spatial-Use Conflict Types between Recreational Use and Nature Conservation**

| Conflict subject / Points of contention / Spatial relationship | Conflict participants | Outward form / Time relationship / Conflict result | Long-term conflict effects |
|---|---|---|---|
| **Leisure-time activities in sensitive areas** | | | |
| The demands placed on the landscape and spatial use when performing certain leisure-time activities collide with goals for conservation and restrictions in sensitive areas, worth protecting,<br>→ conflicts, because restrictions on use or control measures were, or should be, threatened, implemented or increased,<br>usually small-scale, sensitive areas such as the banks of lakes and rivers, the upper reaches of flowing waters, steep and flat coasts, moors and silt areas, dry-grass areas, close-to-nature woods, subalpine meadows. | leisure-time sport clubs and societies, homeland and hiking associations, tourism providers, societies and organisations, communities, national park or biosphere reserve management, environmental protection clubs and associations, ecologists | In principle, permanent and not capable of being conclusively solved, fluctuation between latent and active conflicts, in recent times numerous examples of agreements and negotiations between management of protected areas, environmental protection bodies and users concerning routing, control measures, etc.,<br>compromises, temporary or permanent regulations, e.g., closing off of paths and water areas, relocation of paths and ski-trails, total or limited bans on admission, measures to control visitors and traffic guidance systems. | Partial solutions which permit a reduction in the conflict potential concerning spatial structure, e.g., relief for sensitive biotopes, reduction of the occurrence of erosion,<br>cooperation with environmental protection and leisure-time sport organisations in the field of visitor management and environmental education,<br>increase in the acceptance of national park or biosphere reserve. |
| **Tourism projects and plans** | | | |
| Above all, large-scale tourist facilities and construction, and those in sensitive landscape areas, are seen as an attack on nature and the landscape, e.g., large-scale recreational facilities, harbours, winter sport facilities<br>→ conflicts result from the resistance of environmental protection and other groups against tourism plans,<br>small-scale, large-scale projects spreading across the region. | environmental protection clubs and associations, nature conservation authorities, national park management or biosphere reserve management, landscape and regional planning, communities, civic action groups, investors, tourism providers, leisure-time sport clubs and societies | Open carrying out of conflicts, partly strong escalation, creation of coalitions for and against the project, limited-period conflicts, partly long-lasting,<br>counter-suggestions, alternatives, discussion of variations, e.g., in the press and at events, protest meetings,<br>statements by public agency concerning the project, approval, partially with stipulations (compromises), or refusal of the project. | Effect of tourism plans on nature and the landscape as well as the economic development of the community and region,<br>discussions on the problems of tourism development and maintaining the landscape. |

Source: ZIENER 2003, p. 88, abridged

Tab. 1: Examples of the Description of the Spatial-Use Conflict Types between Recreational Use and Nature Conservation

## Conflict solution

Two key factors must be taken into consideration when dealing with, and solving, conflicts: The conflict parties and the different roles of the management of the nature reserve in the conflict process. In conflicts over leisure-time activities in sensitive areas the administration of the conservation area and environmental protection organisations have leisure-time sport clubs, tourism providers and organisations, as well as the communities as their opponents. The more a leisure-time sport is organised, the more can be achieved through regulations and agreements. The national park, and/or biosphere reserve, management is a conflict party but increasingly also a moderator in conflict management. In this double capacity, it should take a direct approach to the process of problem solution and be actively involved. Conflicts based on an individual's lack of acceptance of restrictions resulting from environmental protection are usually carried out by single persons, mainly local recreation seekers living in the vicinity, residents and property-owners, and only secondly by clubs, organizations and communities. Here, the main necessity is to prevent an escalation of the conflict spreading over the entire region through targeted intervention and intense negotiation. However, sometimes it is necessary to take legal action when dealing with violations of conservation area regulations. There are usually two camps when dealing with tourism projects and plans – supporters and opponents. Today, the latter are not only comprised of nature and environmental representatives. The group also includes residents, communal representatives, tourism providers and businesspeople who fear additional competition or influence from outside and can, therefore, be won as partners.

## Conflict prevention

Targeted conflict prevention must take its start from the conflict potential. The conflict potential of spatial structures can be categorized as pairs of opposites:

- A landscape is evaluated as being both **worth protecting** and *attractive for recreation and leisure-time activities* (general view).
- An unfavourable relationship exists between the **sensitivity of a landscape** and the *intensity of its use for recreation and leisure-time activities* (ecological view).
- *Demands on using the area* by those seeking recreation and leisure-time activity, are opposed **to restrictions resulting from environmental protection** (user's view).

Conflict potential can also be a result of the persons involved, their interests and demands, deficits in information and communication, through misunderstandings and a lack of involvement by the relevant users and interest groups. Divergent conflict, and conflict avoidance, potentials exist in the individual conflict groups.

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# Economic Aspect of Sustainable Development in National Park Djerdap

**Goran Zikic, Nenad Radakovic, Sasa Nestorovic**

## Keywords

fish stocking, protection, development

## Territory characteristics

The territory of the NATIONAL PARK DJERDAP extending from Golubac to Sip includes as unique natural entirety gorges, canyons, valleys and basins along the Danube with mountain ranges and massifs raising above it.

Fishery area in National Park Djerdap is extended from Golubac city until first Djerdap barrage (Djerdap hydro plant). This area covers 6.000 ha.

Decrease of some autochthonous fish species like: carp, perch, sheatfish, etc and enlarge number of Asian species, have severe influence in negative flora transformation Danube river. Consequences of these changes are also Djerdap hydro plant operation. Huge water level variation in accumulation (1m and more per one.day) is one of numerous facts that are damaging natural reproduction of autochthonous species.

Fig. 1

## Area of study

Fish, as a natural resource, contribute to the food supply, economy, and health of many nations worldwide. This project establishes the importance of integrating into planning the essential relations between the environment and tourism, indicating that a fundamental condition for tourism development is the need to avoid damaging the natural, cultural and human environment; and that the rational management of tourism can significantly contribute to the protection and development of the physical environment and the cultural heritage, as well as improving the life quality of coastal communities.

Contribution received at: 08.08.2005

## Aim of this project

1. Endangered and autochthonous fish species protection; introduction and protection of fish species with large scale of nutrition (these species can reduce process of organic pollution)
2. Autochthonous species fish stocking will make balance between fish species in Danube river
3. Direct fishing to rapacity species with large economic value, species that feed with algae
4. Provide reducing of process of organic pollution though fish stocking with autochthonous species

## Importance of this project

As Danube is large International River that flows through several countries, it is not useful to implement this project into one small area and not covers all other area of Danube. If this project shows significant result then this method can be use in other parts of Danube River. Also, methods and results from this project can be used in different water ecosystem, not only rivers, because this can be good example how to protect autochthonous fish species in water ecosystems and how to promote one aspect of eco tourism. Besides, this project can give guide for other water areas not just Danube River, how to reduce organic pollution in water ecosystems and to avoid over production of invasive fish species.

## Results until now

Considering that project duration is 3 years, results from first and second year is following: natural reintroduction of fish species was increase for 15% per year and organic pollution was reducing for 15% in first year and 20% in second year.

## Indicators

Review of project result in previous two years was made thought size of fish catch. National Park Djerdap monitoring unit made fish catch. Quantity and size of catch fish individual's shows that this project was (in 2 years) very useful. These fish specimens were autochthonous species. This is also parameter for organic pollution reduction as this catch species is feeding with water vegetation.

## How this project influence in future planning in protected areas?

Results obtain thought project implementation was very useful for protected managers in future planning in field of water management and sustainable fishery. As National Park Djerdap do not have any financial supports from Government of Republic of Serbia this shows good way how to get self-financing system, and, in the same time to make good and sustainable protection of water resources.

## Social and economic aspect of this project

This National Park is located at the territory of municipalities: Majdanpek, Kladovo I Donji Milanovac in south part of Serbia. This area of Republic of Serbia is one of undeveloped part with lot of social and economic problems. Both commercial and recreational fishing constitutes a major source of employment and contributes significantly to the economy of the global economy. With over fishing occurring at an alarming and disastrous rate, economies and livelihoods are being irrevocably damaged. Large number of inhabitants in this area lives near by the Danube River and main working activity is commercial fishing. The impressive aquatic biodiversity of the Danube River is a key component of the food security of the people. Increasing fishing pressure and alteration of key aquatic habitat are having serious impacts on the fishery.

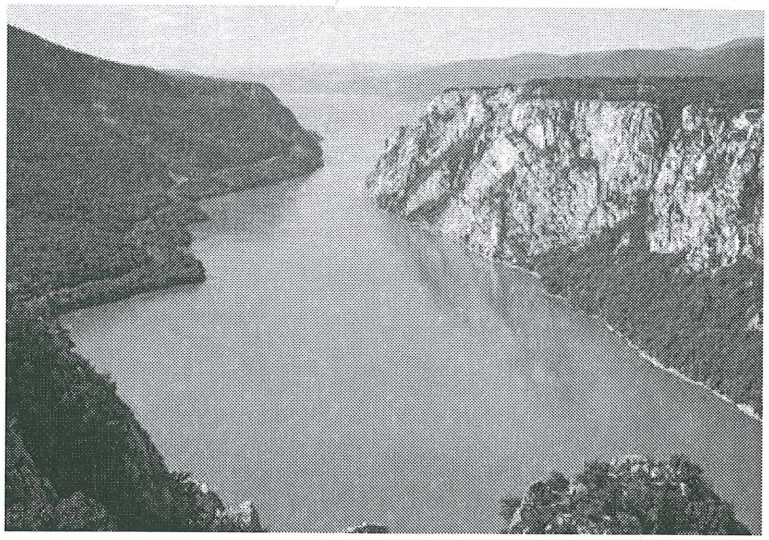

Fig. 2

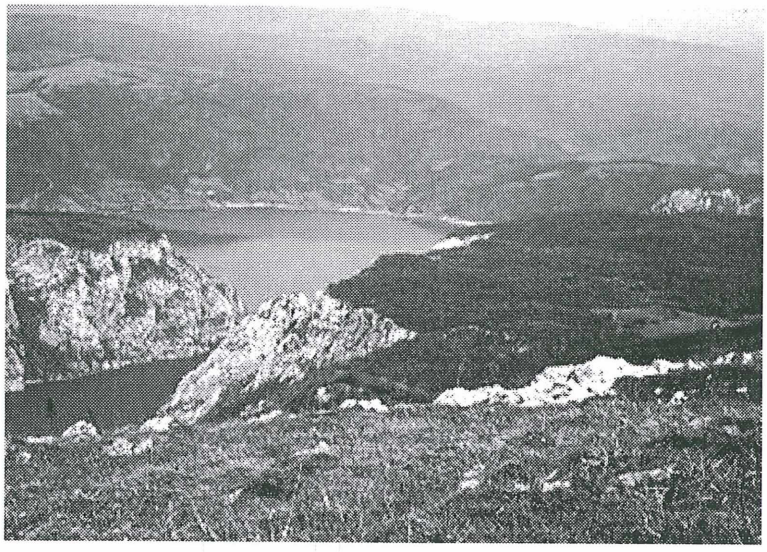

Fig. 3

Fig. 4

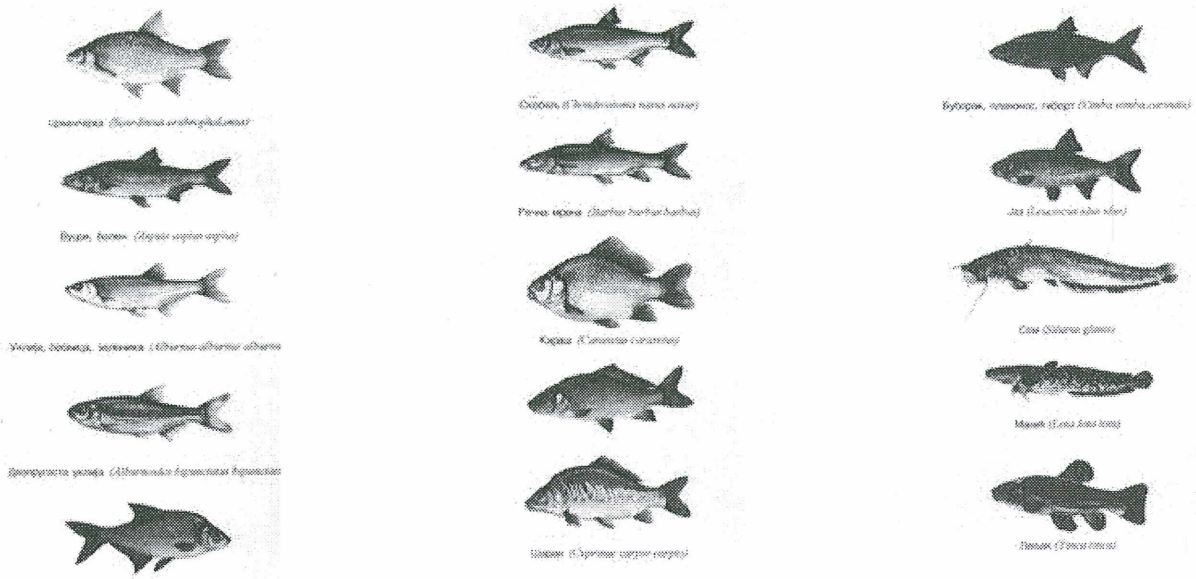

Fig. 5

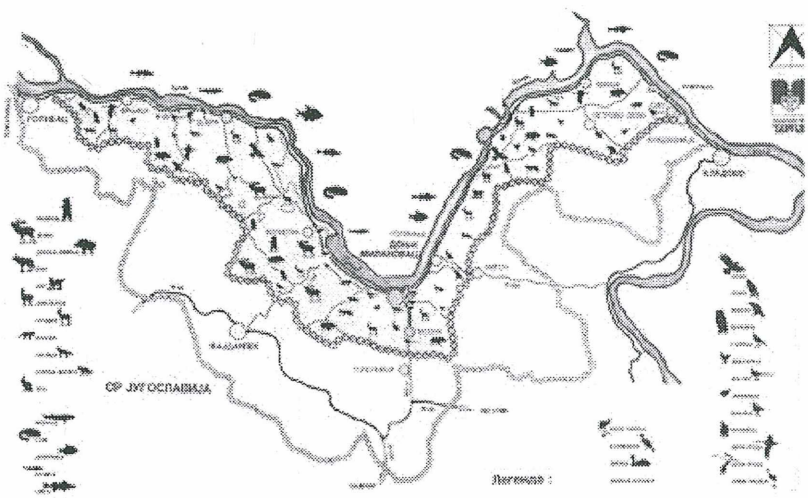

Fig. 6

Also, inhabitants have their own boats and barge that can be used in tourist purpose. If the recreational fishing made some development in territory of National park Djerdap then local inhabitants will have opportunity to development their own business related to the tourism. River, like Danube, clean and pure, with large fish diversity and quantity can give opportunity for local communities to make good quality of live hood. An increase in tourism productivity and competitiveness will necessarily take eco-tourism to protected areas and other places with extensive biological and cultural diversity, it being necessary therefore to take regional measures to manage to maintain these natural corridors.

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# Alpine Bearded Vulture Project: If Ending Releases Signifies Success of Project

**Richard Zink**

## Abstract

A hand full of scientists started with the reintroduction project in the year 1978. Today the project has reached international significance with more than a dozen of experts which coordinate more than 5000 voluntary working observers throughout the entire Alps. Thus success control is well based and monitoring is carried out on entire population level, however it needs huge enthusiasm and long term finances to assure high quality of communication flows within the monitoring network. This article shall summarize the knowledge collected within the last 20 year. Methods of project evaluation as well as possibilitys of communication are presented. GIS-Analyses give a better idea of the way the Alps have been re-colonised and enable the interpretation of delayed reproductive success in the northern Alps. The aim of the reintroduction is to stop release! This will be the case if annual reproduction success has reached the average number of birds released every year. In this case one might expect continuous population growth without human intervention. Relying on the development of pair formations this will come true very soon. The issue of alpine bearded vulture reintroduction is a success story: 10 couples started with incubation in the year 2005; continuously new pair formations can be registered. It seems the population shortly will be self sustaining and will replace the contingent of released birds (7 chicks/a).

## Keywords

bearded vulture, Gypaetus barbatus, release project, monitoring, GIS analyses, population modelling, evaluation methods

## Project Aims

- Re-establishment of a self-sustaining bearded vulture population in the Alps
- Development of a long-term Monitoring
- Analyses of observation data and population modelling

## Duration

Since 1986 (first release in Hohe Tauern National Park)

## Study Area

In Austria the project is divided into three parts: release (study area is the heart of Hohe Tauern National Park), national monitoring (study area extended to the alpine part of western Austria and International Bearded vulture Monitoring (IBM). In the latter case all observations collected on national level are joined for the entire Alps (study area ~150.000km²).

## Material and Methods

Observation data of bearded vultures have been collected in the Alps since 1986 (n = 30.698, July 14$^{th}$ 2005). A territory was defined if at least one adult bird remained resident (e.g. sleeping places) for more than a year or nest building was observed. Every nest site was localised and described as precise as possible. On that data base the following factors were investigated:

- Distribution of birds in the Alps
- Migration due to age
- Dispersal depending on release area
- Survival of birds released (population modelling)
- Relevance of release areas for settlement
- Mortality risks

Contribution received at: 15.07.2005

## Results

Release

Release sites were chosen following mainly the historical distribution of the species and favourable food conditions (figure 1). For release, nestlings were put into natural cavities in the age of about 3-month. During this stage of life birds totally rely on food offer. It takes some weeks until they fledge for the fist time. After fledging, supplementary feeding was continued up to an age of about six months.

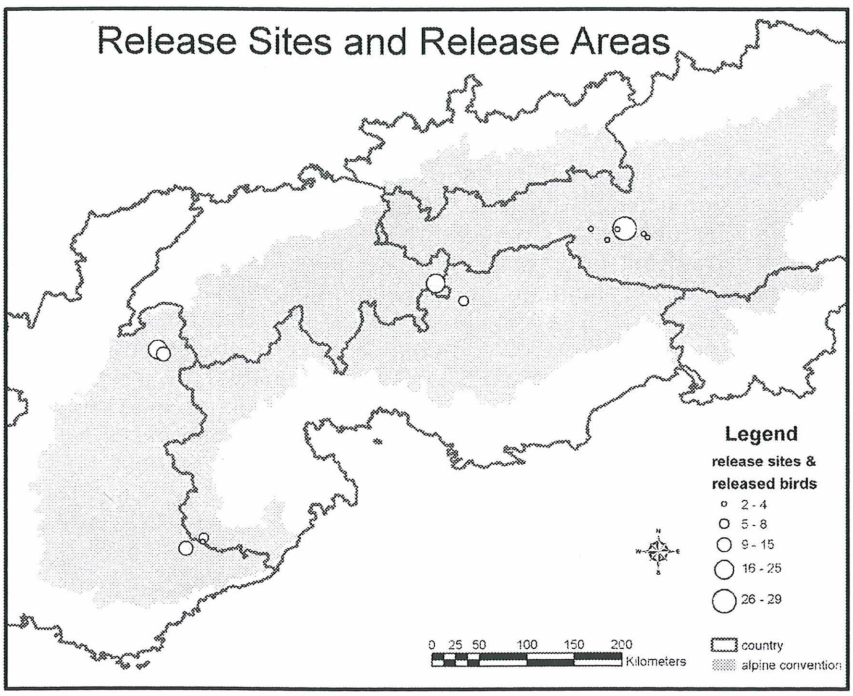


Fig. 1: Release areas and location of release sites in the Alps.

Up to now 137 birds have been released in the Alps. The proportion of birds released in each of the four participating countries is shown in figure 1.

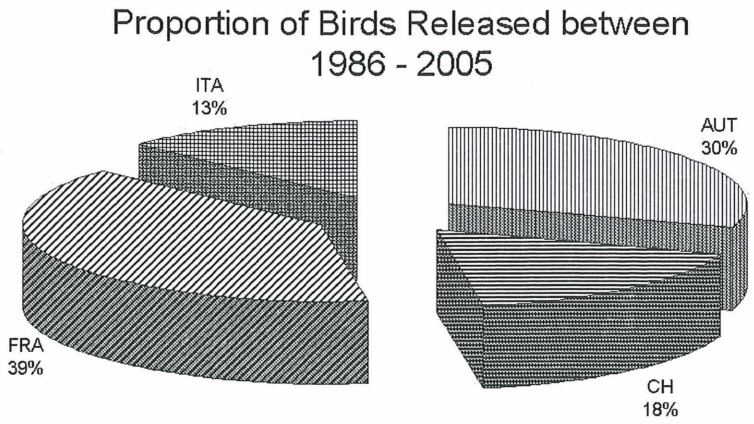


Fig. 2: Proportion of released individuals (1986-2005) in each of the four alpine countries.

Distribution of bearded vultures in the Alps

Considering all verified observations regardless age of birds, the distribution generally equals more or less the distribution of release areas. However, as shown in figure 3 two additional "hot spots" could be identified. The first one is the region of Vanoise- (FRA) and Gran Paradiso National Park (ITA) the second is situated in the area of the Swiss- (CH) and the Stelvio National Park (ITA). It is remarkable that these areas have been foraged intensively soon after the first releases. Today both regions are the heart of the Alpine population hosting 86% of successfully reproducing pairs.

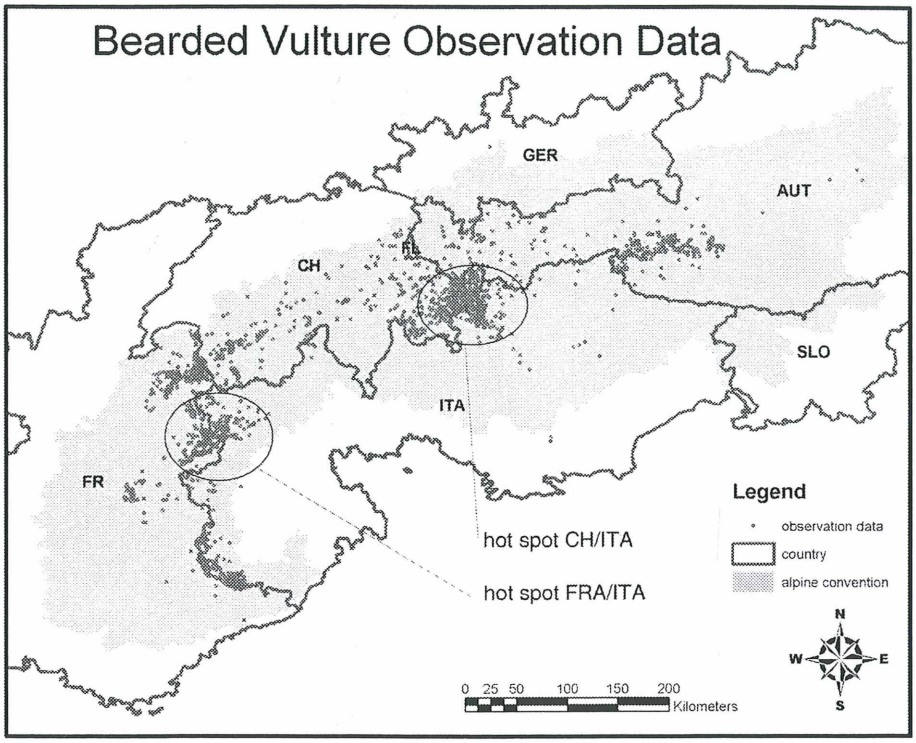


Fig. 3: Distribution of bearded vulture observation data (n = 30.698) in the study area.

Reproduction

Pair formations took place first in Austria in the year 1989. However, successful reproduction could not be registered before 1997 (France). Since than nest building has been observed in 41 cases and territorial behaviour was registered in 24 cases. A total of 27 chicks was successfully reared in seven different territories (figure 4). The proportion of naturally fledged offspring per country is shown in figure 5.

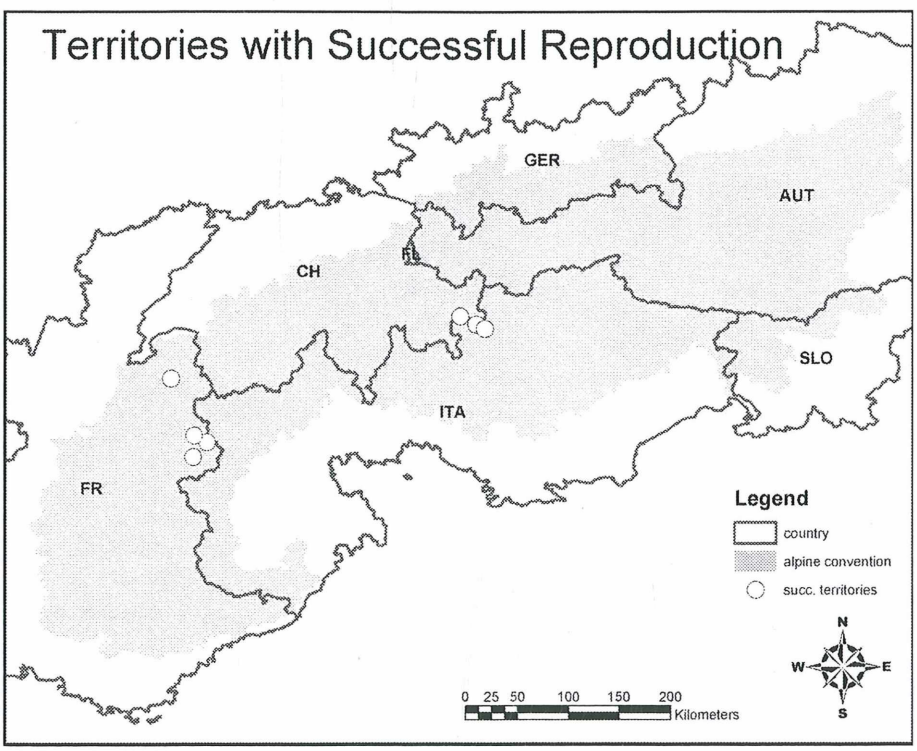


Fig. 4: Distribution of territories with reproduction success in the Alps.

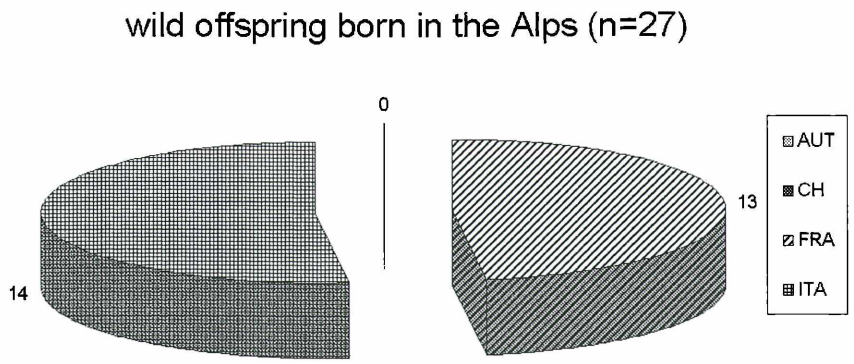


Fig. 5: Proportion of successfully reared chicks (1997-2005) in the four alpine countries.

Dispersal and Migration

Soon after the release the birds emancipate and become independent of any human intervention. Usually in late autumn they undertake their first long distance flights (>100km). For the birds this exploration phase is of high relevance as far as concerns orientation, habitat selection and pairing. Considering the hypothesis of philopatry they should return and settle in their former release area some years later for reproduction purpose.

To better understand the role of each release region dispersal of surely identified birds is shown depending on release site (figure 6a-d). Due to the lack of observers the dispersal in south-eastern direction (the Balkan region belongs to the historical distribution range of the species) might be underestimated.

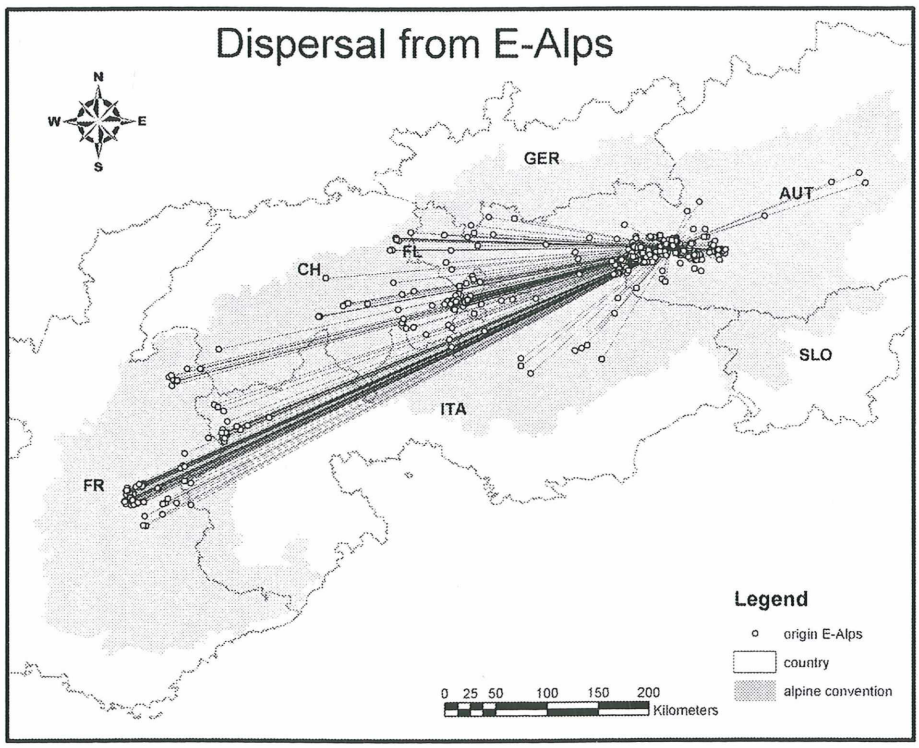


Fig. 6a: Dispersal of birds originating form release area E-Alps

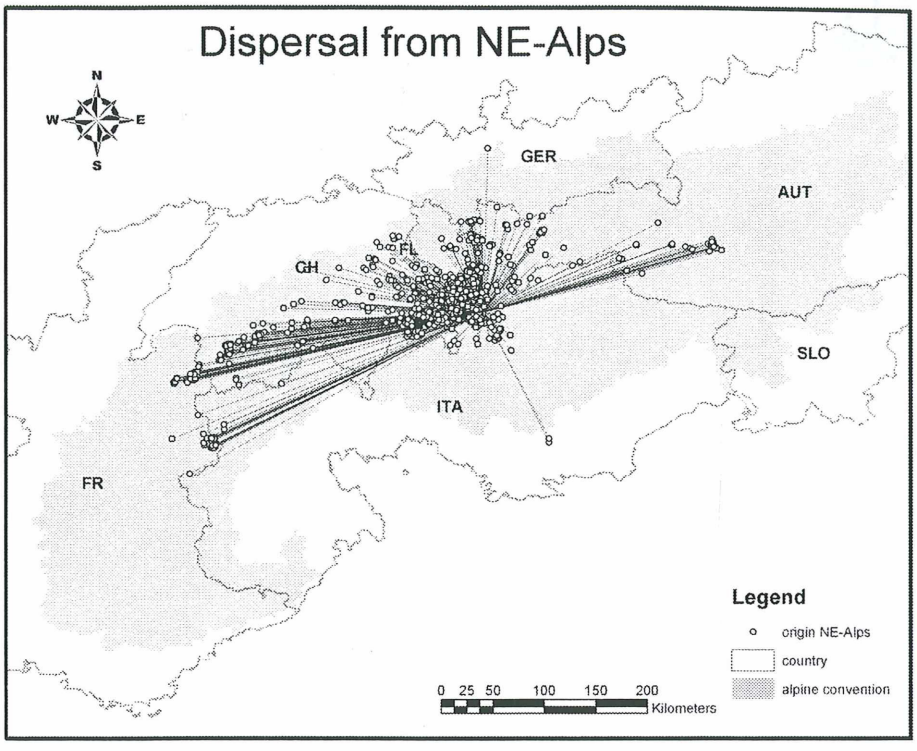


Fig. 6b: Dispersal of birds originating form release area NE-Alps

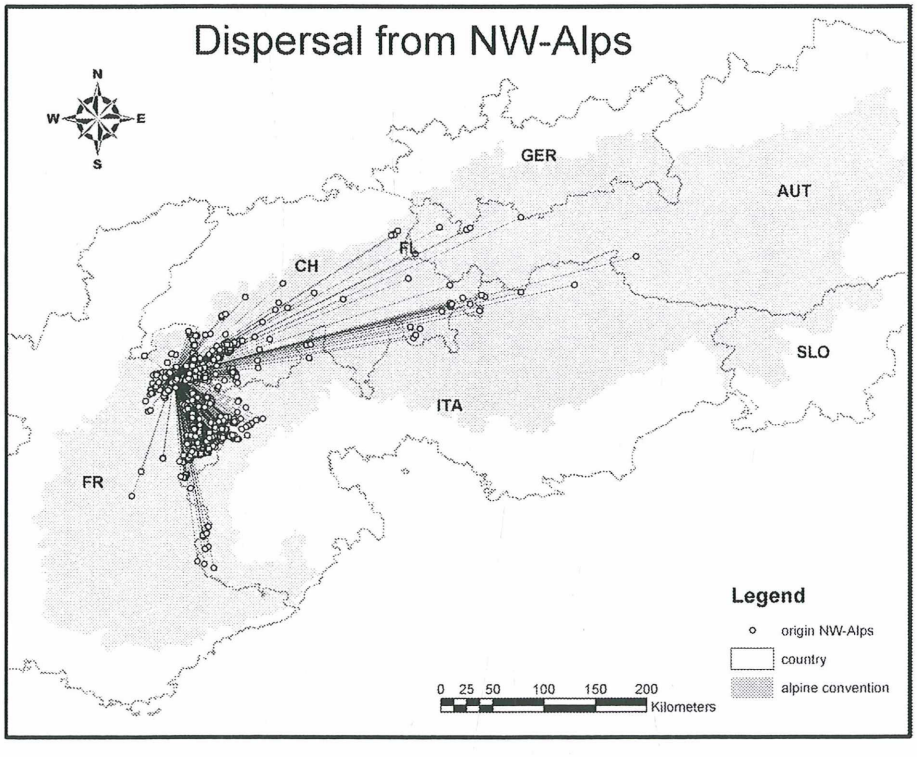


Fig. 6c: Dispersal of birds originating form release area NW-Alps

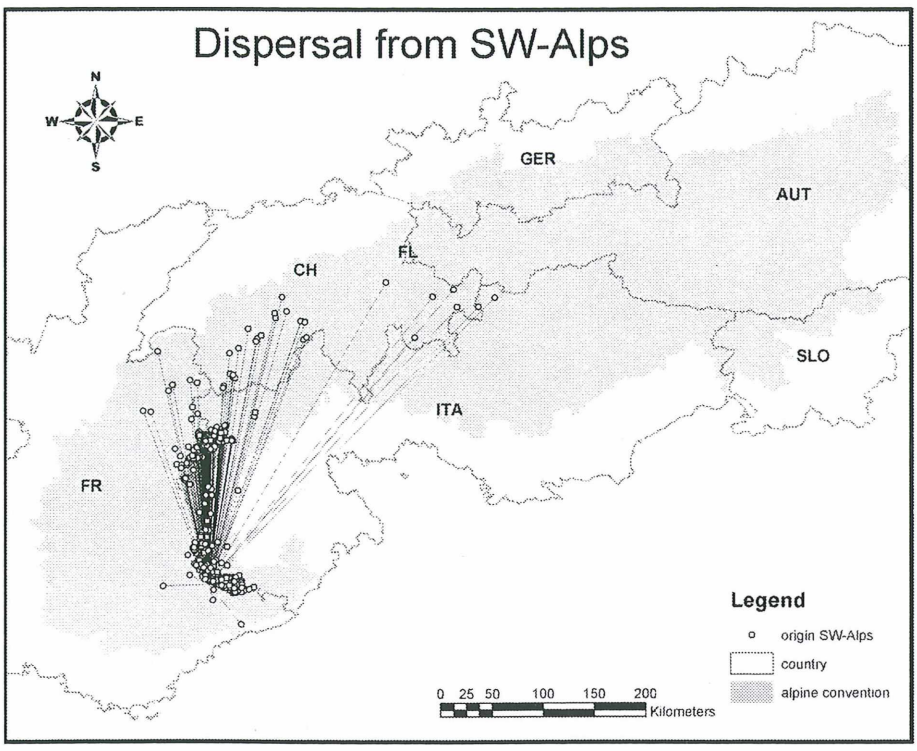


Fig. 6d: Dispersal of birds originating form release area SW-Alps

Especially in the immature phase (2nd and 3rd year of life) it appears that dispersal of bearded vultures follows a seasonal shift. During winter they stay mainly in the south-western Alps whereas they favour northern slopes (Switzerland and Austria) during summer (see figure 7). This could not be observed in other age classes. The area of Hohe Tauern National Park thus plays an exceptionally important role for immature birds. During that phase the suitability is underlined by the fact that flocks of griffon vultures (*Gyps fulvus*) show a very similar dispersal pattern even though they stay in Croatia and in the Balkan region during winter. It appears to be mainly climate and food conditions that generally cause such migration patterns.

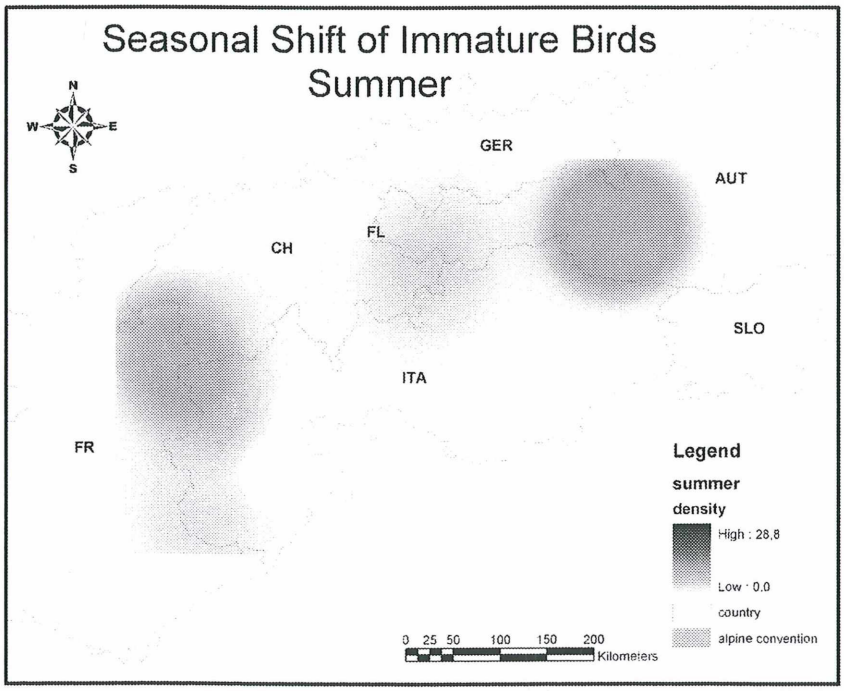


Fig. 7: Seasonal shift of immature bearded vultures between (a) northern (summer) and (b) southern (winter) Alps.

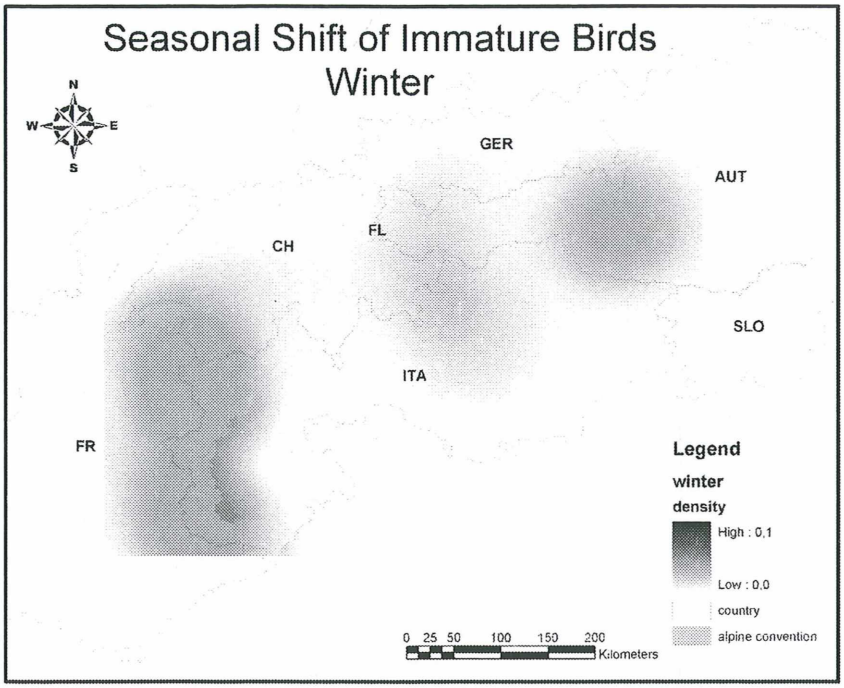


Fig. 7: Seasonal shift of immature bearded vultures between (a) northern (summer) and (b) southern (winter) Alps.

## Survival

With help of unique identification pattern it was possible to analyse population size on base of observation data until 2004. Since the proportion of wild born birds increases steadily furthermore it was necessary to rely on population estimates based on survival data. Because birds sometime disappear for more than a year before they can be identified again survival data have been analysed for all birds released between 1986 and 1996 however, survival was checked until 2004. Survival was calculated for every year of life and a simplified survival model was built.

In the model we extrapolated survival rates to all birds released. We distinguish between 100% identification and serious identification hints. When assuming only 100% identification as a proof for survival the populations size was about 80 birds, additionally using identification hints population size was estimated to be 100 individuals (31.12.2004).

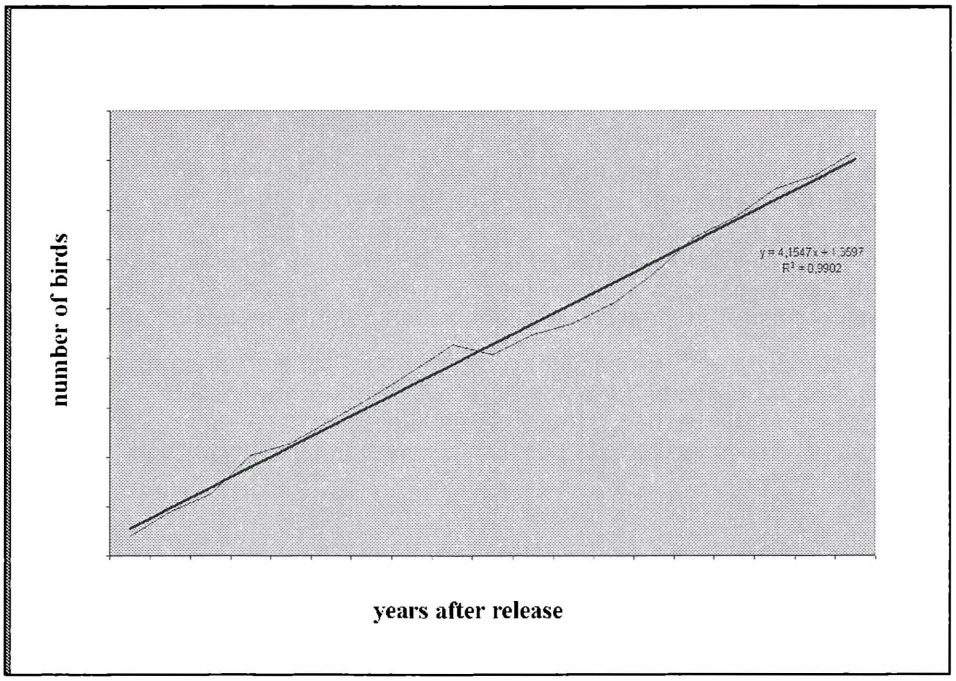


Fig. 8: Modelled survival rate using 100%-identifications

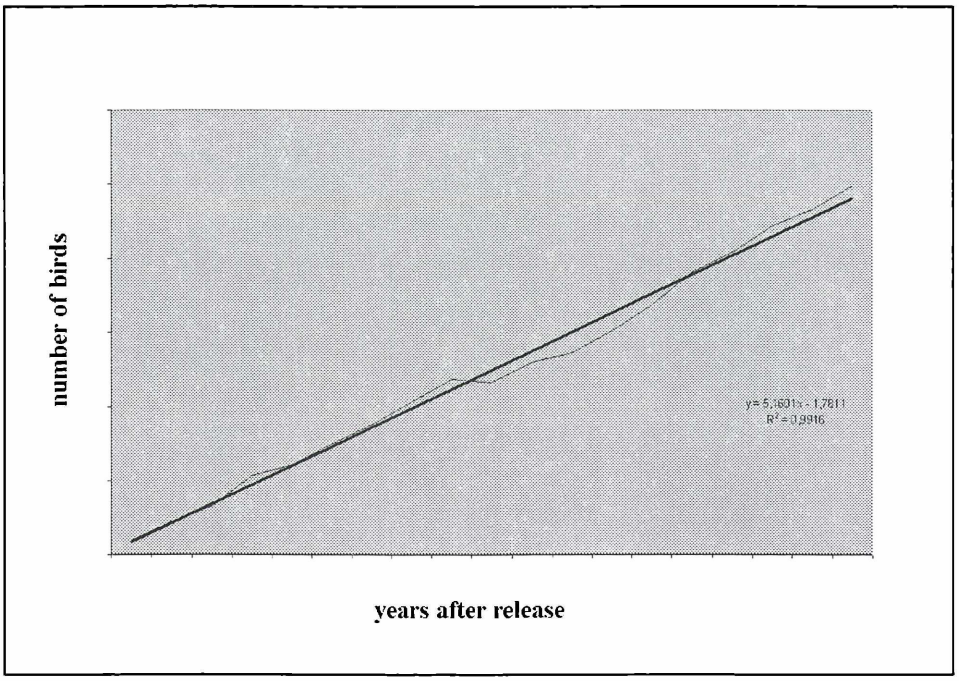


Fig. 9: Modelled survival rate using additionally identification hints

Out of 137 birds analysed only 18 (13%) had to be recaptured or were found dead. The reasons of mortality are tabulated in table 1.

| Group | AUT | CH | FRA | ITA |
|---|---|---|---|---|
| Shooting | | 1 | 1 (2?) | 1 |
| Overhead wire | | | 3 | |
| Avalanche | 1 | 1 | | |
| Disease | 1 | | 3 | |
| Poison | 1? | | (?) | |
| Recapture | 2 | | 2 | |

Tab. 1: Mortality reasons in Alpine bearded vultures

## Discussion

Several aspects are crucial for successful reintroduction. Public relation work undoubtedly makes the project successful. It ensures the acceptance of the species all over the Alps and stimulates comments, while providing an opportunity of regular information exchange. Release sites must be chosen in favourable habitat. Often historical data can be useful to find the best locations. In wide ranging species such as the bearded vulture the study has to be understood in its entireness. As shown habitat suitability has to be differentiated and substantially depends on age and season.

Monitoring of released individuals turned out to be essential to measure project success on the long term. If the distribution range is huge and different people work on data collection in different languages, data format has to be harmonized. It should be agreed upon data publication- and copyrights. This might guarantee cross border co-operational efforts and the exchange of information on the long term.

The role of protected areas - general aspects

Some key factors for successful reintroduction of the bearded vulture are primarily provided within protected areas:

- Save release sites and infrastructure for public relation work
- Huge areas without hunting activities (less risk to be shot for birds) especially in France, Italy and Switzerland
- Better acceptance and therefore better chance to work on the rduction of mortality risks (e.g. modification of dangerous overhead wire which frequently leads to collision
- Better food supply is case carcass of domestic and/or wild ungulates are not removed
- Save nest sites is case there is surplus restrictions for climbing, paragliding and photography.

## Acknowledgements

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# Spatial Coincidence Between Habitat Suitability for Bearded Vultures and Protected Areas in the Austrian Alps

**Richard Zink, Helmut Beissmann**

## Abstract

The Network of Alpine Protected Areas built a GIS of conservation areas in the Alps. Within the framework of the International Bearded vulture Monitoring these regions have been compared with the distribution of Bearded vultures. The original data were provided by several institutions (see logos on the poster). Pair formation is a crucial criterion for the increase of the reintroduced population and will take place only within habitats of high quality. The habitat suitability map for the Austrian Alps is derived from ecogeographical variables at the observation points according to the method described by Hirzel (Ecology, 2002).

The main question is about the relevance of alpine protected areas in Austria for the highly mobile birds and to what extent habitats of high quality coincide with these locations.

## Results

The current distribution of territorial pairs has its main focus in the SW-part of the Alps, therefore, the occurrence of pairs in the N-Alps could be an indicator for excellent habitat quality. So far in Austria pair formation took place only in Hohe Tauern NP.

Species distribution depending on protected areas

Either in Austria and the whole area of the Alpine Convention the proportion of protected areas is 20%. From all alpine observations since 1986 (n=24.661) 64% have been reported from protected areas, whereas in Austria (n=7.817) this fraction was 90%. In the Alps there is no difference in the distribution of age between protected and unprotected areas. However, in Austria the rate of juvenile birds is remarkably higher (26%) than in the total area of the Alpine Convention (15%).

Species distribution depending on Habitat Suitability Index (HSI)

The investigation of habitat suitability for Bearded vultures was carried out at the Konrad Lorenz Institute for Ethology (Vienna) for the Austrian part of the Alps. Our study shows a clear positive relation between numbers of observation and habitat quality [figure 1 in the poster]. Areas of a HSI above 80% can be found 2 times more often in protected areas than in the rest of the Austrian study area while areas below HSI of 20% are predominantly located outside the protected areas [figure 2 in the poster].

The Hohe Tauern NP covers more than 50% of all alpine protected areas in Austria and is therefore of outstanding importance for the further development of the Bearded vulture population in the NE-Alps.

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