Table of Contents

ALLGÖWER, B., STÄHLI, M., BUR, M., KÖTZ, B., MORSDORF, F., FINSINGER, W., TINNER, W: Long-term Fire History and Remote Sensing Based Fuel Assessment: Key Elements for Landscape Management in the Swiss National Park 11

AVIAN, M., BAUER, A., LIEB, G.K.: Monitoring modification of alpine environments: New techniques and perspectives 15

BARTOLOMEI, S., SCIPIONI, A., MORELLI, A., ZULIANI, F.: Emas application in the Euganean thermal Basin 19

BEHM, M., RAFFEINER, G., SCHÖNER, W.: Climate change and possible impacts on alpinism: a case study on the Nationalpark Hohe Tauern 21

BERNHARDT, M., STRASSER, U., ZÄNGL, G., MAUSER, W.: Using MM5-derived wind fields for the modelling of snow transport processes 25

BOCCA, M, CREMONESE, E., FACCHINETTI, A. , MAMMOLITI MOCHET, A., MORRA DI CELLA, U.: Research activities in the Mont Avic Natural Park: Interreg IIIA "COGEVA-VAHSA": project experience 27

BOCCA, M, CREMONESE, E., FACCHINETTI, A. , MAMMOLITI MOCHET, A., MORRA DI CELLA, U.: Vegetation exposure to ozone and atmospheric depositions: monitoring in remote sites in the Mont Avic Natural Park 33

CORTOT, H.: How to manage a national park? Asking the right questions to manage an alpine protected area: les Ecrins 39

DÄMON, W., GROS, P.: The Biodiversity Database of the Hohe Tauern National Park 41

DEMEL, W., KIAS, U.: Aerial image interpretation within the Interreg IIIB project "HABITALP" 45

DUNGLER, H.: Aspects of sports ecology and wildlife biology in high mountain regions of the Alps. Interactions between outdoor sports and rock ptarmigans (Lagopus mutus helveticus) in arctic alpine zones 49

EHRINGHAUS, B.: Towards an international protected area: Lessons from the transfrontier interdisciplinary research network for the protection of the Mont-Blanc 53

FRANZ, H.: Global Change Impact – Projects in the National Park Berchtesgaden 57

FÜREDER, L.: Alpine Streams – Natural Ecosystems as Indicators of Environmental Change 61

GALLAUN, H., PRASCHK, C., SACKL, P., SCHARDT, M.: Remote sensing based monitoring of the Natura 2000 site Niedere Tauern 65

HALLER, R., RHIN, C.: Research becomes public: The use case of WebPark 69

VON HARDENBERG, A., BASSANO, B.: Long-term ecological research in protected areas: The example of Alpine ibex in the Gran Paradiso National Park 73

HENNIG, S., KÜNZL, M.: Toward a Guiding Principle "Recreational Use". The Protected Area Berchtesgaden National Park within the Region 75

JERABEK, M., HÜTTMEIR, U., KREUZBERGER, J., VORAUER, A., WALDER, C., REITER, G.: Building-dwelling bats in the Nationalpark Hohe Tauern (Carinthia, Salzburg, Tyrol) 79

JUNGMEIER, M., KIRCHMEIR, H. , KÜHMAIER, M., VELIK, I., WAGNER, J.: The IPAM-Toolbox: An Expert System for Integrative Planning and Managing of Protected Areas 83

KAUFMANN, V., LADSTÄDTER, R.: Glacier monitoring by means of terrestrial photogrammetry: A case study in the Hohe Tauern National Park 91

KELLERER-PIRKLBAUER, A., BAUER, A., PROSKE, H.: Terrestrial laser scanning for glacier monitoring: Glaciation changes of the Gößnitzkees glacier (Schober group, Austria) between 2000 and 2004 97

KOHLER, Y., PLASSMANN, G.: Ecological Network and NATURA 2000 107

KOLLER, M., KASPER-GIEBL, A.: A lab above the clouds (I). NO_2 measurements at the Sonnblick Observatory 113

KOMPOSCH, C., HOLZINGER, W.: Nature conservation evaluation of alpine pastures in the Gesäuse National Park (Styria, Austria) by means of the bioindicators spiders, leaf- and planthoppers (Arachnida: Araneae; Insecta: Auchenorrhyncha) 117

KONNERT, V.: The medium-term management plan for the Berchtesgaden National Park 121

KREINER, D., ZECHNER, L.: Multifunctional Assessment of Alpine Pastures 123

KREISCH, W., ABL, M.: Interdisciplinary monitoring project of subalpine mountain hay meadows in Hohe Tauern National Park (Carinthia). A model for extensive cultivation and preservation of these endangered ecosystems, their biodiversity and their species interactions 125

KRISAI, R., MAYER, M., SCHRÖCK, C., TÜRK, R.: The mire „Gradenmoos" in the Schobergruppe (National Park Hohe Tauern, Carinthia, Austria) 129

LEITINGER, G., TAPPEINER, U., TAPPEINER, G., WALDE, J.: Perception of the National Park Stilfserjoch by the Local Population 133

LENG, M.: Education for sustainable development in protected areas in Europe - Evaluation of educational concepts 137

LOTZ, A.: Alpine Habitat Diversity – HABITALP. Towards an integrated spatial development in the Alpine Space 139

MAYER, W., TÜRK, R.: Pollutant-related mapping of lichens on the Integrated-Monitoring-site Zöbelboden in the Reichraminger Hintergebirge, Oberösterreich, Austria 143

MEDGYESY, N., LACKNER, R., PELSTER, B., RIEDL, A., MERANER, A., BARIC, S., DALLA VIA, J.: Trout Exam-Invest. The resettlement of the Danubian clade of brown trout in the region of the National Park Hohe Tauern 145

MERANER, A., BARIC, S., RIEDL, A., MEDGYESY, N., LACKNER, R., PELSTER, B., DALLA VIA, JOSEF: The use of molecular markers for the characterisation and rehabilitation of indigenous trout populations in the Central Alpine region 149

MUHAR, A., ARNBERGER, A., BRANDENBURG, C.: Monitoring of visitor flows and visitor needs as a basis for protected area management 153

MÜRLE, U., ORTLEPP, J.: Effects of experimental flooding on the River Spöl, Swiss National Park 159

NEUMAYER, J.: Biodiversity of flower visitors: Enabling and threatening factors for the existence of species – rich communities 163

PFLÜGER, Y.: Value based decision making process for strategic visitor management in the Natura 2000 area Lech River Valley, Tyrol 167

PIROVANO, A., ZECCA, G., COMPOSTELLA, C., SCHROEDER, W.: The Black woodpecker (Dryocopus martius) as focal species in alpine protected areas 175

PROBONAS, M., XIROUCHAKIS, S., GRIVAS, K.: LIFE-Nature Projects for the Conservation of the Bearded Vulture in Crete, Greece: Public Awareness Campaign and Results 179

REIMOSER, F., ZINK, R.: Development of a nationalpark consistent wildlife management in a model region of the Gastein valley 181

SÁNCHEZ OCHOA, A., EFFENBERGER, C., KASPER-GIEBL, A., SCHAUER, G.: A lab above the clouds (II). Aerosol and trace gas measurements at the Sonnblick Observatory 187

SCHAUPPENLEHNER, T., MUHAR, A., FREYER, B.: "Leben 2014": Perspectives for Regional Development in the National Park Region Oberpinzgau/Hohe Tauern (Case-Study) – Methods and selected Results 191

SCHERZINGER, W.: Preservation and dynamics – The charge of conservation in national parks in reflexion to autogenous processes 195

SCHEURER, T.: Research in Alpine protected areas: importance and issues of international co-operations 199

SCHÖNER, W., AUER, I., BÖHM, R.: Climate fluctuation in the Alps during the last 250 years 203

SEEBER, H., SASCOR, R.: 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 207

SLUPETZKY, N.: Weiße Hölle – Hölle Weißsee. Forced Labor at 2.300 meters above sea level 209

SLUPETZKY, H., WIESENEGGER, H.: Glacial changes, water cycle observations and mass balance development on the Stubacher Sonnblickkees in recent years 213

STAUDINGER, M.: Research Activities at the Sonnblick Observatory 219

TÜRK, R.: The importance of National Parks and other protected areas for the surviving of lichens and lichen communities 223

UNGLAUB, R.: IPAM Toolbox. Tools and Pilot Actions for Management Plans. Management plans for 7 Natura 2000 Sites in Carinthia 227

VETTORAZZO, E.: The Dolomiti Bellunesi National Park "Fauna" special project 235

VILSMAIER, U., MOSE, I.: The Implementation of the National Park Idea in Society – The Role of Agenda 21 Processes 239

VLAŠIN, M.: What happened in the Šumava National Park? 243

WALTER, F., ETTINGER, K.: The origin of hollow tubes in Alpine quartz crystals 245

WINDING, N., LINDNER, R.: AQUILALP.NET – The Golden Eagle in the Eastern Alps. A trans-border monitoring project in the Austrian-Italian Alps 251

ZIENER, K.: Types of Conflicts between Recreational Use and Nature Conservation – a contribution to Conflict Analysis, Resolution and Prevention in National Parks and Biosphere Reserves 253

ZIKIC, G., RADAKOVIC, N., NESTOROVIC, S.: Economic Aspect of Sustainable Development in National Park Djerdap 257

ZINK, R.: Alpine Bearded Vulture Project: If Ending Releases Signifies Success Of Project 261

ZINK, R., BEISSMANN, H.: Spatial Coincidence Between Habitat Suitability for Bearded Vultures and Protected Areas in the Austrian Alps 271

Appendix

Guidelines for the Authors 273

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 11-13

Long-term Fire History and Remote Sensing Based Fuel Assessment: Key Elements for Landscape Management in the Swiss National Park

Britta Allgöwer [1], Markus Stähli [2], Michael Bur [2], Benjamin Kötz [3], Felix Morsdorf [3], Walter Finsinger [4], Willy Tinner [4]

(1) GIS Swiss National Park (GIS-SNP) / Geographic Information System Division (GIS) Division, Department of Geography, University of Zurich
(2) Geographic Information System Division GIS, Department of Geography, University of Zurich
(3) Remote Sensing Laboratories (RSL), Department of Geography, University of Zurich
(4) Institute of Plant Sciences, Section Paleoecology, University of Bern

Abstract

Swiss Federal law protects all natural processes occurring within the borders of the Swiss National Park (SNP). Natural wildland fires are counted among them and should not be extinct. Strict nature conservation represents the top goal of the SNP (IUCN category I) and does not allow any mitigation measures being undertaken unless the park is put at risk in its very existence. However, for societal reasons all fires are put out at present regardless whether they are of natural or human origin. Ninety years of strict nature protection have triggered fuels to build up in the boreal type forests of the SNP reaching the point where natural fire cycles could come into play again.

With field-based fuel investigations and high-resolution Remote Sensing (i.e. LIDAR and Imaging Spectroscopy) we get a very good picture of the present forest and fuel structures, allowing us to predict potential fire behavior. On the other hand pollen and charcoal analysis show us that fire has been an important and regular disturbance factor in the SNP area, shaping vegetation succession long before men became a dominant factor in this remote landscape. All these elements are input to the fire management policy of the Swiss National Park.

Introduction and Motivation

The leasing contracts between the Swiss National Park and the land owning communities specify that the SNP is liable for damages emerging from within its borders. Therefore, all fires are extinct at present regardless whether they are of natural or human origin. After ninety years of strict nature protection – meaning no management measures whatsoever – the question arises whether or not fuels are building up in the boreal type forests of the SNP reaching the point where natural fire cycles could come into play again and what to do from a managerial point of view?

The goal of this long-term study is to develop fire management strategies that integrate ecological and societal demands alike and thus have a chance to be accepted by the local population and authorities.

Material and Methods

Fire history and vegetation conditions are part of the puzzle required for the elaboration of a Wildland Fire Management Plan (FMP) that meets the requirements of a nature conservation area such as the Swiss National Park. However, it is not the goal of this paper to give a detailed description of how a complete FMP is developed, yet to give details on a future FMP for the Swiss National Park.

Study Area (Swiss National Park)

The Swiss National Park is situated in the Southeast of Switzerland in the midst of the Engadine Valley, one of the top tourist destinations of the Canton of Grison. Rugged topography, Dolomite limestone and little precipitation (900 mm per year) create harsh environmental conditions. Forests cover one third of the Swiss National Park. Before the foundation of the SNP in 1914 these forests were heavily logged and livestock grazing was going on (PAROLINI 1999).

Contribution received at: 19.07.2005

Fuel Assessment

Specific SNP fuel models were established in former investigations (ALLGÖWER et al. 1998) and introduced to GIS-based fire propagation modeling.

In 2002 a high resolution remote sensing campaign took place where the Ofenpass area was investigated with a LIDAR sensor (Falcon II by Toposys, Ravensburg, Germany) as well as two Imaging Spectroscopy sensors (DAIS and ROSIS by DLR, Germany. Both flight and ground truth campaigns are described in detail by MORSDORF et al. (2004) and KOETZ et al. (2004)

Long-term Fire History

Little is known on the long-term fire history of the Swiss National Park. Unfortunately natural archives such as mires are very rare in that area. Nevertheless it was possible to core one mire south of Il Fuorn (central Ofenpass) and to perform pollen, plant macrofossils, microscopic and macroscopic charcoal analysis. A detailed description of our Holocene fire history investigations can be found in STÄHLI et al. (subm.).

Results

Fuel Models and Fuel Build-up

Former studies produced three fuel models (A, B, and C) for the Swiss National Park (ALLGÖWER et al. 1998). Species names follow the nomenclature of the *Flora Helvetica* by LAUBER and WAGNER (1996).

Model A is an assemblage of mixed conifers, namely *Larix decidua, Pinus sylvestris* L., *Pinus mugo* ssp. *uncinata, Picea abies,* and *Pinus cembra.* This vegetation set-up is typical for N, NW and NE oriented slopes. The understorey is formed by *Erica carnea* L., *Rhododendron* L. *hirsutum* L., and *Rhododendron ferrugineum* L. as well as various *Gramineae* and *Cyperaceae* associations. Fuel loads are low to medium. Fire behavior is expected to be of low to medium intensity. However, some stands could easily develop intense fire behavior as they are rich in vertical fuels consisting of lichens and low reaching branches.

Model B consists of Mountain Pine *Pinus mugo* ssp. *uncinata* mainly and is typical for the S, SW and SE facing slopes. The understorey is formed of dense *Erica carnea* L. 'carpets' that would maintain a low intensity surface fire. Depending on the amount of fine dead fuels and the distribution of vertical fuels fire behavior is expected to vary from medium to severe. In general surface fires are expected to develop into crown fires easily wherever vertical fuels, especially low reaching branches allow for torching.

In Model C the 'dwarfed Mountain Pine' (German Legföhre) *Pinus mugo* ssp. *mugo* is the dominant tree species. Fuel loads are high and fire behavior is expected to be severe. This *Pinus* variation forms a brush like, very dense vegetation cover that grows to an average height of 2 to 3, seldom 5 meters; it is typical for avalanche shoots and other disturbance areas. The understorey often contains dense *Erica carnea* L. 'carpets' but may also consist of gravel which then reduces fire potential considerably.

The LIDAR investigation provided very good data on the vertical and horizontal distribution of the fuels as single tree geometry can be derived, in particular tree height, crown base height, crown diameter and from that fractional cover. The main output of the DAIS campaign are Leaf Area Index LAI (m^2/m^2), crown water content (g/m^2), water equivalent water thickness (g/cm^2), and live fuel moisture content (%). All results are described in detail in MORSDORF et al. 2004 and KOETZ et al. 2004.

Long-term Fire History

Our pollen and charcoal analysis show that fire has been an important and regular disturbance factor in the SNP area, shaping vegetation succession long before men became a dominant factor in this remote landscape. The Il Fuorn core allows us to study approximately 8000 years of landscape and vegetation history. Thereafter we can distinguish two phases: a) 6000 BC to 0 and b) 0 and 2002 AC. Contradictory to all expectations the first phase is characterized by a rather high fire frequency – one event per approximately every 250 to 300 years, whereas fire cycles become almost twice as long during the second phase. During the investigated time period *Pinus mugo* ssp. *uncinata* has always been the dominant tree species and seemed to nicely intertwine with *Picea abies* which was present in higher concentrations than today. Herbs and *Graminacea* pollen do not vary significantly between the two phases; *Cerealia* pollen cannot be found at any time at the coring site of Il Fuorn. This indicates that the Ofenpass was settled only late and for logging purposes mainly. This may also explain why fire cycles increased despite human presence. Logging and livestock activities kept fuel loads low and hence decreased fire ignition probability.

Discussion and Outlook

Fire and Mountain Pine stands seem to go along fine – they even appear to promote each other! This comes as no surprise really as it is a well-known fact that many pine species and fire have a close relationship and depend on each other. Hence, given the fact that fuels are building up in the Swiss National Park it is maybe only a question of time until a natural fire regime will establish itself again. Future fire management that fully respects the park's goals and legislation needs to respect ecological and societal requirements alike and will have to balance them carefully. If the SNP succeeds to handle this challenge successfully, he will become a pioneer in dealing appropriately with (natural) fires in the Alps in the future. Based on the described results, previous analysis of the present fire situation (LANGHART et al. 1998) as well as fire risk analysis (BÄRTSCH 1998) wildland fire management strategies are now being developed that seek to meet the requirements of the SNP and the surrounding areas. With that we hope to set the path for the successful and well-received 're-introduction' of a natural and moderate fire regime to the landscapes of the Swiss National Park.

References

ALLGÖWER, B., HARVEY, S., RÜEGSEGGER, M. (1998) Fuel Models for Switzerland: Description, Spatial Pattern, Index for Crowning and Torching. In: Proceedings of the 3rd International Conference on Forest Fire Research / 14th Conference on Fire and Forest Meteorology, D.X. Viegas (ed.), Luso, Portugal, November, 16 – 20, 2: 2605-2620

BÄRTSCH, A. (1998). Konzeption eines Waldbrandmanagements für die Regionen Engadina Bassa, Val Müstair und den Schweizerischen Nationalpark. Diplomarbeit, Geographisches Institut der Universität Zürich, Abt. Geographische Informationsverarbeitung / Kartographie, Zürich, pp. 149

KÖTZ, B., SCHAEPMAN, M., MORSDORF, F., BOWYER, P., ITTEN, K., ALLGÖWER, B. (2004) Radiative Transfer Modeling Within a Heterogeneous Canopy for Estimation of Forest Fire Fuel Properties. Remote Sensing of Environment, 92 (3): 332 – 344

LAUBER, K. and WAGNER, G. (1996). Flora Helvetica. Flora der Schweiz. Paul Haupt Verlag, Bern; Stuttgart; Wien, pp. 1613

LANGHART, R., BACHMANN, A., ALLGÖWER, B. (1998) Spatial and Temporal Patterns of Fire Occurrence (Canton of Grison, Switzerland). In: Proceedings of the 3rd International Conference on Forest Fire Research / 14th Conference on Fire and Forest Meteorology, D.X. Viegas (ed.), Luso, Portugal, November, 16 – 20, 2279-2292.

MORSDORF, F.; MEIER, E., KÖTZ, B., NÜESCH, D., ITTEN, K., DOBBERTIN, M., ALLGÖWER, B. (2004) LIDAR Based Geometric Reconstruction of Boreal Type Forest Stands at Single Tree Level for Forest and Wildland Fire Management. Remote Sensing of Environment, 92 (3): 353 – 362

PAROLINI, J.D. (1995) Zur Geschichte der Waldnutzung im Gebiet des heutigen Schweizerischen Nationalparks. Diss. ETH Nr. 11187, ETH Zürich, pp.227

STÄHLI, M., FINSINGER, W., TINNER, W., ALLGÖWER B. (subm. to Holocene) Wildland fire history and fire ecology of the Swiss National Park (Central Alps): New evidence from charcoal, pollen and plant macrofossils

Contact

Dr. Britta Allgöwer
britta@geo.unizh.ch

GIS Swiss National Park (GIS-SNP)/
GIS Division, Department of Geography
University of Zurich
Winterthurerstrasse 190
CH 8057 Zurich
Switzerland

Benjamin Kötz
bkoetz@geo.unizh.ch

Felix Morsdorf
morsdorf@geo.unizh.ch

Remote Sensing Laboratories (RSL)
Department of Geography
University of Zurich
Winterthurerstrasse 190
CH 8057 Zurich
Switzerland

Markus Stähli
mstaehli@gmx.ch

Michael Bur
mbur@geo.unizh.ch

GIS Division, Department of Geography
University of Zurich
Winterthurerstrasse 190
CH 8057 Zurich
Switzerland

Walter Finsinger
walter.finsinger@ips.unibe.ch

Dr. Willy Tinner
willy.tinner@ips.unibe.ch

Institute of Plant Sciences
Section Paleoecology
University of Bern
Altenbergrain 21
CH 3013 Bern
Switzerland

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 15-18

Monitoring modification of alpine environments: New techniques and perspectives

Michael Avian [1, 3], Arnold Bauer [2], Gerhard Lieb [1]
(1) Institute of Geography and Regional Sciences, University of Graz
(2) Institute of Digital Image Processing, JOANNEUM Research, Graz
(3) Institute of Remote Sensing and Photogrammetry, University of Technology, Graz

Abstract

The modification of high alpine environments due to climate warming was a topic of increasing importance of research in the 90`s of the last century and is the main objective of research in recent years. Several disciplines use different techniques to draw a comprehensive picture of environmental dynamics. Terrestrial laser scanning is a quite new technique for monitoring glaciers and natural hazards. The ability to acquire high-resolution 3D data of surface structures makes long-range laser scanners a very interesting instrument for measuring geomorphodynamics. The Pasterze glacier in the Hohe Tauern National Park (Central Alps, Austria) is object of a comprehensive monitoring network beginning in 1879. Since the middle of the last decade the glacier retreat increases dramatically, as a consequence a massive modification of the proglacial areas is in progress. To quantify these landscape dynamics with an accurate resolution, terrestrial laser scanning has been used the last years beginning in 2001. In 2004 we started to increase the temporal resolution with two measurements in the summer period to get a better picture of the interannual ablation dynamics.

Keywords

Pasterze Glacier, Terrestrial laser scanning, Landscape modification, Climate change

Introduction and objectives

The Pasterze Glacier (Glockner Mountains, Central Alps) represents the longest glacier in the Eastern Alps and is located S of the main crest of the Hohe Tauern Range (12°44'E, 47°04'N). The glacier`s dimension changed from 1852 to 2002 as follows: length 11.4km to 8.4km (-26%) and area 26.5km² to 18.5km² (-30%). First measurements observing changes at the glacier terminus were carried out by Ferdinand Seeland beginning in 1879 (SEELAND 1880) leading to one of the longest records of annual measurements in the Alps. Annual measurements are carried out in the last decades within the framework of glacier measurements coordinated by the Austrian Alpine Association (OeAV) which now include (a) location of glacier terminus, (b) surface velocity, and (c) surface elevation changes (e.g. WAKONIGG & LIEB 1996). The dramatic loss of ice in the last decades is documented in a comprehensive modification of this alpine environment which is furthermore made available for public in form of the nature trail "Gletscherlehrweg", new adapted and reopened in 2004 (LIEB & SLUPETZKY 2004). Quantification of these changes such as spatial measurements of glacier surface changes are a primary task in the last 20 years with new remote sensing techniques using photogrammetric analyses (e.g. KAUFMANN & LADSTÄTTER 2004), Airborne laserscanning (e.g. GEIST et al. 2003) and radar-interferometry (e.g. KAUFMANN et al. 2005). This article discusses first results of annual terrestrial laserscanning campaigns beginning in 2001 within the monitoring of the glacier tongue of the Pasterze. This monitoring network furthermore consists of additional annual GPS measurements of glacier outline and profile points.

Methods

For the past few years, terrestrial 3D laser scanning (TLS) systems have been employed very successfully in the design and manufacturing industries as well as in industrial surveying (PFEIFER et al. 2004). Further development in terms of measurement speed, accuracy, range, field-of-view, and data sampling rate allow TLS to be applied in terrain surveying (BAUER et al. 2001, 2004, and 2005). The ability to acquire high-resolution 3D data of surface structures makes this technique a very interesting instrument for measuring glacier (AVIAN et al. 2005, KELLERER-PIRKLBAUER et al. 2005) as well as rock glacier dynamics (BAUER et al. 2003, 2005). The integrated measurement

Contribution received at: 08.08.2005

system is capable of describing 3D motion and deformation of glacier surface within a single day's measurement campaign including logistics and evaluation. It is a time-of-flight system that measures the elapsed time of the pulse emitted by a photo-diode until it returns to the receiver optics. Maximum range depends on the reflectivity of surface (which is very good for snow and rock covered terrain), and atmospheric visibility (best for clear visibility, bad for haze and fog). A measuring range of up to 2000m allows hazardous sites to be easily measured from a safe distance. Since each single measurement consists of a multitude of laser-pulses, different measurement modes ("first pulse", "last pulse", "strongest pulse") give proper results even on bad weather conditions and surfaces that may otherwise lead to ambiguous measurements like vegetated, moist or roughly structured terrain.

Single time-of-flight measurements with distance accuracy of better than 5 cm are automatically combined to a measurement grid. Although the data generated by the measurement devices can in principle be directly used for measurement and further visualization, several methodological, technical, and logistic problems are to be encountered when establishing an integrated monitoring system. In case of the Pasterze area this method was selected due to several reasons and advantages: the steep terrain is unfavourable for airborne or satellite data resulting in a better resolution of terrestrial data, a perfect accessibility keeps costs low respectively.

For scanner parameters and values of the used instrumentation cf. Tab.1 in KELLERER-PIRKLBAUER et al. 2005 in this volume.

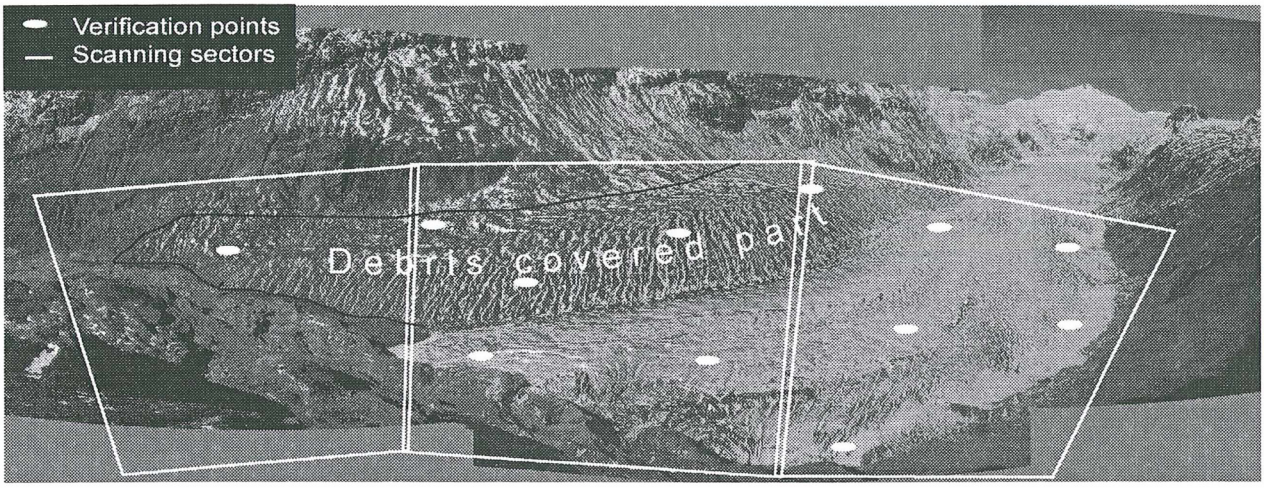


Fig. 1: Situation and scanning sectors (Image: KELLERER-PIRKLBAUER 2003)

Results

Mass losses and deglaciation were successfully measured five times resulting in four data-sets of surface elevation changing rates (xy-resolution 1m, z-resolution 5cm). As expected from simultaneous tachymetric measurements all data sets show a clear trend in spatial distribution of glacier retreat. There is a significant distribution of mass loss from the SW to the NE which also increases towards the glacier terminus on the bare ice glacier part. Quantitative rates begin with about -2m/a on the right boundary increasing to ~-4.5m/a at the boundary of the two glacier parts. Here we can observe a clear leap in mass loss difference between the two obviously different glacier parts from ~-1.5m/a in the upper part to more than -3m/a in the lowest part where absolute rates of ~-7m/a occur. Debris cover with a thickness of at least 5cm is a significant protection against incoming short wave radiation (cf. BENN & EVANS 1998, NAKAWO et al. 2000, KELLERER-PIRKLBAUER et al. 2005, in this volume) as well as less potential radiation in the summer period due to the shadowing effect of the adjacent Großglockner ridge may be a reason as well.

Near the left boundary of the entire glacier the ice body is beginning to collapse in several areas. The lowermost event is already visible in the last years with a dramatic landscape modification near the fenced off touristic area. Following the glacier upwards two further small basins are developing with a distance of 500m. The sinking of the surface occurs with rates of -7.5 to -8.0m/a in 2001/02 and increased to -9.2 to -9.5m/a in 2003/04, 2.0 -2.5m/a above the sinking rates of the surrounding areas. The lower part of the adjacent slope facing to the "Gamsgrubenweg" is also getting increasingly unstable which is observable in mass losses already above dead ice. This part has not been measured consequently in the last years, no comparable rates are calculated.

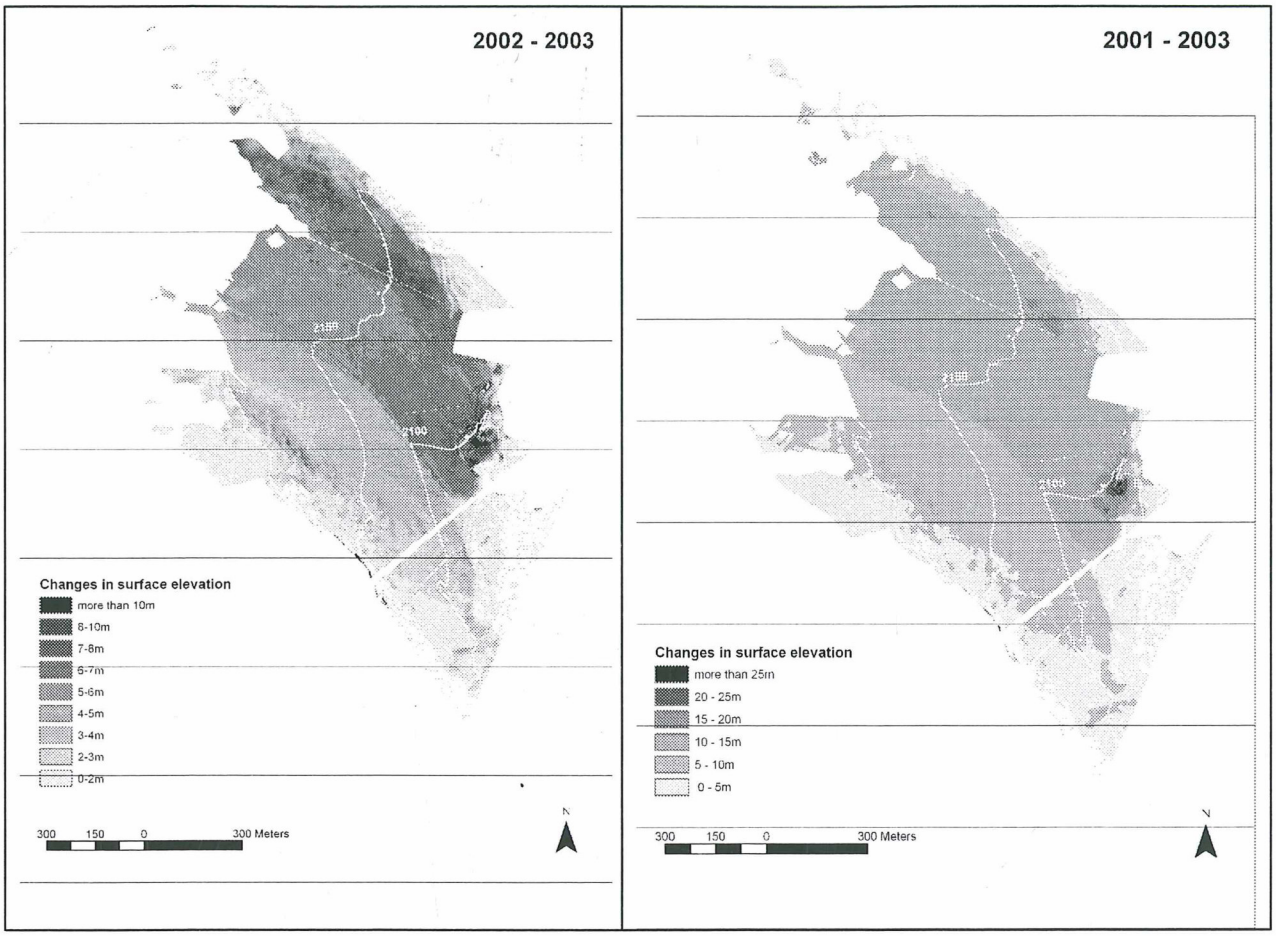


Fig. 2: Results of measurements of the periods 2002/03 and 2001/03

Discussion and Conclusion

The experimental setup at the Pasterze glacier turned out to be very economic in time and costs. The scanner is installed at the Franz-Josefs-Höhe where an appropriate infrastructure in terms of accesibility, power supply, and safety is avaiblable. As a consequence only one person is needed to carry out the measurements within a single day campaign. This TLS measurement system provides nearly real time data for monitoring, whereas protected areas in very sensitive high alpine regions (e.g. National Park Hohe Tauern) and close to intensive tourist utilisation area are of special interest for research and public.

Results from the last five years lead to following future activities:

(1) Interannual measurements at at least three epochs (June, July, and September)
(2) Additional measurements in the upper part of the glacier tongue
(3) Scanning of special areas of interest with higher resolution (e.g. proglacial areas in the vicinity of hiking trails and tourist areas).

All these tasks will lead to new information about:

(1) Area wide information on elevation variation on the glacier tongue;
(2) Spatial surface velocity distribution;
(3) Analysis of different ablation rates (debris cover – bare ice).

Furthermore research activities and results have been made avaible for public in form of:

(1) Media
(2) Journal of Austrian Alpine Association (OeAV)

References

AVIAN M. & BAUER A., 2005. The use of long range laser scanners in terrestrial monitoring of glacier dynamics, Pasterze glacier (Hohe Tauern, Austria). Geophysical Research Abstracts, Vol. 7, 06779, European Geosciences Union General Assembly, Vienna, Austria. April 24–29, 2005.

BAUER A., PAAR G. & KAUFMANN V., 2003. Terrestrial laser scanning for rock glacier monitoring. Phillips M., Springman S.M., and Arenson L.U. (eds.) Proceedings of the 8th International Permafrost Conference, Zurich, p.55-60.

BAUER A., PAAR G., 2004. Monitoring von Schneehöhen mittels terrestrischem Laserscanner zur Risikoanalyse von Lawinen. In *Proc. of the 14th Int. Course on Engineering Surveying. Zurich, Switzerland. March 15-19, 2004.*

BAUER A., PAAR G., KALTENBÖCK A., 2005. Mass Movement Monitoring Using Terrestrial Laser Scanner for Rock Fall Management. In *Proc. of the First International Symposium on Geo-information for Disaster Management. Delft, The Netherlands. March 21-23, 2005.*

BAUER A., KELLERER-PIRKLBAUER A., AVIAN M. & KAUFMANN V., 2005. Five years of monitoring the front slope of the highly active Hinteres Langtal rock glacier using terrestrial laser scanning: A case study in the Central Alps, Austria. Terra Nostra, 2nd European Conference on Permafrost, Potsdam, 91.

BENN D.I. & EVANS D.J.A, 1998. Glaciers and Glaciation. Arnold, London, 734p.

GEIST, TH., E. LUTZ, J. STÖTTER, 2003. Airborne laser scanning technology and its potential for applications in glaciology. In: *Proceedings of the ISPRS Workshop on 3-D reconstruction from airborne laserscanner and INSAR data*, Dresden, p101-106.

KAUFMANN, V., KENYI, L.W. & AVIAN, M., 2005. Messung der Fließgeschwindigkeit von Gletschern mittels satellitengestützter Radar-Interferometrie in der Schobergruppe (Nationalpark Hohe Tauern, Kärnten). Endbericht zum Forschungsprojekt des Kärntner Nationalparkfonds, Institute of Remote Sensing and Photogrammetry, TU Graz, 59p.

KAUFMANN V. & LADSTÄTTER R., 2004. Documentation of the retreat of a small debris-covered cirque glacier Goessnitzkees, Austrian Alps by menas of terrestrial photogrammetry. Proceedings of the 4th ICA Mountain Cartography Workshop, Vall de Nuria, Catalonia, Spain, 30th September – 2nd October 2004.

KELLERER-PIRKLBAUER A., BAUER A. & PROSKE H., 2005. Terrestrial laser scanning for glacier monitoring: Glaciation changes of the Gößnitzkees glacier (Schober group, Austria) between 2000 and 2004. Third Symposion of the Hohe Tauern National Park for Research in Protected Areas. Kaprun, Austria. September 15-17, 2005.

LIEB, G. K., & SLUPETZKY, H., 2004: Gletscherweg Pasterze. – Naturkundlicher Führer zum Nationalpark Hohe Tauern, Bd. 2, Innsbruck, 122p.

NAKAWO M., RAYMOND C.F. & FOUNTAIN A. (eds.), 2000. Debris-covered glaciers: Proceedings of the international workshop held at the University Of Washington at Saettle, Washington, USA, 13-15 September 2000, IAHS publication, 288p.

PFEIFER N. & LICHTI D., 2004. Terrestrial Laser Scanning: Developments, Applications and Challenges. GIM International, December 2004, p.50-53.

SEELAND, F. (1880). Studien am Pasterzengletscher. - Z. d D.u.Ö.A.V. 11, p.205-208.

WAKONIGG H., & LIEB G.K. (1996). Die Pasterze und ihre Erforschung im Rahmen der Gletschermessungen. – Kärntner Nationalparkschriften 8, Großkirchheim, p.99-115.

Contact

Mag. Michael Avian
m_avian@yahoo.com

Institute of Remote Sensing and Digital Photogrammetry
Graz University of Technology
Steyrergasse 30
A 8010 Graz
Austria

Emas application in the Euganean Thermal Basin

Silvio Bartolomei [1], Antonio Scipioni [2], Ambra Morelli [2], Filippo Zuliani [2]

(1) Parco Regionale dei Colli Euganei
(2) Centro Studi Qualità Ambiente, Università degli Studi di Padova

The EMAS project was started at the beginning of 2003 as an initiative of the Euganean Hills Regional Park with the joint signing of a Commitment Protocol by the Euganean Hills Regional Park, as the activities coordinator and promoter, five municipalities in the Euganean Thermal Area (Abano Terme, Battaglia Terme, Galzignano Terme, Montegrotto Terme and Teolo), the Province of Padua, the Regional Agency for Environment Prevention and Protection (ARPAV) and the Regional Agency for Agricultural, Forestry and Food Sectors (Veneto Agricoltura). It represents an implementation of the requirements stipulated in European Regulation No. 761/2001 - EMAS (Eco Management and Audit Scheme).

The main objective is to implement five Environmental Management Systems in the five municipalities concerned, which are to adopt an Environmental Policy of observing legal prescriptions, commit themselves to introducing measures for the concrete and continuous improvement of environmental performance and put into effect transparent communication with stakeholders.

The first phase of the project provides for the Initial Environmental Analysis study applied to the five municipalities, identifying direct and indirect environmental aspects relating to municipal activities and evaluating their effects as potential impacts on the environment, checking environmental legislative conformity with the aim of precisely identifying the responsibilities and methods necessary to ensure conformity with the law.

The second phase of the project, which is based on the Initial Environmental Analysis results and on the strategic content of the Environmental Policy, provides for the organization and the implementation of five Environmental Systems, the definition of methods and responsibilities for managing activities relating to environmental aspects and the setting of specific indicators for monitoring environmental performance as it relates to municipal structures and to the territory, with the object of providing a complete picture in order to support decision-making and specific active programmes of action aimed at environmental protection and conservation.

The third project phase is intended to improve stakeholders' awareness through the circulation of the document called "Environmental Declaration". In fact, as the EMAS Regulation requires, the municipalities must guarantee to provide public information on their Environmental Policy, on environmental objectives and targets fixed in advance and on their own environmental impact and performance, by means of the periodic publication and distribution of a checked and validated document.

The environmental improvement finds its highest expression in the research into even more ambitious environmental objectives and in a commitment to the improvement of the territory's careful management which is why the project agreement has, as its ultimate aim, not only the achievement of EMAS registration of the 5 municipalities but also the growth of environmental awareness in the municipalities and the extension of the stakeholders' active involvement to encompass the entire territory.

Contact

Dr. Silvio Bartolomei
info@parcocollieuganei.com

Parco Regionale dei Colli Euganei
Via Rana Ca´Mori, 8,
I 35042 Este (PD)
Italy

Contribution received at: 13.08.2005

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 21-24

Climate change and possible impacts on alpinism: a case study on the Nationalpark Hohe Tauern

Michael Behm [1], Georg Raffeiner [2], Wolfgang Schöner [3]

(1) Vienna University of Technology, Institute of Geodesy and Geophysics
(2) Umweltdachverband
(3) Central Institute of Meteorology and Geodynamics – ZAMG, Department of Climatology

Abstract

Besides its importance for nature conservation as the largest protection area of the Alps and for scientific research, the Nationalpark Hohe Tauern (NPHT) represents a major tourist attraction in the central part of the Eastern Alps. Mountaineering in many forms, especially high alpinism has a long tradition in the region. Several economic branches (e.g. hiking tourism) depend on tourism. Studies from Switzerland show that climate change and subsequent effects (e.g. glacier and permafrost retreat) can have a considerable impact on those and related alpinistic fields. The results of such studies do of course depend on the region. Therefore the recent climate change and the glacier retreat in the Glocknergruppe/Goldberggruppe in the NPHT have been examined. Furthermore an opinion poll has been undertaken, addressing mountain guides, mountain huts and alpine clubs, regarding their perception of and reaction to climate change. The compiled results of a sample of more than 100 participants show that most of the respondents are concerned over the issue of climate change. Besides new information on impacts on certain routes and huts, there is common sense in each focus group that an adaptation of current strategies is already in progress or will be necessary in the future. Problems resulting from permafrost retreat or from changed water supply may lead to substantial financial issues for singular huts and also for maintenance of routes, especially in an area of conflict with strict regulations in protected areas.

Keywords

Glacier, climate change, alpinism, Hohe Tauern, socio-economic impact

Area

The area of investigation was defined as the Goldberg-, Granatspitz-, Schober- and Glocknergruppe (see figure 1), regions famous for its mountaineering facilities. It covers an area of approximately 1370 km² lying predominantly within the Nationalpark Hohe Tauern (NPHT). The highest elevations in both regions are Hocharn (3254 m) and the highest peak of Austria, the Großglockner (3798 m). Approximately 75% of the area is situated between 2000m and 3000m a.s.l. The Pasterze, Austria's largest glacier, is one out of many glaciers in the area.

Tourism has a long tradition in the region not only as downhill skiing, cross country skiing and mountaineering but also in its more extreme variants of alpinism like ice/rock climbing. All these activities are supported by a dense infrastructure provided by the alpine mountaineering clubs, private owners and public authorities. More than 30 mountain huts and more than 1.100 km of trails are found in the area. The economic value of alpinistic infrastructure of Alpine mountaineering clubs is huge not only for mountain huts, mountain guides etc. but also in general for Alpine tourism.

Climate / Glacier change

A climate observatory has been built at the summit of Sonnblick more than 100 years ago. Since then, continuous monitoring of climate is available. Within the last decades, many more scientific programmes have been established at the observatory. These data sets allow a very detailed analysis of climate change and glacier retreat in this area.

Figure 2 shows the temperature increase since the end of the Little Ice Age. The average annual temperature has risen by 2°C since 1890. A strong increase can be observed since the mid 1980ies.

Contribution received at: 20.07.2005

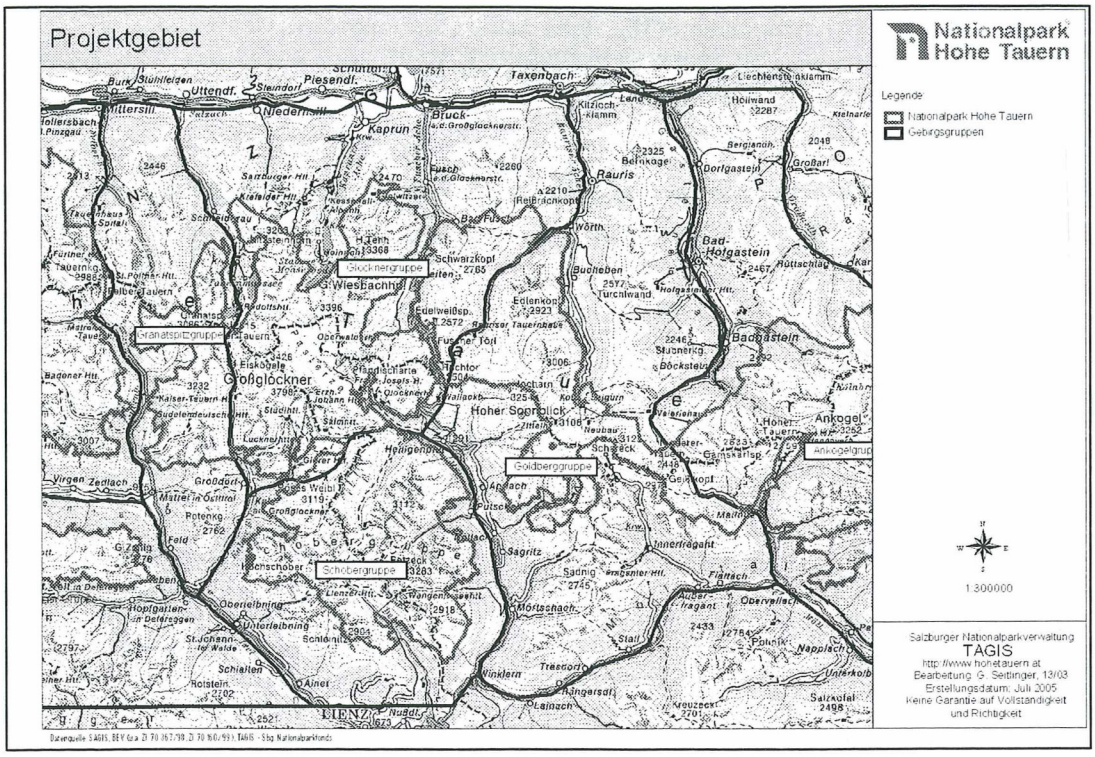


Fig. 1: Area of investigation

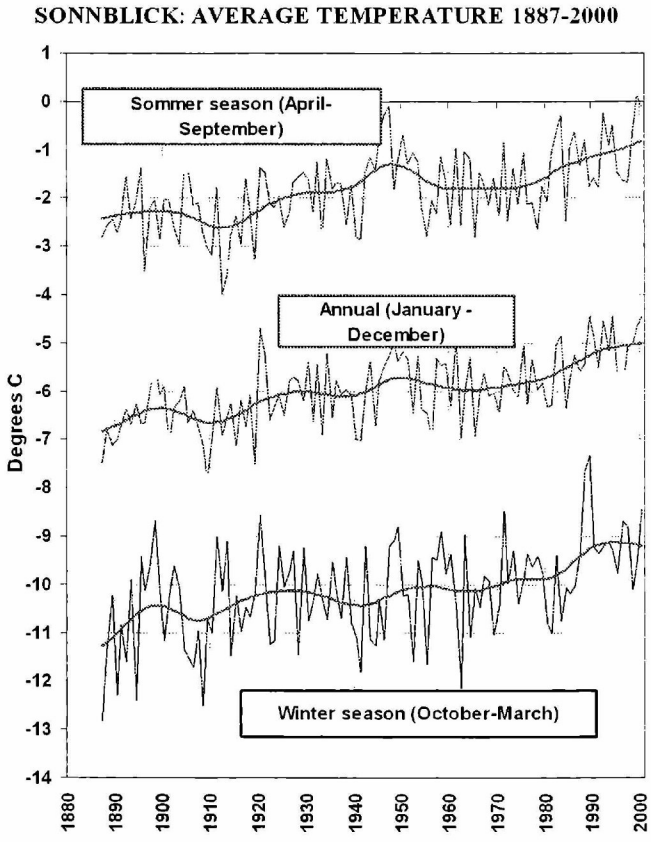
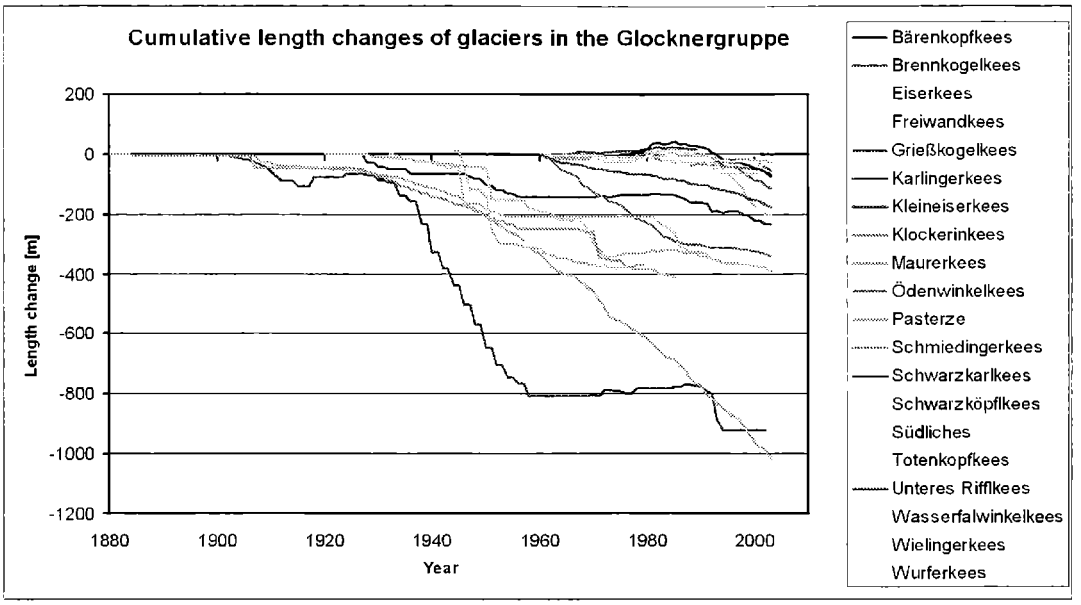


Fig. 2: Average temperature recorded on the Sonnblick observatory (3106 m a.s.l) since 1887. The violet curve shows the smoothed average (low pass filter of 30 years).

Figure 3a and 3b show the cumulated length measurements of individual glaciers since the beginning of their observation. More or less all glaciers have been retreating in the last decennium.



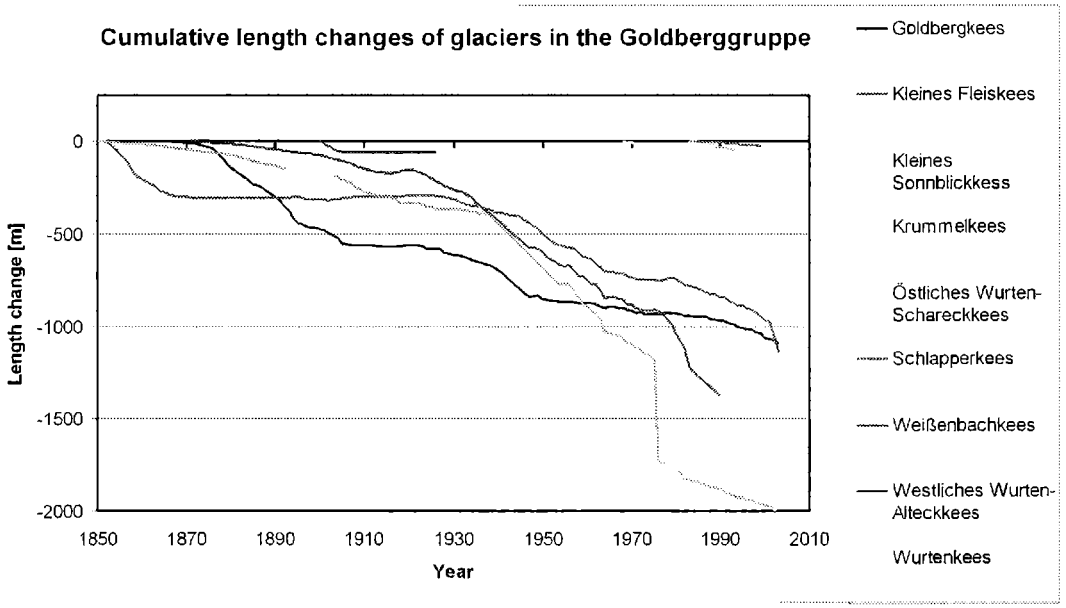


Fig. 3a and 3b: Cumulative length changes of glaciers in the Glocknergruppe (a) and Goldberggruppe (b) since the beginning of measurements.

Glacier behaviour is better indicated by mass balance than by length measurements. These observations correlate well with climate data (SCHOENER et al. 2000). Periods of mass loss are mainly caused by increased summer temperatures whereas periods of mass gain are more related to winter snow fall.

Besides glacier retreat, permafrost melt is a serious problem in high elevated regions (e.g. Sonnblick Observatory), but is yet not enough investigated. A higher risk of rockfall and damages of infrastructure are examples for first impacts of the decreasing permafrost.

Opinion poll

An opinion undertaken among swiss mountain guides (SCHWOERER 1997) shows possible impacts of climate change and subsequent effects (e.g. glacier retreat, increased rock fall due to permafrost melt) on their profession. Inspired by this study and the poor general knowledge of impacts of climate change on alpinism in the region, an anonymous opinion poll in the Glockner- and Goldberggruppe was performed. Three focus groups were identified: Hut owners, mountain guides, persons in charge of hiking trails.

The main goals of the survey were:

- To examine the perception of and the reaction to climate change in the region
- To analyse possible changes in the behaviour of local people
- The identification of heavily effected localities (huts, paths and routes)
- The estimation of additional costs induced by climate change impacts (conservation of paths, maintenance of huts)

First Results

The survey was supported by relevant alpine mountaineering clubs in Austria (Oesterreichischer Alpenverein, Naturfreunde Österreich, Österreichischer Touristenklub, Deutscher Alpenverein) and the NPHT itself. Partly thanks to this, a very high participation in the opinion poll was achieved. 114 out of 266 questionnaires were returned, despite that not all of the recipients were affected or based in the region. This shows an enormous interest in the topic. The questionnaire was split in a general part (identical for all three focus groups) and a specific part for each focus group. In detail, 32 hut owners/tenants, 68 mountain guides and 14 persons in charge of hiking trails sent the questionnaire back. Some of the main results are:

- Climate change is perceived by different factors (e.g. raising temperature), a huge range of changes in the environment is observed (e.g. retreat of glaciers).
- Most of the participants see direct effects on their profession or activities due to climate change and react accordingly.
- A clear indication that the behaviour of visitors is changing as a result of climate change.
- Rock fall due to permafrost melt is increasing.
- The impact is not evenly distributed: Most huts are not seriously affected, but a few will encounter problems. The same accounts for the conservation of paths and climbing routes.

Discussion and outlook

The results show that climate change has considerable effects on alpinism in the region. Especially for Alpine clubs climate change will have big impacts for maintaining huts and hiking trails. In future, their financial demands will increase significantly. Furthermore their expertise on this topic will be sought increasingly. The aspect of safety is also a concern (e.g. dismissing certain paths because of increased rock fall) getting more and more important. Adaptation strategies will be necessary in the future. This is already happening on a "personal" scale. According to the results of the survey, mountain guides are aware of a higher risk due to increased rock fall and avoid certain routes. This awareness will have to be also transferred to non-professional hikers. However, issues like stated above are still waiting for answers.

References

SCHOENER, W., AUER, I. & R. BOEHM (2000): Klimaänderung und Gletscherverhalten in den Hohen Tauern. In: Salzburger Geographische Arbeiten, Band 36, Seite 97-114.

SCHWOERER, D. (1997): Bergführer & Klimaänderung. Eine Untersuchung im Berninagebiet über mögliche Auswirkungen einer Klimaänderung auf den Bergführerberuf. Diploma thesis, Universität Bern.

Contact

Dipl. Ing. Michael Behm
mbehm@luna.tuwien.ac.at

Institute of Geodesy and Geophysics
Vienna University of Technology
Gusshausstrasse 27-29/1282
A 1040 Vienna
Austria

Dr. Wolfgang Schöner
wolfgang.schoener@zamg.ac.at

Department of Climatology
Central Institute of Meteorology and
Geodynamics – ZAMG
Hohe Warte 38
A 1190 Vienna
Austria

Mag. Georg Raffeiner MSc
georg.raffeiner@umweltdachverband.at

Umweltdachverband
Alser Strasse 21
A 1080 Vienna
Austria

Conference Volume | 3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas | pages 25-26
September 15th to 17th, 2005, Castle of Kaprun

Using MM5-derived wind fields for the modelling of snow transport processes

Matthias Bernhardt [1], Ulrich Strasser [1], Günther Zängl [2], Wolfram Mauser [1]

(1) Dept. for Earth and Environmental Sciences, Ludwig-Maximilians University, Munich
(2) Dept. of Physics, Institute for Meteorology, Ludwig-Maximilians University, Munich

Abstract

In the last years different research groups emphasized the importance of wind-induced snow transport on the variability of the snow cover. Knowledge about the causing processes saltation is important for determining the temporal dynamics of the snowmelt runoff. Furthermore interception losses induced by snow transport can have reasonable effects on the water balance. In addition wind induced snow transport can lead to a reasonable avalanche risk in deposition areas.

For accurate modelling of the snow pack preferably good climatologic parameters are alienable. There are two major factors which influence the quality of these input data a) the closeness and the temporal resolution of the meteorological network and b) the suitability of the parameters to be interpolated over a given area. It is a known problem that in high-alpine terrain wind fields can not be provided by a simple interpolation of station recordings. Therefore we use a modified version of the PSU/NCAR Mesoscale Model MM5 with a multiple nesting approach to derive wind fields for a 24 x 19 km area at a target resolution of 200 m. The wind fields are validated by station data. In a last step the modelled wind fields are used as an input for a snow model bond (PROMET and SNOWTRAN3D). The modelled snow cover will then be compared with measurements made in the National Park of Berchtesgaden and with remotely sensed data.

Keywords

Snow transport, MM5, wind field catalogue, modelling

Project aims

The superior goal of the project is to investigate how snow transport processes influence the hydrology of alpine catchments. All processes which are relevant for the description of a snow cover shall be assimilated into a model assembly. For doing so we use different approved model schemes like MM5, PROMET and SNOWTRAN3D.

Study area

The test sites are located within the National Park of Berchtesgaden. Founded in 1978 the park is the only one in Germany providing high alpine terrain. A benefit of the park is the dense met-stations network which is owned by the Lawinenwarndienst Bayern (LWD, the Bavarian avalanche forecasting service), and by the National Park. Special attention is given to the areas around the meteorological stations of Kühroint and Reiteralm. Kühroint is located near the centre of the national park (4572386E, 5270606N) at an elevation of 1416 m a.s.l and was installed in winter 2004/2005. Reiteralm is located in the north western part of the biosphere reservation (4560495E, 5279439N). This site contains three stations which were installed by the avalanche forecasting service of Bavaria especially for reconstructing blowing snow events. The stations lie between 1615 and 1755 m a.s.l. Stations at both sites measure wind speed, wind direction, air temperature, humidity, snow surface temperature, snow height and the snow temperature in four depths. Kühroint also provides a snow pillow which enables us to measure the snow water equivalent.

Method

Caused by the fact that MM5 would be to slow for being an operational part of our modelling network we run it separately. So as a preparatory work we made statistical studies of historical DWD (German weather service) Local Model reanalysis data for the Alpine region. By doing so we were able to figure out the most relevant synoptic situations. For these situations we run MM5 in order to derive wind speed and direction for each raster element. For the intended snow modelling

Contribution received at: 16.08.2005

a library of wind fields was composed on a LINUX cluster computer resulting in 226 data files.

The criteria for the extraction of the wind field to be used for the current snow-model time step are mean wind speed and direction in the 700 hPa level derived from DWD (German Weather Service) Local Model data. This data comes with a / has a temporal resolution of one hour and is then compared to the corresponding mean wind speed and direction of the appropriate MM5 nesting area. From this comparison we can decide which library file represents the best fit. Verification is conducted by comparison of historical station measurements with corresponding downscaled simulation results.

Results

It could be shown that MM5 can reproduce the wind speed on a daily basis very well. Here we found a coefficient of determination of 0.7 between station data and simulated wind fields for the years 2000 2003. On an hourly basis the coefficient is decreasing to a value of 0.5 for the same period. We have also seen that we are underestimating the wind directions. Our values are about 40-50 degrees lower than the values at the station but the time-dependence is pretty good.

Discussion

The presented scheme shows that available mesoscale atmospheric models can be effectively used to provide valuable wind fields even in areas of a larger scale. So one can provide wind speed and direction for a variety of applications such as the modelling of snow transport processes. The application of the wind fields as an input for our snow model will be the next work package. Finally one can say that the National Park provides ideal conditions for such a work. The dense network of meteorological stations allows us to find a better understanding of the meteorological processes within alpine terrain. Another advantage are the constant boundary conditions within the park. These constancy makes the data and results comparable over several years.

Contact

Dipl. Geogr. Matthias Bernhardt
m.bernhardt@iggf.geo.uni-muenchen.de

Dr. Ulrich Strasser
u.strasser@iggf.geo.uni-muenchen.de

Prof. Dr. Wolfram Mauser
w.mauser@iggf.geo.uni-muenchen.de

Dept. for Earth and Environmental Sciences
Ludwig-Maximilians University (LMU)
Luisenstr. 37
D 80333 Munich
Germany

Dr. Günther Zängl
guenther@meteo.physik.uni-muenchen.de

Dept. of Physics
Institute for Meteorology
Ludwig-Maximilians University (LMU)
Theresienstr. 37
D 80333 Munich
Germany

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 27-31

Research activities in the Mont Avic Natural Park: Interreg IIIA "COGEVA-VAHSA": project experience

Massimo Bocca [1], Edoardo Cremonese [2], A. Facchinetti [2], A. Mammoliti Mochet [2], Umberto Morra di Cella [2]

(1) Mont Avic Natural Park
(2) ARPA Valle d'Aosta – Aosta Valley Environmental Protection Agency

Abstract

"Cogeva-Vahsa" Interreg IIIA, a project which involves Italian and French protected areas management subjects (Mont Avic Natural Park; Regione Autonoma Valle d'Aosta; ASTERS), is focused on different scientific research activities and on the communication of their results to general public.

The recent Mont Avic Natural Park widening gives the needing of a revision of its management plan articulated on three actions. The first action outlines the development of research activities to get a capillary knowledge of both environmental and anthropogenic issues of the park, allowing a homogeneous distribution of information between the old and the new park areas.

In 2003, from the Environmental Management System (Regulation EC 761/2001, ISO 14001 standard) raised the individuation of the most important environmental themes in terms of nature conservation. Because of the needing to preserve such themes, the second action involves the implementation of monitoring activities mainly linked to biodiversity conservation and water management strategies.

The third action concerns public communication of the results coming from these activities in different ways, depending on target categories.

Keywords

scientific communication, ecological survey, management plan

Project's aim and duration

In 2004 the Mont Avic Natural Park – with the cooperation of the Aosta Valley Autonomous Region (Italy) and the association ASTERS (France) - started a three-year project within the framework of the Interreg IIIA Alcotra programme, aimed at the integration, management and enhancement of the protected areas in the High Savoy and Aosta Valley territories. The project actions involve the drafting of management plans, the launch of multiannual monitoring activities aimed at the protection of biodiversity, and the creation of tools for the spreading of the results achieved. The project core scientific activities are accompanied by several communication initiatives targeted at the general public, schools and all those who are interested in environmental sciences.

Area of study

The project activities cover nine natural reserves located in the High Savoy area, the Natura 2000 sites on the Italian side of Mont Blanc and the Mont Avic Natural Park. In this document, we will describe the actions concerning the Mont Avic protected area, which covers 5747 hectars in the Champdepraz and Champorcher valleys (Aosta Valley, Northwestern Italy). The altitude of the area ranges from 1000 m a.s.l in Boden to 3185 m a.s.l on Mont Glacier. The most representative substrates are ophiolites and lime schists, which produce extremely varied and unusual environmental situations at Alpine level. The morphology of the orography, characterised by valleys stretching from East to West, is the result of the combined erosive and cumulative action of water streams and glaciers. The forest surface, dominated by the Mountain Pine, covers over 2000 hectars in the Champdepraz area, while it is virtually non-existent in the Champorcher high valley. The area includes over 40 standing water bodies and several peat-bogs.

Contribution received at: 22.07.2005

The project structure

The following actions are currently under way (some of them will be later described in further detail):

- Review and update of the Territorial Management Plan prescribed by existing regulations.
- Multiannual environmental monitoring, accompanied by the launch of studies on air and water quality, fauna and lichen flora, carried out in sample areas.
- Creation of suitable communication tools to:
  - disseminate the results of in-situ research,
  - describe the specific features of Mont Avic,
- compare the actions implemented by the three project partners (Website, publications, illustrated panels).
- Launch of a twinning protocol and constant exchange of information among the protected areas in the Aosta Valley and High Savoy territories.

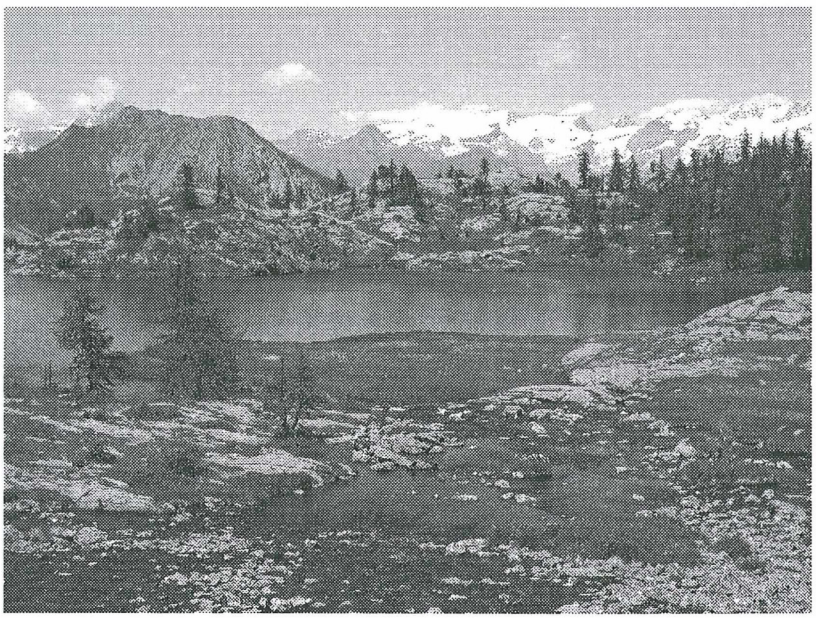


Fig. 1

The Territorial Management Plan

In 1994, the first Territorial Management Plan for the Mont Avic Natural Park was approved. After the park territorial expansion in 2003 – the protected area almost doubled in size – and given the significant changes in the regional, national and international legal framework since that first text, a thorough review of the document has been deemed necessary. An accurate data gathering has therefore been started, aimed at:

- Ensuring in-depth knowledge of both the park valleys.
- Identifying the environmental critical aspects and emergencies which need safeguarding and enhancing.
- Allowing the drafting of management rules that can be easily understood by the public and by local residents.

In order to review the Territorial Management Plan, in compliance with the national guidelines issued by the Italian Ministry for the Environment, the following studies will be carried out:

- Synopsis of the existing climatological and geological knowledge.
- Pedological characterisation and cartography of soilscapes. Although often overlooked, the study of soils gives precious indications for the interpretation and the safeguard of mountain environments. The research will include the execution of several profiles, the chemical and physical analysis of humuses and the creation of related cartographic representations.

- Completion of the inventory of water bodies and gathering of chemical-physical and flow rate data.
- Study of the ichthyofauna and benthonic macrofauna in some water streams. The Mont Avic Natural Park includes several types of water bodies concerned by the monitoring activities. The fish populations of the two main streams (Chalamy and Ayasse) are investigated using electrofishing equipment to obtain biodiversity, structural and functional information. At the same time, the river macrobenthos is sampled using semi-quantitative protocols to obtain useful taxonomic data for the evaluation of current and potential impacts caused by water catchments and discharges.
- Study of rock and soil lichen flora, brioflora and vascular flora in the area included in the park after its recent expansion.
- Study of entomological fauna and molluscs. Some groups of particularly interesting insects have been selected for the characterisation of open and semi-open environments, such as lepidoptera, orthoptera, coprophagic coleoptera and carabidae. So far, molluscs have been virtually ignored by researchers working in the area.
- Systematic gathering of observations on vertebrated animals in the Champorcher valley, and update of the database managed by the park staff since 1991, which currently contains more than 25.000 records.
- Inventory of the mountain pastures in the protected areas and nearby territories.
- Gathering of data on socio-economic issues, with the creation of sector archives and cartographic documents.

All georeferenced data will be gradually integrated in the Geographical Information System (ESRI Arc View 8.1) of the Park in order to optimise its management and update, and to facilitate its use through query functions.

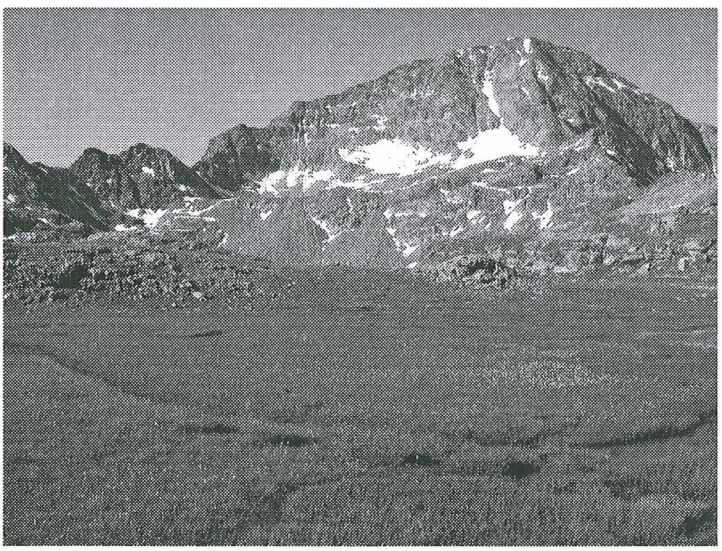


Fig. 2

The environmental monitoring

Several monitoring campaigns have been launched. In the longer term, these will continue to be carried out on a regular basis with the aim of following the development of the habitats mentioned by the European directive 92/43 and of species of high conservation interest. In addition to the investigations on the impact of ozone and atmospheric depositions on vegetation, described in a separate document, the action includes the following reasearch areas:

- Water quality. The impact of the discharges of two tourist huts on streams is evaluated through a seasonal check based on chemical, physical and microbiological parameters (temperature, pH, nitrites, nitrates, total phosphorus, COD, surface-active agents, hydrocarbons, fatty oils, E.coli and Enterococcus). Peat-bogs are very common in the park and some of them are affected by the presence of livestock, which might influence the hydrochemical balances. Seasonal water samples are collected to evaluate the impact of such presence on the chemical forms of main nutrients (N and P).

- Biomonitoring of lichens. A screening of lichen biodiversity (LB) in the forest area of Champdepraz is currently being carried out. This is integrated by surveys carried out according to the ICP/Conecofor guidelines and by the analysis of lichen individuals in permanent squares.

- Ornithological investigations. Birds, safeguarded by the European directive 79/409, are considered as good indicators of environmental changes. The action aims at setting up a system for the monitoring of interesting species from a management point of view. For such species, the park staff should be able to gather qualitative and quantitative data. In the Mont Avic area, the following species have already been identified for such monitoring activity:

  diurnal birds of prey (Honey Buzzard, Goshawk, Sparrowawk, Common Buzzard, Golden Eagle, Short-toed Eagle, Peregrine, Kestrel)
  Corvidae (Alpine Chough, Chough, Raven)
  Galliformes (Rock Ptarmigan, Black Grouse, Rock Partridge)
  woodpeckers (Green Woodpecker, Black Woodpecker, Great Spotted Woodpecker).

- Entomological investigations. In the past few decades, the open environments in the hill, mountain and subalpine areas in the Champdepraz valley have been constantly contracting due to the reduction of traditional rural activities. In order to evaluate the consequences of such transformation in terms of biodiversity loss, studies are being carried out on groups of insects with different diffusion patterns. Some live predominantly in the grassland areas, others in ecotones or in forested areas (orthoptera, lepidoptera, carabid coleoptera, coprophagae, borers). The surveys are carried out in sample areas and along transects, both with traps and by direct observation. As of 2006, an investigation protocol will be defined and implemented on a multiannual basis.

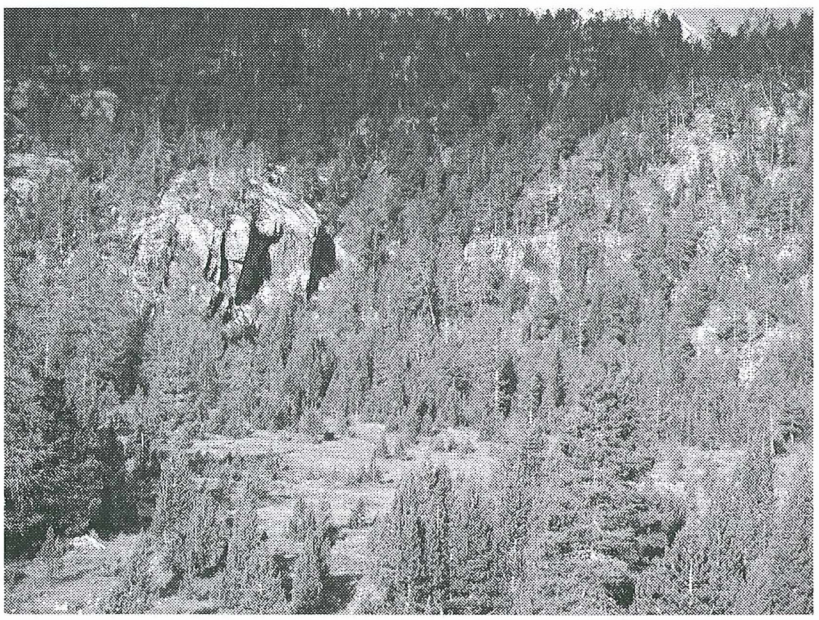


Fig. 3

- Disturbance of sensitive mammal and bird species during winter. Some vertebrated animals, such as ungulates, game birds and - to a lesser extent - lagomorphs, can be negatively influenced by a strong anthropic presence in their wintering grounds, during a very sensitive stage in their biological cycle. In winter 2004-2005 a systematic gathering of observations was launched, aimed at:

  quantifying the problem at local level
  identifying the most popular routes followed by skiers and trekkers
  creating a cartography of the sites that need safeguarding.

  The species taken into account are the following: Ibex, Chamois, Mountain Hare, Rock Ptarmigan, Black Grouse and Rock Partridge.

The communication tools

The results of scientific research carried out in parks and natural reserves are often little known by the users of such areas. This lack of communication often leads to a reduced cultural and educational interest in the data acquired and a very limited understanding of the management strategies for environmental protection. An effective dissemination of scientific knowledge can result in a wider acceptance of potential limitations on economic and recreational activities.

Four different communication tools have been envisaged:

- Website. By autumn 2005, the structure of the Website www.montavic.it will be reviewed and implemented. Different types of layout and language will be used in order to effectively present the research to the various users of the Website.
- Scientific monographies. New publications containing a synopsis of the various research areas results will be published, in order to organically present data now scattered in several specialised publications, often difficult to access. When possible, a non technical language will be used, while still providing rigorous and complete information. The topics selected for the Mont Avic park are as follows:

  forests – the park contains a wide variety of forest types, and they are particularly interesting in terms of environmental management;
  the Black Grouse - a species which has been continuously studied in-situ for over 20 years;
  the Black Woodpecker – in-depth investigations on this species have been carried out with the help of radiotracking.
- Information leaflets. Illustrated flyers for the general public will present the results obtained by the project partners on three common research areas: the ecology of the Black Grouse, the winter fauna and lepidoptera.
- Information panels. These will be located in alpine huts and at a winter sports resort in the vicinity of the park, with the aim of raising awareness on the safeguard of the Alpine environment among visitors.

Conclusions

In conducting research activities, managing bodies of protected natural areas shall:

- meet the knowledge needs related to management issues;
- transfer the results obtained to the public through suitable communicaton tools.

The COGEVA – VAHSA project aims at enabling the optimal achievement of the above objectives by exploiting the sinergic international cooperation and know-how exchange among the participating subjects.

Contact

Dr. Massimo Bocca
Parc.avic@libero.it

Parco Naturale Mont Avic
Loc. Fabbrica 164
I 11020 Champdepraz (AO)
Italy

Dr. Edoardo Cremonese
e.cremonese@arpa.vda.it

A. Facchinetti

A. Mammoliti Mochet

Umberto Morra di Cella
morradicella@netvallee.it

ARPA Valle d'Aosta – Aosta Valley Environmental Protection Agency
Loc. Grande Charrière, 44
I 11020 Saint-Christophe (AO)
Italy

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 33-38

Vegetation exposure to ozone and atmospheric depositions: monitoring in remote sites in the Mont Avic Natural Park

Massimo Bocca [1], Edoardo Cremonese [2], A. Facchinetti [2], A. Mammoliti Mochet [2], Umberto Morra di Cella [2]

(1) Mont Avic Natural Park
(2) ARPA Valle d'Aosta – Aosta Valley Environmental Protection Agency

Abstract

The impact of tropospheric ozone and atmospheric depositions on forest ecosystems is of considerable concern in Europe. Monitoring the dynamics of such pollutants in remote sites is a way to understand how uncontaminated areas are exposed to diffuse atmospheric composition alterations coming from elsewhere.

Since spring 2005 two different ozone and deposition monitoring sites are operating in the Mont Avic Natural Park. The aim of this research activity is to compare pollutants exposition in open field and through canopy sites. The ozone concentration is measured by passive samplers on a weekly basis from May to October, while atmospheric depositions are evaluated on bulk samples collected with continuously exposed collectors.

The impacts of ozone concentration and atmospheric depositions on forest ecosystems are evaluated with weekly chlorophyll fluorescence measurements made on needles of mountain pine, *Pinus uncinata* (MILLER), the most widespread tree species in the Mont Avic Natural Park forests.

The monitoring results will be disseminated through the park communication activities, with the aim of highlighting that even places which are generally deemed as uncontaminated, are affected by alterations in the atmospheric composition.

Keywords

Ozone, Atmospheric depositions, Chlorophyll fluorescence, Pinus uncinata.

Introduction

The evidence of damages on European forest ecosystems due to atmospheric pollutants and the implementation of various monitoring activities in different EU countries have pushed the Mont Avic Natural Park to start a research activity on vegetation exposure to ozone and atmospheric depositions. The project aim is to measure temporal variations of such pollutants in two different remote sites and evaluate their potential effects on forest ecosystems. These objectives will be achieved through a two-year monitoring programme managed by the Environmental Protection Agency of the Aosta Valley (ARPA Valle d'Aosta), with the cooperation of the Mont Avic Natural Park foresters.

Study Area

The Mont Avic Natural Park is the first Regional Natural Park of the Aosta Valley, a mountainous region in northwestern Italy, on the southern side of the Alps.

With a total area of 5747 ha, and a mean altitude of 2270 m a.s.l. (920-3185 m a.s.l.), the protected area lies over two east-west oriented valleys and is characterised by the most typical alpine landscapes: uncontaminated deciduous and coniferous forests, wide alpine pastures and lofty unvegetated areas.

The monitoring sites are located in the Chalamy Valley, in the subalpine layer, at 1550 m a.s.l..

Contribution received at: 11.08.2005

Fig. 1: Geographic location of the Mont Avic Natural Park (black dot).

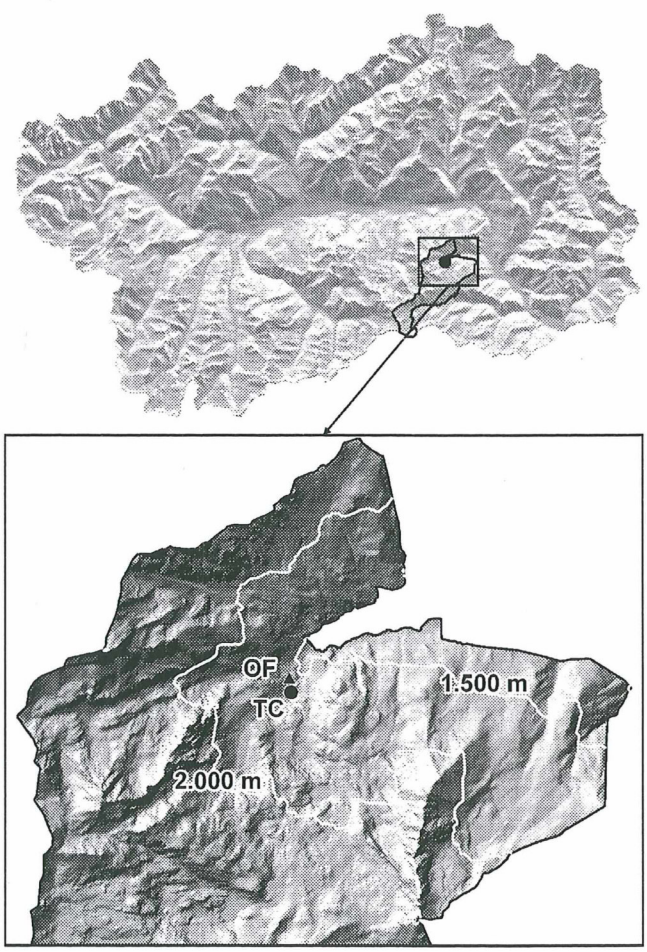


Fig. 2: Geographic location of the monitoring sites (OF: open field; TC: through canopy).

The first site, called open field (OF) site, is in the middle of a scarcely exploited pasture, while the second, the through canopy (TC) site, is located in a coniferous forest stand, whose main tree species is the mountain pine, *Pinus uncinata* (MILLER). The distance between the two sites is less than 200 m. In both, the ozone concentration, atmospheric deposition composition and mountain pine needles chlorophyll *a* fluorescence are measured or analysed.

Methods

Ozone concentration measurements

Ozone measurements are carried out using passive samplers which are continuously exposed. These diffusive tube type samplers rely on the reaction of 4,4'-dipyridylethylene with ozone to 4-pyridylaldehyde, which can be determined spectrophotometrically. The limit of detection is 2 $\mu g/m^3$ for 7 days exposures. The uncertainty at 2σ is 14.5% over the whole sampling rate linearity range.

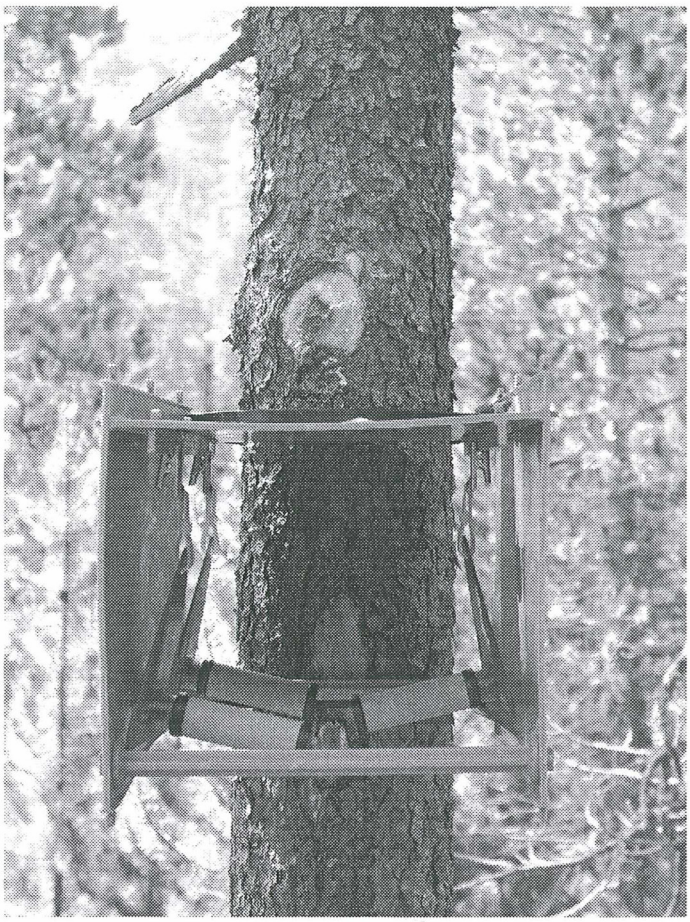


Fig. 3: Passive samplers exposed in the through canopy site.

The weekly samplers substitution and analysis yields a mean weekly O_3 concentration for the two monitoring site. Measurement are made from April to October and will last two years.

Atmospheric depositions

The composition of atmospheric depositions is evaluated on bulk samples collected on continuously exposed collectors.

The two monitoring sites have a different number of such collectors due to the expected differences in samples heterogeneity: the open field site is equipped with only 3 samplers, while the through canopy site has 8. Samples will be collected each week for 12 months starting from August 2005. In winter, because of snow, the samplers exposed will be different from the one shown in Fig. 4. The parameters analysed on each sample collected are listed below.

pH	Sulphate
Conductivity	Calcium
Alkalinity	Magnesium
Ammonium	Potassium
Nitrate	Sodium
Total nitrogen	Chloride
Total phosphorous	

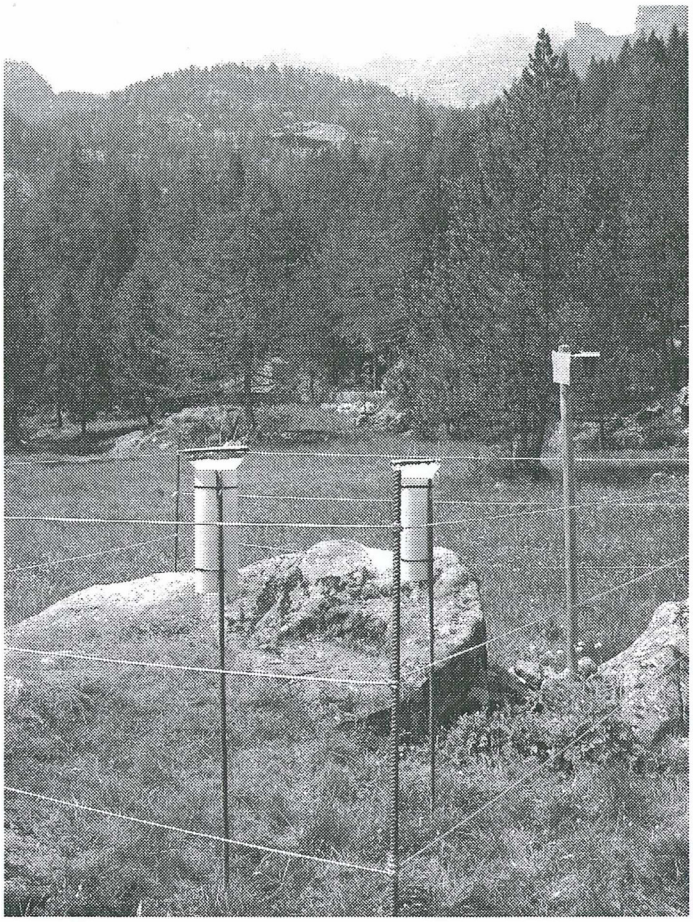


Fig. 4: Atmospheric depositions bulk collectors in the open field site.

Chlorophyll a fluorescence

The effects of atmospheric pollutants on forest ecosystems are investigated through measurements of chlorophyll a fluorescence, carried out with an active fluorimeter (Handy PEA). The fluorescence transients of 10 samples, taken from three *Pinus uncinata* trees in each monitoring site, are analysed on a weekly basis. Each sample comprises of four needles and in order to allow a complete understanding of damage spreading, measurements are carried out both on the apical and the basal portion of the needles. Before each measurement, the needles are dark adapted for 60 min with leaf clips; the rising transients are induced by a red light (peak at 650 nm) of 1300 W/m^2 which is readily absorbed by the chloroplasts of the leaf.

Fluorescence transients are then analysed with the JIP test, which takes into account the fluorescence values at different time steps. This test is widely accepted and has been successfully used to analyse stress conditions in plant samples subjected to high levels of ozone exposure.

Preliminary Results

Ozone

The data on ozone concentration gathered over the first eight weeks show a high degree of correlation between the measurements at the two sites. These first results also indicate an interesting pattern of differentiation between the two monitoring sites, outlying significantly lower concentrations in the through canopy (TC) one.

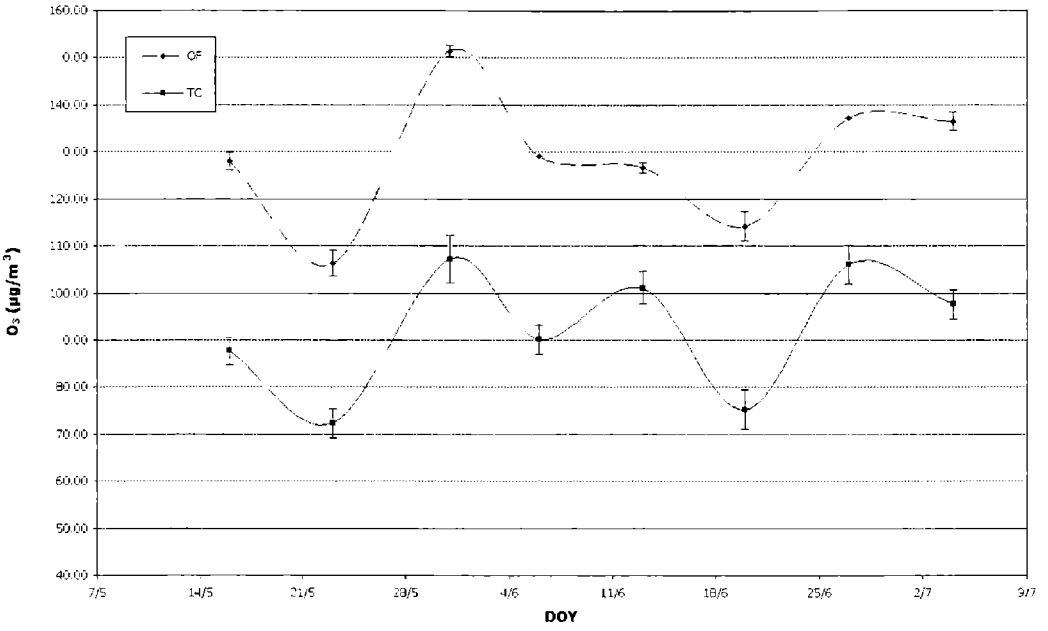


Fig. 5: Ozone concentration during the first eight weeks of the monitoring project (TC: through canopy; OF: open field)

Chlorophyll a fluorescence

At the time of drafting of the present document, data on fluorescence transient derived vitality index (PI) were not enough to see any ozone induced damages. The period when stress phenomena are expected to be detected is actually late summer, when a higher degree of ozone exposure may lead to damages in the forest ecosystems. However, favourable indications are given by the clear-cut difference observed between the two sites after the first measurements. Such situation should provide a better understanding of the effects of different ozone exposures on the same tree species. Fig. 6 shows such first results.

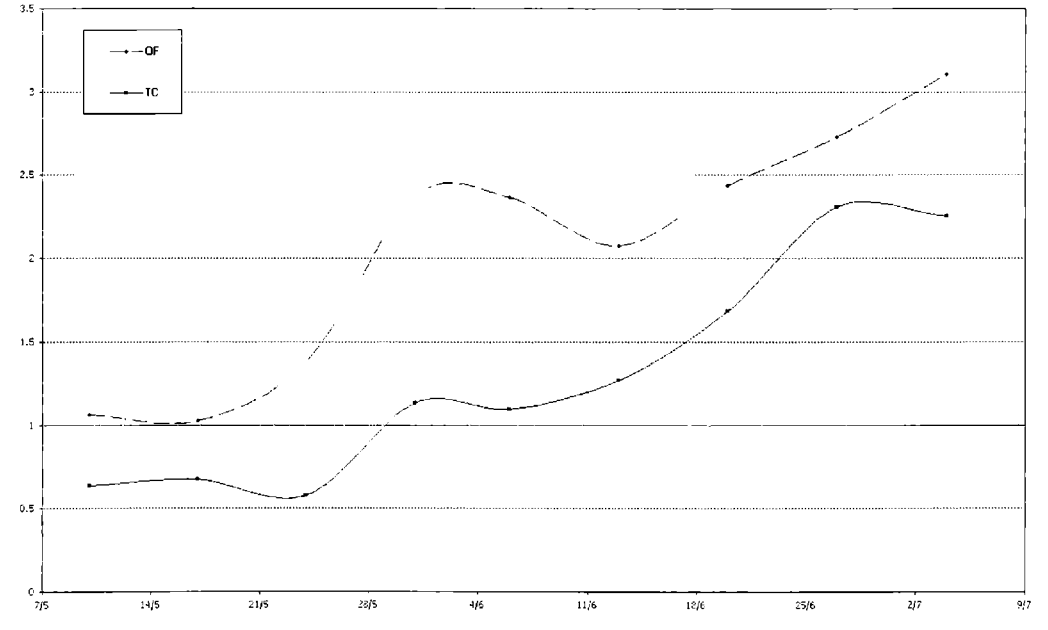


Fig. 6: Performance index (PI) variations during the first nine weeks of the monitoring project (TC: through canopy; OF: open field)

Discussion

The research activity presented has two main purposes: providing the Mont Avic Natural Park with the first data on air quality - seen from an ecological point of view - and investigating, with a basic approach, the main differences experienced by sites with different micrometeorological conditions.

Measurements of ozone concentrations and the analysis of atmospheric depositions will be compared to the same data collected in the more urbanized area of the Aosta Valley and in other forest ecosystems in Italy and Europe. Even if atmospheric pollutants dispersion dynamics act on a bigger scale, providing protected areas with such information is of considerable importance, both for communicating with the general public and for management plan development purposes.

On a more local scale, comparing the measurements made in the open field and through canopy site is a way to analyse the atmospheric pollutants dynamics that forest ecosystems experience. Keeping in mind that only flux modelling techniques can lead to a complete quantification of the pollutants dose to which plants are exposed, the strategy suggested is a first step for a better understanding of vegetation damages induced by atmospheric pollutants.

Contact

Dr. Massimo Bocca
parc.avic@libero.it

Parco Naturale Mont Avic
Loc. Fabbrica 164
I 11020 Champdepraz (AO)
Italy

Dr. Edoardo Cremonese
e.cremonese@arpa.vda.it

A. Facchinetti

A. Mammoliti Mochet

Umberto Morra di Cella
morradicella@netvallee.it

ARPA Valle d'Aosta – Aosta Valley Environmental Protection Agency
Loc. Grande Charrière, 44
I 11020 Saint-Christophe (AO)
Italy

Conference Volume | 3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas | pages 39-40
September 15th to 17th, 2005, Castle of Kaprun

How to manage a national park? Asking the right questions to manage an alpine protected area: les Ecrins

Hervé CORTOT

The National Park les Ecrins

Created in 1973, the National Park les Ecrins has a special place in the Alps: it is the largest park in France located between the North and the South Alps. The central area (91.800 ha of protection) and the peripheral area spread over 270.000 ha with approximately 30.000 inhabitants. The National Park Les Écrins is a public establishment and employs one hundred of persons.

The Écrins territory is organised around a series of high mountaintops: Meije, Écrins, Pelvoux, Bans, Olan, and Sirac. Some of the mountain sides cover an altitude range of more than 2000 m. Long and deep valleys meet at the core of the crystalline massif. To the North and especially to the South, the relief is less rough: sedimentary mountains open on wider valleys, with far-reaching plateaux that allow the development of high pastures. Mountain passes make the exchanges between valleys easier. Today, the Cols that are easy going and easy to set up are used as road crossings in particular: the main Cols are the Col Bayard, the Col d' Ornon and the Col du Lautaret.

High mountains (from 800m to 4102 m, the top of les Écrins) have a significant part of mineral, glacier and grass. Lots of valleys are faced with a decreasing agriculture.

For over 30 year, the National Park benefits from tools on managing information. To gain knowledge and experience in the field is essential for the National Park' missions:

- The rangers (50) are well motivated and qualified. They are long-made up of inhabitants and naturalists.
- There is currently a staff of 7 scientific workers. This staff is advised by a scientific committee. By the way, we are please to work with people on the long view.
- Two universities are not so far: Grenoble (100 km) and Marseille (180 km).

30 years and such a work!

- Strong inventories: ordinary for a protected area: flora, fauna but also geology and geomorphology. Landscapes have been studied within the "DELPHINE" method" Special work on lakes and groves has been carried with Universities. In social studies, the work on the National Park history and on Archaeology are in progress.
- The following step has been the monitoring: of rare plants, populations of chamois, gallineous birds, golden eagles, but also glaciers and physical parameters. The more original is the health monitoring for wild fauna, air pollutions, the visitors management, flying over mountain...
- Main points of this period:
  the growth of biodiversity (by introducing the alpine Ibex, for instance)
  the partnership with farming on 3 types of landscapes: alpine pasture, reaped meadows and hedged farming.
  the symbolic creation of the Lauvitel Reserve with a special scientific program
- After 30 years, it is an important core which is diversified, with different quality, useful for:
  official documents: regional development program, local planning management, atlas, Natura 2000 sites
  databases
  information for visitors centres
  training for the National Park employees

This knowledge is a resource for the scientific research in the territory and an important source of information for visitors and inhabitants.

Contribution received at: 19.07.2005

Challenges for the future

The question is: what kind of information on the long run?

To be exact:

- What is of importance to survey and to monitor?
- Which external links? international or national networks?
  - *In France, an attempt is currently in progress to create real exchanges between French National Parks.*
- Which is the public targeted? How to relate back the information?

These questions have been examined, collected and organised by three axis (during the choice for the regional development program 2005-2010 meeting):

- to consider global factors acting on the territory development
- to measure the environmental changes to use management tools and practices
- to plan out conditions to preserve species
- to give elements concerning the territory memory

After a discussion and a debate, the scientific committee and the board of directors made the following choices:

- to continue the monitoring with priorities
- to start working on biogeographical data by environment (monitoring species - temporal and space)
- the operating of the space (environment and species)
- monitoring and evaluation of human activities (winter tourism, sport pollutions ...)
- going with disturbances (wolf , wild boar)
- to develop long term monitoring (flora, fauna)
- to develop knowledge on water
- to keep up the National Park culture (changes of rangers generation)
- to collect cultural knowledge

Some thoughts

- **Expert or heckler?** If a better knowledge is necessary to legitimate the National Park (useful for communication and for the territory management), the actors of the territory can be embarrassed. "More we know, more it's difficult to integrate obligations and to make choices" for politics.
- **Scientific knowledge, popular knowledge.** How to integrate popular information and to contribute for the preservation of cultural diversity? How to understand the local culture without local staff ?
- **To relate back our information on the territory.** It is necessary for the acceptance and the development not only for inhabitants, but also for the technical public and visitors. It's not the same level of knowledge.
- **Sciences and alpine protected areas:**
  A little research on this particular territory and on protected areas problems. We are concerned by the disappearing of the naturalists able to help us.
- **Long term information:**
  Which information can be useful in the future to preserve and to manage our space? A large amount of work has to be done on the processing of our data.
- **Networks, a chance for protected areas?**
  Today, it's a stake to share our knowledge, our methods and to move on together.

In a world more and more standardized and planned, a National Park is moving, it changes, it goes forward. It's a real dynamic... May be it is like our knowledge where it's possible to get lost and to find back, as in the Écrins territory!

Contact

Hervé CORTOT, chef du service scientifique
hervé.cortot@espaces-naturels.fr

Parc National des Ecrins
Domaine de Charance
F 05 000 Gap
France

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** | pages 41-43
September 15th to 17th, 2005, Castle of Kaprun

The Biodiversity Database of the Hohe Tauern National Park

Wolfgang Dämon, Patrick Gros

Abstract

The biodiversity database of the Hohe Tauern National Park is a multi-functional information system which documents all available data on the biodiversity of the Hohe Tauern region. The database, maintained at the "Haus der Natur" Museum of Natural History in Salzburg, is designed to integrate distribution data on all animal and plant species, while including parameters specific to certain systematic groups. Unit-level data originate from various sources such as field studies, museum collections, literature, and privately maintained databases provided by biologists. Unit-level data are referenced to comprehensive metadata concerning taxa, sites, collections, literature, and contacts. Many ways exist to access the information stored in the database. Possible applications of the biodiversity database are manifold and are of large interest to biologists, teachers, practitioners, politicians, and all who relate to the Hohe Tauern region.

Keywords

Biodiversity, database, digital distribution maps, Hohe Tauern National Park, "Haus der Natur" Museum of Natural History, Salzburg, Carinthia, Tyrol, Austria.

Project aims

The Hohe Tauern National Park biodiversity database was established with the aim of documenting all available data on the distribution of animals and plants in the Hohe Tauern region in one extensive database. The database is a multi-functional information system which allows data query relating to specific questions and quick retrieval in any desired structure and format. The search results are required to be presented so as to permit assessment of potential distribution areas with a special focus on threatened and target species and so as to include increases and decreases of distribution area sizes and population densities. The data should allow the definition of areas of high and specific biodiversity as well as areas requiring special protection and management actions. The database is a valuable basis for the compiled analysis and publication of existing biodiversity data. Furthermore, the project should emphasise the necessity to promote biodiversity research in the National Park, especially where data are scarce or obviously lacking.

Duration

The project started in the year 2000, and the total time for recording biodiversity data within the scope of this project should be seen as infinite. As nature is constantly reshaped by underlying dynamic processes (natural or non-natural) continual changes in biodiversity are to be expected and the documentation needs to be updated on a regular basis.

Area of study

The geographic area covered is the "Hohe Tauern region", including the core zone and the buffer zone of the National Park (ca. 1800 km²), as well as the total surface of the so-called National Park municipalities in Salzburg, Tyrol (Osttirol), and Carinthia.

Methods

The Biodiversity database is maintained at the "Haus der Natur" Museum of Natural History in Salzburg. Database management and data entry is carried out by a small team of biologists specialised in the taxonomy and ecology of vertebrates, invertebrates, and plants respectively, and with in-depth knowledge of informatics.

The main software used in the project is "BioOffice" (by BioGis Consulting), a database program based on a Microsoft SQL-Server with integrated GIS functionality (ESRI Map Objects). The program provides many useful options allowing the adaptation of the database model, application and user interface to exactly fit the scope and particular needs of the project. For each of the some

Contribution received at: 21.07.2005

400 data fields used in this project policies for the contents as well as data integrity and consistency were agreed upon and documented.

Highly accurate and at the same time highly efficient procedures have been developed to guarantee standardised, consistent data.

For all main groups of organisms the database contains comprehensive and standardised taxonomic lists, including information on higher systematics, nomenclature, name codes, general distribution (in Austria, Europe), the degree of endangerment where defined in national and regional Red Lists, and the degree of protection according to European Union Directives.

Unit-level data records (so-called "objects") contain either observations of individuals in their habitat, or collected, prepared, and preserved specimens. Sources of unit-level data include published literature, unpublished project reports, expert mappings and expert opinions, private and public collections, and miscellaneous sources of observational data collected in the field and held by many zoologists and botanists (such as traditional paper card indexes, excursion lists and diaries, but also data already in some way digitised). Consequently, the database contains recently sampled data as well as historical data.

In the course of importing data from these sources, the reliability of the information is evaluated and commented on by scientists (e. g. with respect to taxonomic identification), assuring a high quality standard. Many ways exist to access the information stored in the database. The record sets retrieved from queries may be presented in user-defined reports and on digital maps, or may be exported to be analysed statistically or using GIS software.

Results and discussion

Currently the database contains ca. 61000 records (objects) concerning ca. 4400 species of animals and plants and ca. 5400 georeferenced sites. Table 1 shows the number of data broken down into the main groups of organisms. Since on average each record set comprises about 25 data fields (i. e. filled with information), the total amount of effective information is estimated to exceed 1500000 data.

	Unit-level Data	**Taxa**	**Sites**
Mammals	2419	69	522
Birds	23324	281	2552
Reptiles and amphibians	991	19	544
Butterflies and moths	14821	1290	625
Bees and bumble bees	5487	60	672
Grasshoppers	1481	41	623
Beetles	7857	1810	345
Dragonflies	92	27	18
Spiders	21	13	12
Flowering plants and ferns	4572	575	425
Lichens	130	107	24
Mosses	360	152	99
Total	**61555**	**4444**	**5464**

Tab. 1: Number of record sets in the biodiversity database

Among the most important data sources which have been integrated in the database so far are the following: data collections provided by specialists (of e. g. birds, butterflies and dragonflies); collections of specimens held in the "Haus der Natur" Museum of Natural History; research project reports commissioned by the National Park (vegetation science, monitoring of eagles, vultures, bats); some 150 published papers dealing with faunistics and floristics in the Hohe Tauern region, and last but not least observations reported by National Park authority employees and trainees. Remarkably, an overwhelming amount of data originates from private experts who volunteer their time to unsalaried investigations.

An exceptional number of data comes from a few regions, such as Badgastein, Heiligenblut (Großglockner region), or Prägraten. Actually, places like these have always attracted scientists. On the other hand, the data clearly indicate some regions where biodiversity data are scarce and on which research should be focused. The amount of data available from the core and buffer zones, and thus the number of known species, is rather small compared to the adjacent regions. However, when extrapolating species richness from the number of currently existing records, biodiversity in the core and buffer zones should be distinctly higher than in the adjacent areas.

During four years of database management we experienced the importance of keeping data standardised, cleansed and consistent, which was attempted rigorously from the beginning. However, the effort to maintain the database at a high quality level continuously grows with the number of integrated data sources and takes at least the same time as the digitisation of new data.

The biodiversity database serves as a tool to organise the huge amounts of data originally spread over many sources and makes them easily accessible for use in nature conservation, landscape planning and management of natural resources. It already proved to be a helpful service system for all those who have to consider biodiversity in a decision-making process. In the near future the information stored in the database should be available also to the public (e. g. in the National Park centers) and via the Internet. This should increase the awareness of the public for issues of biodiversity and biological sciences in general.

Contact

Dr. Wolfgang Dämon
wolfgang.daemon@hausdernatur.at

Dr. Patrick Gros
patrick.gros@hausdernatur.at

"Haus der Natur" Museum of Natural History
Museumsplatz 5
A 5020 Salzburg
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 45-47

Aerial image interpretation within the Interreg IIIB project "HABITALP"

Walter Demel, Ulrich Kias

Abstract

Eleven protected areas from all over the Alps are working together in the project HABITALP to derive habitat-data from aerial images. This proceeding gives an overview on the approach, the status of the activities and future trends in remote sensing which may be important for monitoring in protected areas.

Introduction

Color infrared-sensitive films ("CIR"-films) are established as one of the most important source of information for land use mapping and even for detailed monitoring of vegetation. Because of the considerably higher differentation of the reflection of vegetation in the range of near infrared the reconnaissance of species in such images is much more easier and reliable compared to panchromatic or true color images. Very good examples are the distinction of decidous and coniferous trees and the identification of moist and wet areas.

Since 1980 CIR aerial images are used in the Nationalpark Berchtesgaden for the mapping of biotop and land use types. Rotational repetitions of the flights took place in 1985, 1990, 1997 and 2003, the updating of the mapping was carried out at the Center for Landscape Informatics (LIZ) of the FH Weihenstephan. During the long lasting cooperation with other nationalparks in the alpine area the idea arose in the mid 90s to start a project to aim at a concept for a standardised interpretation method of aerial photographs.

Within the scope of an Interreg IIa project (KIAS et al., 2001) an appropriate study was conducted at the LIZ from 1999 to 2001 which produced an interpretation key extended for the special conditions of the high mountains. Basing upon this interpretation key in november 2002 started the project HABITALP with partners from eleven protected areas from Austria, Italy, France and Swiss under the leadership of the Nationalpark Berchtesgaden. And as biotop and land use types or rather habitats are intended to be mapped all over these aereas with CIR aerial images in HABITALP, the CIR aerial images are the most important basis of this project.

Flight campaigns: Technology, organisation, problems and profits

Whereas some of the project partners had already wide experiences with flights for aerial images, it was totally new territory for most of the participants. Nevertheless within a short time it could be managed to provide the corresponing specifications in all languages for the tender procedure of the flights and the following orthophoto production.

A small summary of the technical specifications:

- film: Kodak Aerochrome III Infrared 1443
- average image scale: 1:11000 up to 1:13000
- flight period: july – august (september)
- scan-resolution: 12,5µ
- resolution of the digital orthophotographs: 20cm
- optional: digital terrain model (DTM) production

With these requirements the project was intentionally based on approved methods, whereas new technologies like digital camera systems were not excluded a priori. However only one tenderer in France did ask if he could offer also flights with digital cameras, but a corresponding offer wasn´t submitted.

Finally in summer 2003 the protected areas Les Ecrins, ASTERS and Berchtesgaden could be processed. Five areas in Italy attempted to make a collective tender procedure, but the bidding had to be repeated as the offers were way too expensive. Beside a loss of time this turned out to have

Contribution received at: 05.08.2005

also some advantages: Because of the opening of the procedure also for non-italian tenderers it was possible to get much better prices.

Summer 2004 was planned as an "backup" date for the flights of 2003. While the flights of 2003 couldn´t be accomplished because the vegetation was heavily suffering under the dryness of this hot summer, the weather of 2004 was so bad that flying was only possible in La Vanoise, Bozen and some small parts of Stelvio. For these reasons the whole project was suddenly put into question, but the project leader Nationalpark Berchtesgaden could manage it to get a prolongation from the EU authorities.

Interpretation key: Development, deployment and application

The Interreg IIa study was the prototype of the interpretation key which was used as from summer 2003 both in Nationalpark Hohe Tauern, applying the CIR and FDIA aerial images from 1998, and in Nationalpark Berchtesgaden. Basis for the interpretation key is the „Systematik der Biotop- und Nutzungstypenkartierung" of the german Federal Agency for Nature Conservation (BFN, 2002). The assignment of attributes is made by a hierachical system in three columns:

biotop-/land use type (4-digits)	e.g.: 7215	coniferous forest (pure stand), old growth stand
species/genus/character (3-digits)	e.g.: 120	dominant: spruce; accompanying: fir
degree of cover (1-digit)	e.g.: 4	canpoy: 60% - 90%

In order to start the process of harmonisation the LIZ at the same time did gather proposals for additions from the other project partners. Commencing with a first common workshop in Salzburg in June 2003 step by step suggestions were collected via the internet forum of habitalp.org. The realisation was done by a smaller team of experts (coordination group for the aerial image interpretation) where experienced interpreters met as representatives of the western, central and eastern parts of the alps.

Quickly was revealed that specially the requirements of the partners of the south side of the alps could overextend the previous coding system with its limited scope.

The first revision ended in the autumn of 2003 resulting in the publication of a complete new translated mapping guide in german, french and italian language within the series of publications of the Alpine Network of protected Areas (ALPARC, 2003). In march 2004 the first training of the interpreters took place in Gap. Participants were not only the partners who had flights in 2003, but also the coordination group. An interesting side effect of the successful team work was the acquisition of several high-value stereoscopes for those park administrations who had till then no or not sufficient equipment for stereoscopic analysis of the aerial images.

Finally in the course of the application of the interpretation key so many pervasive change requests were brought forward that it was necessary to totally revise the mapping system. Basically following the same logic the orignal three columns became around 20 columns representing single criterias (e.g. degree of scree, rock, water, trees ...). With a translation routine it´s possible to convert the old data into the new schema.

The new system was presented in July 2004 during a workshop in Lausanne, where the arrangement was made to decide the realisation after a testing phase until autumn 2004. A serious consequence of this change was the necessity to revise and translate all documents of the interpretation key. This was achieved in time tili the second training of the interpreters in March 2005 in Freising.

Data: habitalp.org

As already mentioned a multilingual internet platform with discussion forums was established within the project HABITALP to provide the up-to-date interpretation key and the photo examples for all project partner in their national language. This media was embraced during the first revision of the interpretation key. The second revision did happen „offline" in the circle of the coordination group.Having the first results of the aerial image interpretation digital maps will be integrated in the internet platform by using the free map sever of the University of Minnesota. The goal is to provide the project partners with cost-saving mapping results of the project. In this context legal aspects, mainly questions concerning the release of the data, are examined at the moment.

Monitoring: Change detection in the Nationalpark Berchtesgaden

The question about the best monitoring system came up in the project HABITALP after having meanwhile results from four aerial image flights in the Nationalpark Berchtesgaden. In the course of the change to the new interpretation key a new procedure could be developed which seamlessly fits in the schema and uses the advantages of the new system.

Significant features are „Delta-Colums" for the documentation of changes (e.g. increase or decrease of the number of trees) as well as a column for description of the change causing process. With this system it´s possible to record also minor changes in detail and not only major incidents in the landscape which would lead to a new biotop- and land use type or a new shape of the polygon.

Future: New sensors, data and software

The flights within the project HABITALP were offered only with analogue cameras because at this particular time the switch to digital systems of the flight companies hadn´t already started. In a few years however this technology will be the standard and also remote sensing projects like HABITALP will benefit from the fact that digital cameras will have beside the classical RGB channels also a fourth channel in the range of near infrared.

On the other hand with Quickbird and Ikonos two high-resolution satellites are available delivering pictures with ground resolutions between 0,6m and 1m within the panchromatic spectrum. In the Nationalpark Berchtesgaden the provision of Quickbird data is planned for 2005 in order to make comparative tests related to interpretation results of conventional aerial images. In spite of this impressive technology there are remaining doubts if it´s possible to abstain from flights especially in the alpine regions where flight periods are typically shorter due to climatical reasons.

An absolute innovative and useful additional information will be data from airborne laserscanning (KRAUS, 2005). This technology provides not only precise digital terrain models (DTM) with unprecedented resolutions for alpine regions but also digital surface models (DSM) delivering vertical informations about the objects on the ground (e.g. vegetation, buildings...) and thus enabling interpreters to better map roads or geomorphology especially in areas with a lot of forests. The availability of such data will push modern image processing systems like eCognition because the integration of the elevation information in this quality will reduce a lot of difficulties for environmental modelling in the near future.

Summary

The project HABITALP started with the goal to create a standardised data basis for eleven protected areas in the Alps by the use of aerial image interpretation. Even if the project was temporary endangered because of delayed flights the result for research in alpine regions is already a success by now: Due to the perennial co-operation standards could be created ranging from multilingual bidding documents to a shared interpretation key on an internet platform.

References

KIAS, U., DEMEL, W. & SCHÜPFERLING, R. unter Mitwirkung von EGGER, G. 2001: Koordination der Auswertung von Biotoptypen in alpinen Schutzgebieten als Grundlage für Management und Planung. Abschlußbericht eines INTERREG-II-Projektes der Nationalparks Berchtesgaden (D) und Hohe Tauern (A) in Zusammenarbeit mit dem Schweizer Nationalpark, unveröffentlichtes Manuskript, Freising-Weihenstephan, 68 S. und Anhang (Teil A: Homogenisierung von Luftbildinterpretationen und Codeplänen in den Alpen-Nationalparks), 26 S. und Anhang (Teil B: Automatische Bildauswertung von Orthophotos aus Hochgebirgslagen)

BUNDESAMT FÜR NATURSCHUTZ (BFN) / FEDERAL AGENCY FOR NATURE CONSERVATION (Ed.), 2002: Systematik der Biotoptypen- und Nutzungstypenkartierung (Kartieranleitung) / A System for Survey of Biotope and Land Use Types (Survey Guide) (überarbeitete zweisprachige Ausgabe / updated bilingual edition). Schriftenreihe für Landschaftspflege und Naturschutz, Bonn, Heft 73, 169 S. (deutscher Teil), 166 p. (english part)

ALPARC, 2003: HABITALP Monitoring der Diversität alpiner Schutzgebiete. Die Dossiers des Alpinen Netzwerkes, Nr. 10 / 2003

KRAUS, K., (2005): Laserscanning und Photogrammetrie im Dienste der Geoinformation. Vortrag auf der AGIT ´05. Angewandte Geoinformatik, Wichmann Verlag, Heidelberg

Contact

Dipl. Ing. Walter Demel
walter.demel@fh-weihenstephan.de

Prof. Dr. Ulrich Kias
kias@fh-weihenstephan.de

Weihenstephan University of Applied Sciences
Fachbereich Landschaftsarchitektur
Landschaftsinformatikzentrum LIZ
Am Hochanger 5
D 85350 Freising
Germany

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 49-51

Aspects of sports ecology and wildlife biology in high mountain regions of the Alps
Interactions between outdoor sports and rock ptarmigans (*Lagopus mutus helveticus*) in arctic alpine zones

Heinz Dungler

Abstract

In this project sports ecology combines sports sciences and wildlife biology for research in high mountain regions. The relationship of sports and nature is the main theme of sports ecology. The example of rock ptarmigans shows interactions between outdoor sports and wildlife. Abundance and parts of behaviour like attraction, habituation, sensitisation and avoidance are examined to show effects. Philosophical aspects of sports ecology make us think about the value of wilderness. The educational part of sports sciences and several other institutions like protected area management can realise the results. The basic research is done in the area of Nationalpark Hohe Tauern.

Keywords

Sports ecology; sports sciences; wildlife biology; outdoor sports; natural resources and wilderness; rock ptarmigans; effects; abundance; behaviour; symbols of wilderness; didactic of sports; education; protected areas management

Introduction and project aims

The coincidence of sports and nature is a sensible complex. Natural resources and wilderness are limited, intrinsic values. They are resources for a harmonic development of humans. Health, fitness and quality of life are related to biodiversity and natural evolution.

The growing number of outdoor sports activities in protected areas shows that sportsmen are attracted by values like natural resources and wilderness.

Sports ecology, as a part of sports sciences tries to discuss scientific basics for a harmonic development of sports and nature. In the presented project the example of rock ptarmigans shall show us interactions between outdoor sports and wildlife. The educational part of sports sciences and several other institutions like protected areas management can realise the results.

Methods

Study area

The basic study area was the Weißsee area around Alpinzentrum Rudolfshütte, upper Stubachtal, Granatspitz- und Glocknergruppe, Nationalpark Hohe Tauern (ÖK 153, 47°80´ N, 12°37´O). Some data about the behaviour of ptarmigans are collected in different parts of the Alps like Radstätter Tauern and Sextener Dolomiten.

General study time

The basic study time was the seasons of recreational use in the time of 7. 5. 2000 21. 10. 2000, 18. 1. 2001 - 9. 9. 2001, completed in summer 2002 and winter 2003 / 2004.

Methodical design

The methodical design uses methods to examine outdoor sports and methods of wildlife biology to examine rock ptarmigans. The combination leads into questions of sports ecology.

One part of the methodical design is to examine area use by outdoor sport activities and the behaviour of sportsmen and visitors. It is separated in seasonal and daily use and several kinds of human behaviour.

With rock ptarmigans, abundance, sports ecological abundance and scanned samples of animal behaviour are examined.

Contribution received at: 10.08.2005

The assumption for these examination is the proximity of infrastructure like ski slopes, ski touring tracks, off piste skiing possibilities, ice climbing areas, hiking paths, rock climbing areas, alpine huts etc. and their use by sportsmen and visitors.

Distances of reaction between rock ptarmigans, infrastructure or humans are the basic for the data. The combination of distances of reaction and samples of behaviour are used to show effects like attraction, habituation, sensitisation or avoidance.

Sports ecological methods are descriptive. They also relate to philosophy and didactic of sports and outdoor education.

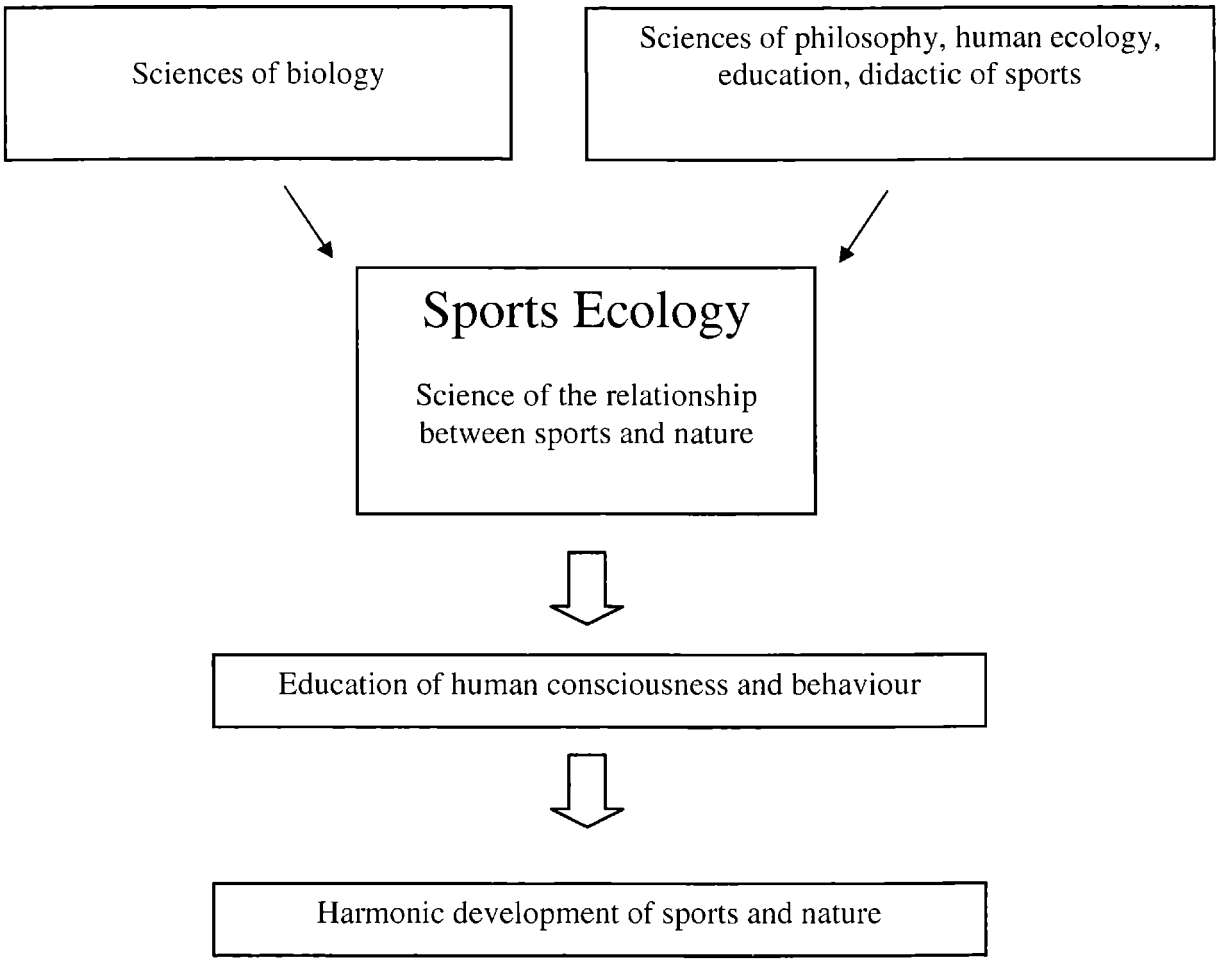


Fig. 1: Model of scientific parts and aims of sports ecology

Results and Discussion

In the Weißsee area visitors and alpine courses cross the ranges of ptarmigans. Between summer- and winter seasons there are some months without recreational use.

The "ecological abundance" of ptarmigans in the observed area was *4,04 territories/km²*. This value does not significantly differ from other regions of the Alps.

Compared with the high recreational use of the area no obvious negative effects on the abundance of ptarmigans were observed. This does not mean, that there could not be a higher quantity than *4,04 districts/km²* if the tracks were not used that much.

The sports ecological abundance and the ecological abundance of ptarmigans per track use show that during the studied periods the seasonal and daily use of outdoor activities had no direct connection to distribution and behaviour of ptarmigans.

May and June are the critical months because during this period, the animals begin to build their nests and to brood during a time of low recreational use. If the ptarmigans have been successful with breeding and the recreational season in their districts starts suddenly, normally they do not leave their nests or territories. So habituation is one of the possibilities for successful breeding.

Early habituation of juvenile ptarmigans is probable because some of the breeding areas and nests were close to tourist infrastructures.

The migration of the birds in higher regions of the area is natural and a connection to outdoor sports was not evident.

During the period of research no impact from outdoor activities on autumnal mating, territories or social structure could be found.

A lot of observations of breeding- and resting places were close to tourist infrastructure. Habituation of ptarmigans appears very probable. The loyalty of ptarmigans to their home ranges and successful experiences in these places are possible reasons for this behaviour.

If ptarmigans had a special interest in tourist infrastructure this could not be through experience, although the distances between the birds and tourist infrastructure did not demonstrate sensitisation or avoidance. Loss of home range area is possible because of the ski slopes and buildings. The activities of two ptarmigans close to a ski slope showed that even skiers under defined conditions caused no disturbance. These birds did not show any reaction of sensitisation or avoidance. It seems that this could also be habituation.

Measuring distances of reaction, consequences from outdoor activities on the behaviour of ptarmigans could clearly be recognised. From situation to situation ptarmigans used the most effective and economical reaction. Flying was less often recognised than all other reactions. A general sensitisation against or a special interest in human beings could not be recognised. Most of the reactions were forms of avoidance and habituation. Only aeroplanes and dogs out of lead excited the animals very early.

Rock ptarmigans are good indicators of habituation of wildlife towards humans but they are no indicators for borders of tolerance against outdoor activities.

Ptarmigans are symbols of wilderness in the Alps. They give sports ecology the chance to use educational values for a development of sports, natural resources and wilderness in harmony.

Contact

Mag. Dr. Heinz Dungler
heinrich.dungler@aon.at
Univ. Lekt. f. Sports Ecology

University Salzburg
Depart of Sports Sciences and Kinesiology
Schloss Rif
A 5400 Hallein
Austria

Conference Volume | 3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas | pages 53-55
September 15th to 17th, 2005, Castle of Kaprun

Towards an international protected area : Lessons from the transfrontier interdisciplinary research network for the protection of the Mont-Blanc

Barbara Ehringhaus

Background

The Mont-Blanc, the highest massif of the Alps and of EU-Europe, continues to have a surprisingly low and spatially limited protection status that is inadequate in view of its ecological, historical and symbolical importance. This vulnerability is compounded because the Mont-Blanc area is a hotspot of international mountain and mass tourism and lies along a main European transport corridor, contrary to most other protected areas (PA). In 1990, responding to the demands of the worldwide environmental community the respective ministers of France, Italy and Switzerland agreed on creating an International Park at the « Roof of the Alps ». To date, however, only some nature reserves at the fringes of the central massif exist on the French side. As the local authorities protested against a park project fearing an « Indian reserve » they were instead entrusted to build the »Espace Mont-Blanc» project in 1991, pledging to harmonise development and protection in a much larger region of 2.100 km^2. Nevertheless, the three project scientists withdrew soon, regretting the lack of political will and progress towards the ambitious double goal. In a parallel process, between 1993 and 2004 the World Conservation Congress has adopted three resolutions demanding the international protection of Mont-Blanc. In recent years ProMONT-BLANC, the international umbrella NGO regrouping over 20 organisations for the protection of Mont-Blanc (MB), has attempted to draw researchers of all fields into the PA lobbying process and to provide a scientific dialogue and basis for a proposed transfrontier World Heritage (WH) nomination, as well as the required management plan and prior legal protection status.

Project aims

The multiple goals of the research network are to further cooperation between scientists across borders and fields and to popularize scientific results and predictions for decision-makers and the general public. In spite of MB's importance as the cradle of earth sciences and mountain research there is still very little cross-national and inter-disciplinary exchange of research in this region. Furthermore, solid scientific arguments needed to be assembled in order to lobby local and national authorities in respect to their responsibility towards this iconic mountain range. Scientific input is also necessary to demonstrate the massif's outstanding environmental services, the specific threats and their impacts, and the consequent needs for protection. Also, in view of a potential World Heritage nomination the uniqueness and the exceptional features of MB have be to specified in comparison with other similar sites of the world. Most urgently, ProMONT-BLANC wants to assure scientific input into the highly politicized « Sustainable Development Scheme » which is currently being prepared by Espace Mont-Blanc as an EU-INTERREG III project.

Though the local population around the MB is very proud and knowledgeble of «their»mountains, much better communication is needed on pros and cons of different PA alternatives and on research data of complex issues such as climate change and tourism trends to motivate and mobilise them towards active participation in protection efforts. For unlike earlier PAs, today the protection status can neither be imposed by the state, nor by international institutions, but has to be supported by local stakeholders and authorities, who need to be better informed about the issues at stake.

Approach

The targeted involvement of researchers started in early 2002 with a series of expert meetings with social and natural scientists and PA practicioners and a subsequent international conference on the MB as a potential World Heritage site (October 2002). Since then, ProMONT-BLANC gradually enlarged the network of researchers from France, Italy and Switzerland through several tri-national and interdisciplinary meetings and electronic communication. Initially, the strategic goal for protection is the uninhabited central area, therefore the first steps assembled mainly natural scientists. For the human dimension and for the wider region social scientists are ready to

Contribution received at: 30.07.2005

re-integrate the network. As a result, so far 34 natural scientists from 12 Universities and other research institutions in the three countries have volunteered to contribute to the analysis of highlights, risks and environmental services of Mont-Blanc as well as of MB's scientific importance and ecological specificity citing recent and ongoing research (including data from the hot summer of 2003). Outstanding glaciologists and geologists, hydrologists and climatologists, as well as biologists and ecologists have each used the methods of their own discipline and the long data series available for MB and then jointly summarised their findings and possible trends with their colleagues from the same field. Written additions by those not present at the meetings have completed the inter-disciplinary overview of MB's natural features and possible future role.

Achievements

Researchers from all three countries have volunteered their time and drafted a preliminary dossier and are ready to work on a solid scientific dossier for a transfrontier management plan of Mont-Blanc, if so requested by the respective authorities. In this they underline MB's importance for current and future dynamic processes and strongly advocate a more coherent and effective transborder protection status of its core zone with corridors to the surrounding «balconies» and connection with the nearby National and Regional Parks in France and Italy. The researchers also confirm the compliance with at least 3 of the 4 selection criteria for a natural World Heritage site: 1) representative of earth history, 2) representative of on-going ecological and biological processes, 3a) exceptional scientific importance, 3b) unique aesthetic beauty, and 4) while the area does not excel in endemic and threatened species, it contains an extraordinary abundance of all species representative of the Western and Central Alpine arch. Therefore they strongly endorse its transfrontier nomination, although there is concern about the absence of the required prior «integrity» in legal protection.

In particular, the scientists maintain that the MB, while in the midst of densely populated Europe, distinguishes itself by offering all the world's mountain features in a nutshell, such as

- High diversity of cold, warm and black glaciers in all expositions and gradients
- All altitudinal levels and expositions suitable for plants and wildlife, including extreme ecosystems in arctic environments unsuitable for permanent life forms
- Presence and visibility of most of the geological stages and the resulting phenomena
- A reservoir of water and humidity and a buffer for the expected regional repercussions of global warming thanks to the convergence of 5 different climate zones around the summit elevation.

Therefore, the research network urges to use the massif more systematically as an ideal observatory for inter-disciplinary research on the dynamics of mountain ecosystems. They insist on intensifying the regular data gathering in view of the unique climatic conditions and the long data series that have been collected since the 18th century and which are available only on the MB. Climatologists, glaciologists and hydrologists agree on the utmost importance of this European hotspot of precipitation for the study and application of the findings about future climate risks and chances, about the renovation mechanism of glaciers throughout annual seasons and pluri-annual cycles. Geologists underline MB's crucial role for man's growing understanding of earth history and its geographical location in the Alpine arch.

While presenting a high risk for degradation by mass tourism, the area's easy accessibility compared to other higher mountain ranges of the earth – presents the opportunity of MB as a unique outdoor show case where the general public can appreciate and learn about processes of life's adaptation to extreme conditions, of ecological diversity and altitudinal variations, and of specific phenomena of climatic change (e.g. growth and decrease of glaciers in time) as well as the overwhelming richness and beauty within a compact and steeply rising mountain range.

Finally, the scientists also recommend MB as a priviledged laboratory for innovative PA strategies and policies (e.g. mountain tourism) and the application of the protocols of the Alpine convention with high potential for multiplication elsewhere in the Alps and beyond because of its exemplary role.

Challenges and difficulties of the research network

While researchers and activists reached unprecedented levels of communication and enthusiasm, the process towards a *de facto* protection and concrete WH nomination is very slow and hampered by the ups and downs of voluntary NGO engagement, limited funds, and political obstacles. In addition, there are a number of difficulties regarding:

- the respective national frames of reference that are still prevailing, rather than an ecosystem perspective which transcends national species and habitat categories.

- the spatial strategy to be adopted in the initial lobbying efforts, i.e. how far to extent the future PA beyond the core area of the massif into the so-called surrounding balconies, which might compromise the political will for protection altogether.

- a recommendation as to which combination of PA types to establish around the natural WH core area (e.g. MAB Biosphere Reserve, Parc Naturel Régional and/or mixed natural-cultural WH site)

- the biologists' and ecologists' hesitation to elaborate on potential future scenarios, in particular regarding climate change and plant diversity

- the integration of social sciences into the process that underline the socio-economic, political, symbolic and historical dimension that are so crucial to the area, but might complicate the first initiative to protect the uninhabited, but contested, core zone.

Outlook

While ProMONT-BLANC was successful in bringing together researchers from the three concerned countries in a creative dialogue and in engaging them in the lobby for a PA status, the biggest challenge for MB's transfrontier protection still lies ahead: How to bridge the wide gap between the exemplary wealth and level of scientific achievements on the one hand and the decisions of local people and their elected representatives on the other. Specifically, this process now needs to strategically deploy research into creating a significant PA which is actively promoted by local, regional and national decision-makers and supported by the wide array of local and non-local stakeholders. This requires that local authorities of «Espace Mont-Blanc» become convinced that protection of their natural capital, the basis of their current prosperity, will have to be protected adequately in order to achieve realistic long-term sustainable development of tourism, mountain farming, as well as cultural and natural landscapes. In particular, issues such as environmental risks and services both for the region itself and for the wider downstream area, offer an opportunity to engage a broader set of decision-makers and stakeholders in a PA debate and to develop and implement protection schemes with people rather than in opposition to them. As one step to address these challenges we currently search for scientific journalists capable of summarising the results in a non-scientific format for political decision-makers and a popular version for the general public, primarily in French, but also in Italian, German and English.

Contact

Barbara Ehringhaus
b.ehringhaus@bluewin.ch

ProMONT-BLANC
CP 61
CH 1299 Crans
Switzerland

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 57-59

Global Change Impact – Projects in the National Park Berchtesgaden

Helmut Franz

Abstract

The National Park Berchtesgaden was founded in 1978. Protection of nature, research focussed on observation and monitoring of biocoenoces and recreation as well as environmental education, are the most important tasks, defined by the Bavarian Parliament. Research and long term monitoring will support understanding of ecological processes. The natural und man made changes will be identified for the whole area. Research in National Park Berchtesgaden is applied research. It supports the management measures as well as the long term development tendencies. This is defined in the National Park plan and put into force by the Bavarian Ministry of Environment in 2001 (StMUGV 2001).

The tasks of the research and monitoring distinguish between topics in natural and near natural ecosystems of the core zone and topics in human influenced ecosystems in buffer zone. In addition to these topics, the development of ecosystems, which are no more used by human activities, should be worked out in core zone. The results of these synthesises should be compared to the present expectations.

Basics of long term monitoring in Berchtesgaden

A Geographic Information System (GIS) is the basis for research, planning and monitoring in Berchtesgaden. It was introduced in 1984 as a part of the UNESCO-MaB – Project 'Impact of human activities on high mountain ecosystems', which took place from 1981 – 1991. These data were consequently processed for the management plan from 1991 – 2001. At present, all data models are refined for long term monitoring.

Hierarchy of long term monitoring – the management projects

Basic of all the previous and present research projects, of the management plan and the long term monitoring is the interpretation of colour infra red (CIR) aerial photos at a map scale of about 1: 10000, combined with the digital elevation model. In Berchtesgaden, CIR-photos exist for the years 1980, 1985, 1990, 1997 and 2003. This method was adopted by 10 other protected areas within the HABITALP-project (LOTZ 2005).

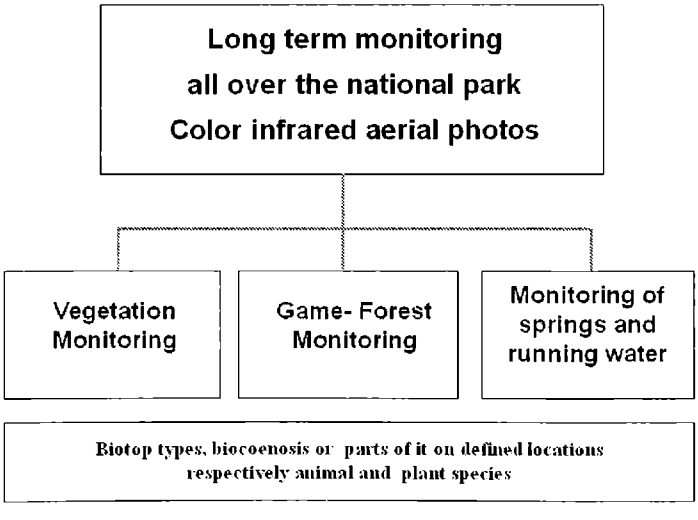


Fig. 1: Hierarchy of monitoring programmes in the National Park Berchtesgaden

Contribution received at: 07.08.2005

Temporary buffer zones are defined in the management plan. Exclusively measures for game management are taken in these zones. They will be change into buffer zone in ten years, if the measures for forest development will succeed. Methods for validation are

- monitoring of chamois
- comparative monitoring of vegetation inside and outside fences
- forest inventory

The data structures and the routines will be developed at the basics of the existing data models.

The Global Change Monitoring Projects

The projects on climate change are embed in this framework. The effects of global change will be worked out at present in three projects:

- Impact on global change on high alpine vegetation including contribution to the GLORIA-Project
- Phaenological monitoring
- Monitoring of water sources

Impact on global change on high alpine vegetation

A hypothesis assumes, that the plant species of alpine calcareous grasslands (Carex simpervirens-, Carex firma-community) have changed during the last 20 years. For this reason, historical plant mappings between 1984 and 1988 in the National Park Berchtesgaden were repeated in the year 2003 by Thomas Kudernatsch, Weihenstephan Center of Life and Food Sciences. Floristically changes between 1988 and 2003 were evident. The increase of temperature during the last two decades caused the changes of plant species. Since 1988 the average number of species per mapping site increased significantly by 11 species in the plant communities above 2000 m about sea level. This rise is not caused by the immigration of new species but by an increase in the frequency of species, which existed still 1988. A trait analysis showed that species which have clearly increased in their frequency are from small growth, preferably generative reproduction and have light seeds. In the Carex firma-community the species are also characterized by a late start of flowering time. Different exogenous and endogenous factors were discussed as possible reasons for the documented changes. The floristically changes should be explained by global warming. Natural succession, nitrogen deposition as well as changed land use practices obviously play not an important role (KUDERNATSCH 2005).

Phaenological Monitoring

Phaenology works on periodical returning phenomena of development of plants and animals. The appearance of flowering and leaf stages is documented for plants. It is closely linked to phenomena of weather and climate conditions. Phaenological data will be used more intensively for future analysis of trends of climate change. In the National Park Berchtesgaden, two international Phaenological gardens (cf. http://www.agrar.hu-berlin.de/pflanzenbau/agrarmet/ipg_de.html) are installed at Schapbach and Kühroint. In addition, the NP Berchtesgaden runs another 30 places for phaenological documentation in an altitude profile from 700 to 1400 m above sea level since 1994.

Monitoring of water sources

Water sources are very outstanding biocoenoces. Their temperature fluctuates in a very narrow range between 3 respectively 4 to 6 ° C. The fauna of water springs is adopted to this special condition. Till now, about 750 zoological species were identified. A third of these species, found in about 60 water sources of the NP Berchtesgaden, is strongly adopted to the conditions in water sources and might change with global warming. This special programme will be continued for next decades.

Integrated environmental monitoring

The approach to put integrated environmental monitoring into concrete terms, was developed in the Biosphere Reserve. It is based on development of a core set of parameters, corresponding with data collected in the process of integrated environmental monitoring or provided by existing measurement and monitoring programmes: the parameters of the core set are selected by a problem and a data oriented approach as well as a system theoretical approach, based on a runoff model.

The biggest development potential of environmental monitoring is to realise an integrative interpretation: by bringing together data sets, the value of the statements of the existing monitoring programmes and measurement networks can be significantly increased.

The exemplary implementation and assay of the methodological proposals in the Biosphere Reserve Rhön (SCHÖNTHALER et al. 2003) will be implemented in the National park and Biosphere Reserve Berchtesgaden on behalf of the management plan. The interpretation of colour-infrared aerial photos is the most important data layer for this monitoring.

Summary

1. Research and long term monitoring are central areas of responsibility of a national park (cf. decree of implementation of the national park, § 6(1))
2. On behalf of the NP Berchtesgaden, the Free State of Bavaria accepts responsibility for the alpine region within the scope of the national and international framework
3. National park administration will concentrate on long term monitoring, especially on the integrated environmental monitoring concept, developed in the biosphere reserve Rhön
4. At the same time, this work can support the duties for the Natura 2000 duties of the European Union
5. At last, the management measure will be validated by this concept of long term monitoring

References

KUDERNATSCH, T., BECK, S., KRENZER, M., FISCHER, A., BERNHARDT, M., FRANZ, H., VOGEL, M. & C. ABS.: Recent changes in species composition and species richness of alpine grasslands in the Biosphere Reserve and National Park of Berchtesgaden. Proceedings L'Aquila Workshop Glochamore (Global Change in Mountain Regions). In Preparation by UNESCO/MaB.

LOTZ, A. (2005): Alpine Habitat diversity – HABITALP – Towards an integrated spatial development in the Alpine Space. Present Paper.

SCHÖNTHALER, K., MEYER, U., POKORNY, D., REICHENBACH, M., SCHULLER, D. & W. WINDHORST (2003): Ökosystemare Umweltbeobachtung. Vom Konzept zur Umsetzung. Bayerisches Landesamt für Landesentwicklung und Umweltfragen, Umweltbundesamt Berlin (Hrsg.). Erich-Schmidt-Verlag.

STMLU (Bayerisches Staatsministerium für Landesentwicklung und Umweltfragen) (Hrsg.) (2001): Nationalparkplan Berchtesgaden. ISSN 0172-0023.

Contact

Dipl. Biol. Helmut Franz
h.franz@nationalpark-berchtesgaden.de
Sachgebietsleiter Forschungskoordination und Informationssysteme

Nationalpark Berchtesgaden
Doktorberg 6
D 83471 Berchtesgaden
Germany

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 61-64

Alpine Streams – Natural Ecosystems as Indicators of Environmental Change

Leopold Füreder

Abstract

Streams are common features of alpine landscapes, and the attention given alpine streams has increased recently in response to increased recognition of the important role that these headwater streams play in major river systems throughout the world, and the vulnerability of these streams to local and regional environmental change (e.g., associated with changes in adjacent land use, acid and nutrient deposition, global climate patterns). Current climate change scenarios indicate proportionally more detectable impacts at both high altitude and latitudes. In recent investigations we have been focusing on the large variety of natural freshwater ecosystems in the Hohe Tauern Nationalpark, as their importance is often recognised in their dominating appearance in the alpine landscape, their re-creating and formative, sometimes threatening natural dynamics, but also in their progressive decline within the Alpine countries. Since lakes and rivers are highly driven by climatic, catchment and thereof dependent internal processes they are considered to be sensitive ecological systems and may serve as models to examine the consequences of environmental changes. Our results from various investigations in high mountain landscapes help to understand how alpine running water systems and their biota can be regarded as catchment-scale integrative monitors for a set of hydrological, thermal and biotic variables. In that sense, Alpine running waters can be regarded as research foci in the context of environmental change. These investigations in larger protected areas provide essential contributions for a forward-looking environmental research.

Keywords

River typology, habitat assessments, glaciation, global climate change, aquatic invertebrates

Project aims and duration

Running waters are inherently important components of alpine landscapes because they are vital water and nutrient conduits that connect high elevation snowfields, glaciers, and alpine meadows to natural and human resources at lower elevations. Awareness of the environmental value of headwaters, as ultimate resource of unpolluted waters for the future, has grown among the scientific community, land/water managers, administrators and the public. Notwithstanding this interest, few studies have focused on the ecology of mountain running waters. However, recently, greater attention has been given alpine streams in response to increased recognition of the important role that these headwater streams play in major river systems throughout the world (e.g., BRITTAIN and MILNER 2001). In the last decade awareness of the environmental value of Alpine headwaters has grown, as testified by various international activities, like recent international congresses and scientific programs. Interest has also grown among the general public as a consequence of a more widespread knowledge of environmental problems caused by human activities, both at the local (hydropower, tourism, artificial snow, etc.) and global scales (climate change, acid rain effects, etc.). These changes are known to impact even the most remote areas, at high latitude and elevation, in ecosystems that are particularly vulnerable to organic pollution, tourism, acid rain and global warming.

In this presentation I want to summarize the results of several research projects carried out within the last decade in the Central Alps. The major aims of these investigations were to

- provide an inventory of Alpine running waters in selected mountain areas,
- identify the habitat conditions at reach as well as catchment scale in a representative selection of Alpine running waters within these areas,
- identify major abiotic and biotic factors important for the structure and function of running water ecosystems, and
- identify the indicator role and quality of alpine running water systems and their biota for climate and environmental change issues so that they can be regarded as catchment-scale integrative monitors for a set of hydrological, thermal and biotic variables expected to change.

Contribution received at: 17.08.2005

Area of study

The investigations presented and summarised herein were carried out in the Nationalpark Hohe Tauern (Austria), the Naturpark Rieserferner-Ahrn (Italy) and in various running waters in the Inner Oetz Valley around Obergurgl (Austria).

Methods

Detailed descriptions of research methods were provided in several publications (Füreder et al. 2000, Füreder et al. 2001, Füreder et al. 2002, Füreder et al. 2003), and used for further analysis for answering the above mentioned questions.

Results

With the inventory of 344 streams and rivers (1159 km) and the habitat assessments of 354 reaches (from 33 streams and rivers comprising 187 km) in randomly selected running waters in protected areas in Austria (Hohe Tauern National Park) and Italy (Naturpark Rieserferner-Ahrn) (FÜREDER & AMPROSI 2001, FÜREDER & VACHA 2001, FÜREDER et al. 2001,), a comprehensive characterization of alpine streams and a database is available which resulted in a typology of Alpine running waters (FÜREDER et al. 2002). The defined stream types are based on the origin, hierarchy and channel/catchment morphology, together with the detailed characterization from habitat measures, and provide important information for the definition of reference conditions for impact measures and for the evaluation of the ecological status of alpine streams. The principal components of the abiotic milieu of river ecosystems – hydrology, temperature and channel morphology – reflected regional-scale climate and geology.

When we looked into the structure and function of Alpine running water ecosystems, four main factors were found to be responsible for species numbers, abundances and diversity (Fig. 1): time since glaciation, temperature, channel stability and nutrient / food availability. Results from several investigations indicated that these factors had a pronounced effect on ecological conditions in these systems.

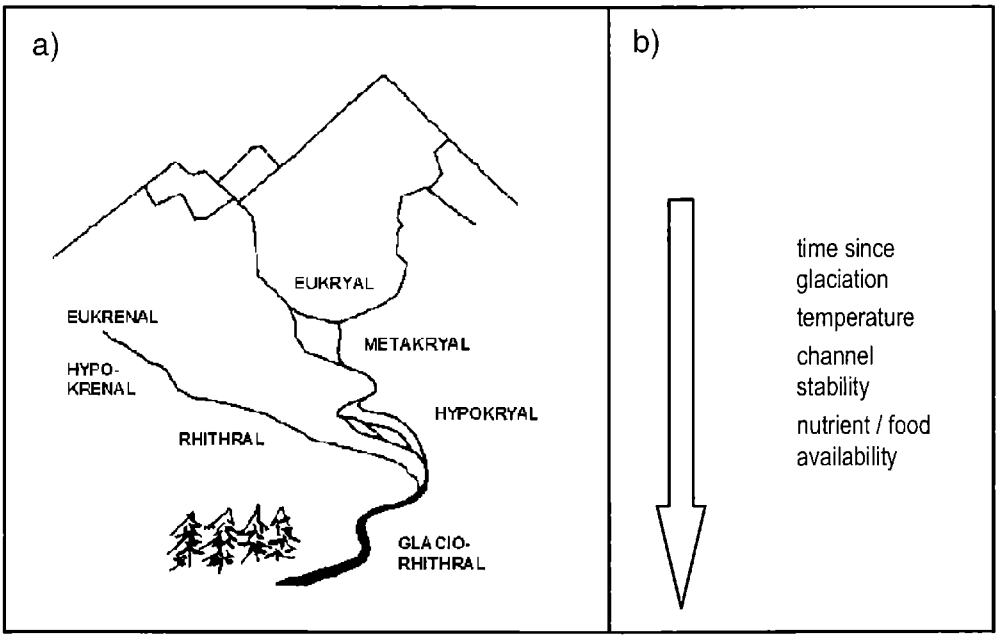


Fig. 1: a) Alpine stream types and b) factors responsible for the structure and function of running water ecosystems.

Alpine streams were found to be extreme environments and to be located on the declining limb of a harshness-diversity curve (Fig. 2). Decreasing environmental harshness (e.g., due increasing groundwater influence, decreasing glaciation) favours overall biodiversity, which also is expected to occur as a potential effect of climate change. After considerable alterations of flow patterns as well as temperature and channel dynamics, the relative contribution of channel types providing numerous refugia for the aquatic fauna will increase with the continued glacial retreat. The occurring flora and fauna will indicate a less harsh environment.

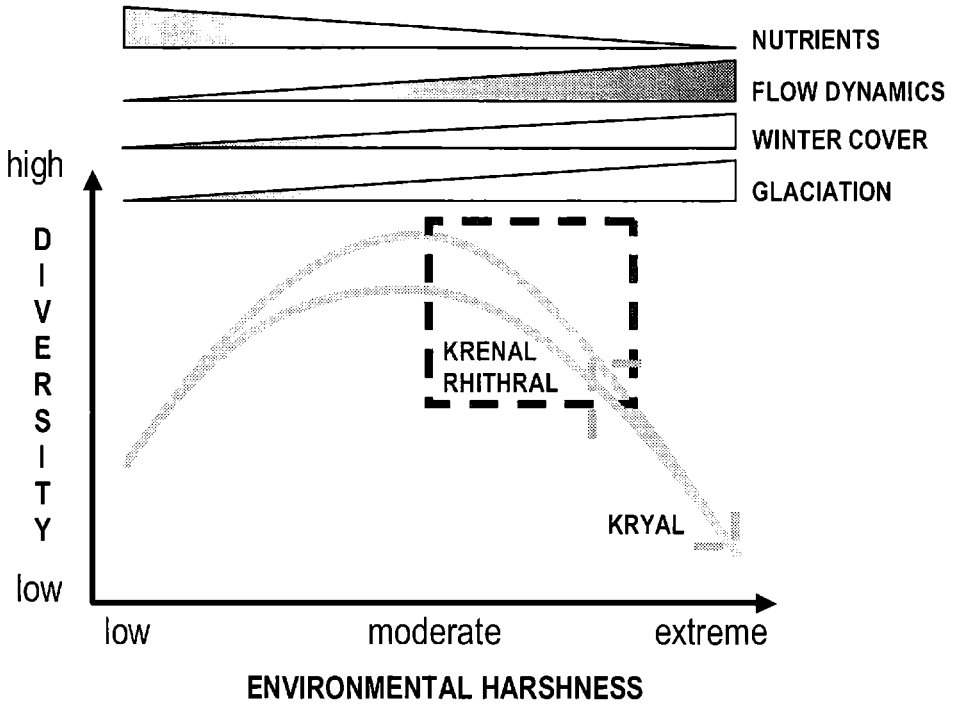


Fig. 2: Scenario of climate change effects on the abiotic factors and consequently on structure and function of aquatic biocenosis (here as diversity) in alpine streams. Alpine streams are situated along the right slope of the curve, where environmental harshness is moderate to extreme, depending on the glacial influence. In glacial streams (KRYAL) the environmental factors, like flow dynamics, temperature, nutrients, are most extreme and therefore only few but highly adapted species can be found. In spring-fed streams (KRENAL) and in snowmelt and rainfall induced systems (RHITHRAL) because of moderate environmental conditions the existence of many species is possible. Only when the environmental harshness is low, freshwaters can get very productive, single species are promoted resulting in lower species numbers but usually with high abundances. Climate change effects would alter the situation: glacial retreat would reduce the glaciation of the catchment, diurnal and annual dynamics of flow would decline. The duration of snow cover is expected to be reduced. As a consequence, the production both in the stream and in the catchment, respectively would increase and consequently favour nutrient and food availability for the aquatic fauna.

Results of our investigations demonstrate how alpine running water systems and their biota can be regarded as catchment-scale integrative monitors for a set of hydrological, thermal and biotic variables variables that might be modified by climate change. Since current climate change scenarios indicate proportionally more detectable impacts at both high altitude and latitudes, alpine running waters can be regarded as research foci in the context of climate change and their communities considered to be as much under change as other biological communities.

Discussion

The herein presented research covers a wide spectrum of themes in stream ecology, ranging from general ecological questions as structural and functional aspects in running water systems (habitat-biota-relationships, food availability and food web structure) to more specific topics, like river typology and the definition of reference conditions. These results provided a substantial basis to approach accurate subjects in ecology, like structure and function of ecosystems, biodiversity, climate change effects and environmental impacts.

Alpine stream ecosystems have been proposed as sensitive indicators of climate change and anthropogenic impacts (McGregor et al. 1995). Albeit scattered information existed from European limnologists early in the last century, only few holistic ecological studies have been carried out on alpine streams. Recently, greater attention has been given alpine streams in response to increased recognition of the important role that these headwater streams play in major river systems throughout the world, and the vulnerability of these streams to local and regional environmental

change (e.g., associated with changes in adjacent land use, acid and nutrient deposition, global climate patterns).

Our accomplished research in alpine streams provides essential knowledge for the assessment of biodiversity in alpine catchments. Besides well known and easily applicable parameters of the aquatic fauna (like taxa number, diversity, abundance) functional relationships (e.g., species traits vs. autochthonous production and/or habitat templates) in alpine stream communities are still poorly understood. Further investigations including field and laboratory experiments should approach these topics. Investigations of the distribution and ecology of Alpine aquatic invertebrates are of major concern when long-term monitoring is planned to elucidate climate change effects and human impacts. Without a profound knowledge in the taxonomy of aquatic invertebrates together with their biological and ecological traits, clear and satisfying results would not be achieved. Continued monitoring efforts would help on building reference collections for comprehensive biological and ecological data of species, the essentials for the quality of indicators of environmental change.

With the existing knowledge gained from our studies in streams and rivers in high altitudes in protected areas in Austria (Hohe Tauern National Park) and Northern Italy (Naturpark Rieserferner-Ahrn) it will be possible to model potential climate change effects and to differentiate anthropogenic effects from climate effects. As introduced herein, future research should encompass both short-term intensive studies and long-term monitoring studies developed within comprehensive experimental arrays of streams and lakes specifically designed to address the issue of anthropogenic versus climatic effects. Especially, in larger protected areas, like the Hohe Tauern Nationalpark, the conditions for these applications can be found, and when research is carried out in correspondence of current national and international research, these topics will meet high scientific value.

References

BRITTAIN, J. E., MILNER, A. E. 2001. Glacier-fed rivers – unique lotic ecosystems. Freshwater Biology 46. Special Issue.

FÜREDER, L. (1999): High Alpine Streams: Cold Habitat for Insect Larvae. – Pages 181 – 196 in MARGESIN, R. & F. SCHINNER (Eds.): Cold Adapted Organisms. Ecology, Physiology, Enzymology and Molecular Biology. – Springer Verlag, Berlin.

FÜREDER L. & K. AMPROSI (2001): Gewässerinventar im Nationalpark Hohe Tauern. – Wiss. Mitt. Nationalpark Hohe Tauern 6: 213-240

FÜREDER L. & C. VACHA (2001): Typisierung alpiner Fliessgewässer (Nationalpark Hohe Tauern). – Wiss. Mitt. Nationalpark Hohe Tauern 6: 191-209.

FÜREDER, L., SCHÜTZ, C., BURGER, R. & M. WALLINGER (2000): Seasonal abundance and community structure of Chironomidae in two contrasting high alpine streams. – Verh.Internat.Verein.Limnol. 27: 1596-1601.

FÜREDER L., BÜHLER S., AMPROSI K., VACHA C. & C.M.E. HANSEN (2001a): Ökomorphologische Zustandskartierung ausgewählter Fliessgewässer im Nationalpark Hohe Tauern. – Wiss. Mitt. Nationalpark Hohe Tauern 6: 169-190.

FÜREDER L., SCHÜTZ C., WALLINGER M. & R. BURGER (2001b): Physico-chemistry and aquatic insects of a glacier-fed and a spring-fed alpine stream. – Freshwater Biology 46: 1673-1690

FÜREDER L., WELTER C. & J.K. JACKSON (2003): Dietary and stable isotope ($\delta^{13}C$, $\delta^{15}N$) analyses in alpine stream insects. – Internat. Rev. Hydrobiologie.

FÜREDER L., VACHA C., AMPROSI K., BÜHLER S., HANSEN C.M.E. & C. MORITZ (2002): Reference conditions of alpine streams: Physical habitat and ecology. – Water, Air & Soil Pollution, Focus 2: 275-294.

MCGREGOR, G., PETTS, G. E., GURNELL, A. M., MILNER, A. M. 1995. Sensitivity of alpine stream ecosystems to claimate change and human impacts. Aquatic Conservation: Marine and Freshwater Ecosystems **5**: 233-247.

Contact

Ao. Univ.-Prof. Mag. Dr. Leopold Füreder
leopold.fuereder@uibk.ac.at

Institut für Zoologie und Limnologie
Leopold-Franzens-Universität Innsbruck
Technikerstr. 25
A 6020 Innsbruck
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 65-67

Remote sensing based monitoring of the Natura 2000 site Niedere Tauern

Heinz Gallaun, Claudia Praschk, Peter Sackl, Mathias Schardt

Abstract

Information on alpine Natura 2000 sites frequently fails to meet decision-makers' requirements, since comprehensive, systematic and comparable data acquired over longer periods of time are available only in exceptional cases. The present project thus focused on developing remote sensing based methods tailored to the mapping and habitat assessment of large-scale alpine protection areas. These methods were implemented in the Natura 2000 site "Niedere Tauern" designated as a SPA according to the EU Birds Directive. The following results are now available:

- Criteria catalogue for comprehensive data coverage
- Colour infrared orthophoto mosaic
- Land cover map at 1:10,000 scale
- Knowledge-based habitat models for 13 bird species listed in Annex I of the EU Birds Directive
- Remote sensing based monitoring system for the assessment of habitat changes
- Natura 2000 decision support system for the Niedere Tauern protection area

The developed methods can easily be adapted for application in other alpine protection areas.

Keywords

Natura 2000, Niedere Tauern, alpine SPA, remote sensing, land-cover classification, monitoring changes, GIS, knowledge-based habitat models

Introduction

The Niedere Tauern range forms part of the Austrian Central Alps and rises between the Enns Valley in the north and the upper Mur Valley in the south. The region is characterised by the close vicinity of natural and cultural landscapes, which evolved in centuries of extensive agricultural and forestry use. The Natura 2000 "Niedere Tauern" region is classified a "Special Protected Area (SPA)" according the EU Birds Directive. The region is home to a total of 16 breeding bird species listed in Annex 1 of the EU Birds Directive (SACKL & ZECHNER, 1995). Large parts of the Niedere Tauern bird protection area are also listed as protection areas in the Fauna, Flora and Habitats (FFH) Directive. Covering an area of 107,000 hectares, the Niedere Tauern region is the largest Natura 2000 protection area in Styria.

The project was commissioned by the Government of the Province of Styria within the EU-cofinanced **IPAM** (**I**ntegrative **P**rotected **A**rea **M**anagement) project. The multidisciplinary work was carried out by Joanneum Research (project management, remote sensing, geo-informatics) in cooperation with Landesmuseum Joanneum (ornithological aspects), the University of Graz (habitat assessment) and the Styrian Government (nature conservation specifications) (GALLAUN et al., 2005).

Criteria Catalogue

As basis for the work, a criteria catalogue with detailed specification of the nomenclature and the data sets to be derived was elaborated by the multidisciplinary project team where those parameters were selected, which

- are required for nature conservation work,
- can be mapped using remote sensing or can be derived from existing information,
- can be generated for the entire Natura 2000 Niedere Tauern area at justifiable expense (total area of 120,000 ha, including border areas).

Contribution received at: 04.08.2005

For the detailed specification of the parameters, a comprehensive literature search of the habitat requirements of 13 Annex I bird species selected for the habitat assessments was performed (PRASCHK, 2004).

Use of remote sensing and geoinformatics for comprehensive data coverage

Flight missions with colour infrared (CIR) film were performed to create a colour infrared orthophoto mosaic. The land cover was classified by means of on-screen visual interpretation. All other parameters were automatically derived from the digital terrain model and the land cover data using geoinformatics methods. The following data sets were generated according to the specifications of the criteria catalogue:

- Colour infrared orthophoto mosaic with a spatial resolution of 0.5 m per pixel
- Land cover map at 1:10,000 scale
- Parameters derived from the digital terrain model
- Structural parameters derived from land cover mapping

The developed cost-effective methods are suitable for comprehensive data coverage and can be readily adapted to other alpine protection areas.

Landscape-level habitat suitability models

According the requirements of the nature protection department of the Styrian Government, landscape-level habitat suitability models were developed for the following 13 species listed in Annex I of the EU Birds Directive:

- Dotterel
- Rock Partridge
- Ptarmigan
- Bluethroat
- Golden Eagle
- Black Grouse
- Capercaillie
- Tengmalm's Owl
- Pygmy Owl
- Three-toed Woodpecker
- Grey-headed Woodpecker
- Black Woodpecker
- Hazel Grouse

The habitat models were defined on the basis of literature searches and the expert ratings of the ornithologists involved in the project. Habitat suitability for all parameters was coded separately for the 13 bird species in matrix form. As opposed to case-based habitat models, which require comprehensive empirical observation data, the developed rule-based habitat models use empirical observation data only for the verification of the assessment results.

Habitat Monitoring

In order to monitor the implementation of the EU-birds and FFH directives, the member states are required to submit reports to the EU Commission at six year intervals. In view of these requirements, methods were developed to detect changes in land cover and to assess the resulting changes in habitat suitability. For detecting severe changes, which cause a significant change in reflection properties, semi-automatic classification of satellite imagery is applied. The implementation is much more cost-effective than the initial land cover mapping, since the existing land cover data are used as a basis and only the changes are classified. Areas affected by long term succession processes at the alpine tree-line which lead to only small changes in reflectance within the 6 year reporting period are not assessed by this change detection approach, but are mapped by visual interpretation. The effects of the land cover changes are then assessed through repeated application of the habitat models and comparison of the assessment results.

The developed methodologies thus allow to assess the presence of the habitat structures required, the location, size and distribution of potentially suitable habitats, and the temporal and spatial changes in habitat suitability for 13 annex I bird species. The methods do not, however, provide information about the population dynamics.

Niedere Tauern Decision Support System

To allow efficient use of the comprehensive project results, a decision support system was implemented, which is based on the ArcMap and ArcReader software. The main functionalities of the system include on-screen visualisation, generation of cartographic output and database queries. All project results are integrated in this GIS based decision support system and can be directly linked with further data of the Styrian Government in order to support the management of the Natura 2000 Niedere Tauern protection area.

References

GALLAUN H., SACKL, P., PRASCHK, C., WACK, R., SCHARDT, M., TURK R. (2005): IPAM-Toolbox. Großflächige Inventur eines Alpinen Natura 2000 Gebietes mittels Fernerkundung in den Niederen Tauern / Steiermark. Hrsg. vom Amt der Kärntner Landesregierung, Klagenfurt. ISBN 3-9502026-4-1, 32pp.

PRASCHK C. (2004): Erstellung eines Habitatmerkmalskatalogs für 13 Vogelarten des Anhang I der EU-Vogelschutzrichtlinie. Diplomarbeit – Inst. für Zoologie der Universität Graz, 95pp.

SACKL, P. & ZECHNER, L. (1995): „Niedere Tauern" in Dvorak, M. & Karner, E. (1995): „Important Bird Areas in Österreich" – Umweltbundesamt Monogr. 71, Wien: 367-373.

Contact

Dipl.-Ing. Heinz Gallaun
heinz.gallaun@joanneum.at

Joanneum Research
Institut für Digitale Bildverarbeitung
Wastiangasse 6
A 8010 Graz
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** | pages 69-71
September 15th to 17th, 2005, Castle of Kaprun

Research becomes public: The use case of WebPark

Ruedi Haller, Christophe Rhin

Abstract

Thanks the EU research project „WebPark Geographically relevant information for users in protected areas", the Swiss National Park (SNP) has established a mobile digital visitor information system called WebPark^{2005}. The system was developed as prototype and could be a model for protected areas. The overall aim of the system is to provide visitors in protected areas with location based information. A common personal digital assistant (PDA) with an integrated GPS is used.

The current version of WebPark^{2005} integrates the following applications: A topographic map and a profile of the selected trail allow the cartographic overview. On request, a "search around" tool lists the available information around the current position. This tool integrates thematic map information (e.g. distribution of mountain ungulates) as well as general information (e.g. general description of the selected animal). A interactive tool allows the visitor to store and send their own observations to a server in the National Park house. If wanted, the observation can be submitted to other online users of the system. This tool is used for survey purposes by the administration staff as well. Moreover, a virtual natural trail on wildfire and a classification key for butterflies has been integrated.

The integration of existing GIS data and information was an explicit task of the project. The huge knowledge from research could be offered to the guests, obviously filtered and redesigned.

WebPark was a successful project, not only due to the completion of a number of technical tasks. As important as the technical work was the work on additional components like the accurate definition of user needs and the continuously collaboration with the staff of the protected areas. The combination of nature and high technology was on interest for media. Due to the overall positive feedback it was possible to find sponsors for the next years to maintain the system in the SNP without project support. Further development shall integrate tourism relevant information too.

The project WebPark

The EU research project "WebPark Geographically relevant information for users in protected areas" has been started in autumn 2001 with the aim to demonstrate the possibilities of a Location Based Service (LBS) for leisure and professional users in recreational and protected areas. Therefore, visitors of natural areas and parks should be provided with information about their surroundings using smart phones or personal digital assistants (PDA) and GPS. The objectives were divided in two main directions: (1) Developing a prototype for the test sites and (2) investigating intensively the user needs and reactions. Moreover, the potential of the service should be tested under the premise of policies on conservation and safety in recreational areas.

The project consortium was composed of six partners from five European countries: Geodan Mobile Solutions (NL), European Aeronautic Defence and Space Company EADS (F), the City University London (UK), the Geographical Institute of the University of Zurich (CH), Laboratório Nacional de Engenharia Civil (P) and the SNP as the main test site. The other test site was established on the island of Texel (NL).

User needs and information strategies of protected areas

The visitors of protected areas were identified as the end users of the LBS. Therefore, the main questionnaire was distributed within the subscribers of the journal of the SNP and on the park's website. It has to be pointed out that most of the visitors could only react from the basis of their imagination what an LBS could serve for, as the service not yet had been established in the first year and LBS at that time was not commonly used.

In situ monitoring showed in the SNP, that 95% of all visitor groups carry a mobile phone at least for safety purposes. Out of 1000 responses of the questionnaire of the journal subscribers, 23% wanted to use such a digital mobile service, 24% would like to use it for safety reasons and 37% refused the use of a PDA in the SNP. 10% could not imagine, how the service would work (KRUG,

Contribution received at: 21.07.2005

ABDERHALDEN et al. 2003). The possible contents were also evaluated: Safety information was rated with the highest priority, followed by possible locations for the observation of wild animals in the SNP, topographic and thematic maps with the current position of the visitor and location based information. A possible virtual natural trail was not highly prioritised (see Table 1).

n=1000	% very important	% important	% less important	% not necessary	
Safety information	*51,2*	*26,7*	*8,9*	*4*	
Locations of particular animal species	*36,1*	*37,3*	*7,3*	*8,6*	
Information for orientation purposes	*20,5*	*37,4*	*12,8*	*17,2*	
Current information about vegetation	*20,1*	*45,3*	*13,2*	*8,7*	
Thematic maps (e.g. geology, vegetation)	*15,4*	*45,4*	*16,3*	*10,4*	
Information about current research projects	*8,7*	*40*	*26,5*	*11,9*	
Route information	*15*	*37,3*	*18,6*	*18,2*	
Nearest possibility of personal information	*12*	*34,6*	*26,1*	*14,8*	
Virtual trail guided by a PDA	*2,5*	*19,8*	*28*	*35,4*	

Tab. 1: Possible contents of a Location Based Service in the Swiss National Park and the weighting by visitors.

The needs on information technology from protected area management were collected with online interviews among an expert panel composed by sixty-seven park administrators of distinct protected areas in Europe. The goal was to collect their assessment of the challenges related to the (over)exploitation of the park resources, and the introduction of targeted information provision tool for park sustainability. 22.4% of the information management in protected area (n = 67) have defined the importance of information as "fundamental", 70.1 % still as "very important". No single park is defining the importance as "neutral" or "not important". Different techniques are used to make information available outdoor, mostly guided tours (88.1%) and info boards (94.0%). Although 89.6 % of the areas are maintaining a website, only 17.9% are planning to provide visitors with digital information outdoor in a long term perspective (DIAS, BEINAT et al. 2004).

Functionalities

Based on the questionnaire and first tests in the SNP in 2002 the following core functionalities were developed:

1. A mapping tool provides the user real time with their position on different topographic maps and on the profile of the trail. Moreover, the current coordinates can be listed.
2. Features of Interest (FOI) were integrated and mapped on request. Additionally, more general content (e.g. species descriptions) can be integrated as texts, images, films or audio files. The content of the FOIs in the SNP application is mostly based on existing content from the GIS or information department. In the SNP, a virtual trail on wildfire was developed for 2005, based on research activities and results.
3. All current observations and information outdoor can be forwarded to other users of the system with geographical bookmarks. A specific approach is the development of a butterfly application, which allows the user to identify occurring butterflies with a classification key. The observation can be stored and transmitted online to a server in the national park house.

All the tools had to be developed with the limited resources of a PDA like power availability, processor speed and screen size as well with a limited availability of the mobile network. Therefore, the involved institutes focused on these scopes. The user interface is based on the functionalities of the Internet Explorer and was improved with many hints of test persons (see Fig.).

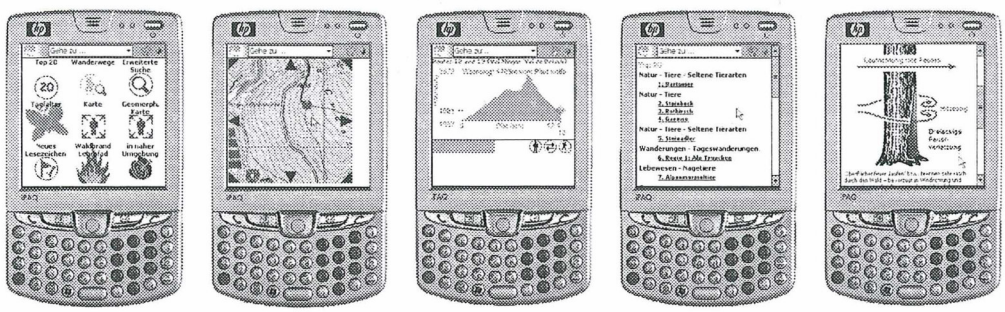


Fig. 1: (1) User interface of Webpark: With 9 symbols the user will be guided to the most important applications.The map (2) and the route profile (3) with the current position. The top 20, the interactive list with the most important key words for the SNP (4). Some explanations on effects of wildfire (5).

The acceptance of the project

The project was launched as a technical research project. Including a protected area as a partner in the consortium illustrates the awareness of the complexity (not only for technical but also for social reasons) to build a bridge between natural environment and high technical tools. The project had the aim to adapt visitors and park managers reactions. The initiating phase showed mainly sceptical or denying attitude. Like many of the visitors managers thought that there is a mismatching of mobile devices in protected areas. Further, they explained that the conservation policies concerning information, communication and geographically based education could be achieved with other solutions. Nevertheless, the acceptance of the new service has grown. In autumn 2004, the SNP has decided to continue the service at least the next three years. A set of strong arguments helped to change the attitude:

The possible impacts of this new instrument could come along with the reduction of other impacts. For example, the number of information boards can be reduced and therefore the impact reduced by using the new technology. This argument is the strongest one in relation to the conservation strategy.

The tests in 2004 showed clearly, that younger people – a target group in the information strategy of a protected area - prefers the use of such a device compared with traditional media.

The protected areas have a strong economic value. They have to follow economic principles of expansion and investment. More and more, the visitors satisfaction will be an important value of the existence of a protected area. The visitors of protected areas will receive additional information, which is not available in not protected, managed and investigated areas.

An interactive process has been started, integrating the knowledge of visitors in the survey processes.

There is an added value of monitoring data and GIS data layers, if they are also used for information purposes.

Conclusion and outlook

The conclusions for the project WebPark might be distinguished into two parts:

1. Does a service as presented could help to spread research results and the need for research in protected areas?
2. Did the WebPark research project became accepted as a substantial research work?

For (1) the answer is not yet fully deployed: Visitors appreciate the possibility to be informed about research results. And WebPark offers a media, which is highly predestined to present these results of research, because different types of information can be integrated and the visitors interest is higher out in the area than elsewhere. Nevertheless, unfiltered and redesigned results can not be integrated. Therefore, other types of media could also be used to provide the public with information. Moreover, no media is the unique one for all visitor types in protected areas.

For (2), the public acceptance of the project idea and its results was the key for the success of the use case WebPark. The decision of the quality and success might differ from different perspectives. Although it might not be a "typical" research project for a protected area, the project has shown that different opinion leaders might influence the overall success. A key to success was the high presence of the press in the last months of the project. The combination of high technology and natural environment was highly appreciated by the media s.o.. Several journalists have reported on WebPark. The overall opinion was very positive. This has been accepted by official bodies after the acceptance through the public.

The further success of WebPark[2005] will also depend on the possibilities to integrate more general tourism information. A close collaboration of tourism and SNP managers will be necessary to provide the tourist with all information needed for his stay and mobility in the area.

Acknowledgements

The authors would like to thank the support of the WebPark team (www.webparkservices.info). The European Commission for supporting the WebPark research (Project Number IST-2000-31041).

References

DIAS, E., E. BEINAT, et al. (2004). Location Aware ICT in Addressing Protected Areas' Goals. EU-LAT Workshop on e-Environment, Santo Tomás de Sant domingo de Heredia, Costa Rica.

KRUG, K., W. ABDERHALDEN, et al. (2003). User needs for Location Based Services in protected areas – case study Swiss National Park. International Conference on Information Technology and Travel & Tourism – IFITT's Global Travel & Tourism Technology and eBusiness Forum, Helsinki, International federation for information technology and travel & tourism.

Contact

Dipl. Geogr. Ruedi Haller
rhaller@nationalpark.ch

Schweizerischer Nationalpark
CH 7530 Zernez
Switzerland

Christophe Rhin
christophe.rhin@camineo.com

Camineo SAS
10 avenue de l´europe - Parc technologique du canal
F 31520 Ramonville Saint-Agne
France

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 73-74

Long-term ecological research in protected areas: the example of Alpine ibex in the Gran Paradiso National Park

Achaz von Hardenberg, Bruno Bassano

Abstract

As an example of a successful Long Term Ecological Research (LTER) in a protected alpine area, here we present the main results of the long term researches on Alpine ibex (Capra ibex) in the Gran Paradiso National Park (GPNP). More than 45 years of regular censuses permitted to test the relative importance of density-dependence and climatic factors on ibex population dynamics. Using an out-of-sample prediction test it was possible to assess the long-term predictive power of a simple model incorporating snow depth and population density. The long-term systematic collection of ibex skulls, found dead for winter starvation, permitted the discovery that horn growth is a good predictor of the onset of senescence in males. The repeated measurement of body weights of individually tagged ibex, using a remotely controlled platform scale, and the regular monitoring of fecal egg counts of nematode parasites over many years, are providing new insight on the-individual variability in these life-history traits. The ongoing LTERs on Alpine ibex in the GPNP are providing essential information on the factors influencing the population dynamics and life history of this species.

Keywords

Long term research, LTER, Alpine ibex, Gran Paradiso National Park, Population dynamics, survival, senescence

Project aims and duration

Long term data on population dynamics and life history of large herbivores are essential for their conservation and management. Alpine ibex (*Capra ibex*) is the flagship species of the Gran Paradiso National Park where it has been the subject of ongoing long term ecological researches (LTER) with the aim of understanding the main factors regulation the population dynamics and the life history of this species. Regular censuses have been conducted in the GPNP since 1956. We examined ibex skulls collected between 1988 and 1997. The ongoing Alpine ibex life history research project started in 2000.

Area of study

The GPNP was established in 1922 in northwestern Italy (45° 25'N, 7° 34'E), in part to protect the only surviving population of Alpine ibex. The park is bounded on the west by the Parc National de la Vanoise in France. The GPNP is composed entirely of mountainous terrain and is sparsely populated by humans. Alpine pastures, moraines, cliffs, glaciers and rock account for 59% of its 720 km^2 area. Ibex use elevations ranging from about 800m above sea level to beyond the upper limit of vegetation at about 3200 m. Long term data on the life history of individual ibex are being collected on free-ranging individually tagged alpine ibex males (N = 83), in the study area of Levionaz, Valsavaranche (GPNP). Most of the Levionaz study area lies above the tree line, above 2300 m a.s.l.

Methods

A total count of alpine ibex is conducted in the GPNP each year at the beginning of September, along trails and from fixed locations within each surveillance area. Ibex skulls of animals found dead for winter starvation, are systematically collected and conserved in the GPNP. The exact age at death in years was determined by counting the clearly separated growth annuli. The length of each annulus was measured for both horns, along a central line on the back of the horn. Alpine ibex males aged 3-16 years were life-captured with a dart-gun in the study area of Levionaz (GPNP). The captured individuals were marked uniquely with different combinations of coloured ear-tags or with differently coloured radio-collars. Individual males in Levionaz were repeatedly weighed from June to September each year with an electronic platform scale baited with salt

Contribution received at: 08.08.2005

(BASSANO et al. 2003). Faecal egg counts of nematode parasites (FEC) were estimated twice a month from all individually tagged males in Levionaz in 2000-2004. Survival of each individually tagged ibex is monitored every year.

Results

More than 45 years of regular censuses permitted to test the relative importance of density-dependence and climatic factors on ibex population dynamics. Yearly changes in total population were correlated with seasonal average snow depth and population density over the 39 years for which climate data were available. Our results show that the ibex population size was limited by both density dependence and deep snow. A model based on these factors fit to the first 19 years of data was used to forecast subsequent changes in total population based on initial population size and yearly snow depth. The model was able to predict the increase and subsequent decline in total population size over the final 20 years of the study (JACOBSON et al. 2004).The long-term systematic collection of ibex skulls, found dead for winter starvation, permitted to test the hypothesis if the size of horn annuli predicted annual survival probabilities in males. Between 5 and 11 years of age, individuals that grew shorter annuli than the population average had a greater probability of mortality over the following years than males with greater rates of horn growth. Annulus size, reflecting the onset of senescence, appeared to be a good indicator of individual quality in Alpine ibex males (VON HARDENBERG et al. 2004). The long term Alpine ibex life-history research project conducted in Levionaz showed that between-individual variability in FEC was higher than within-individual variability in all five years of study suggesting individual differences in parasite resistance, possibly of genetic origin. Body mass increased with age peaking at 12 years, suggesting late maturity in this population. The number of nematode eggs in faeces also increased with ibex age but appeared to peak after 12 year of age. Reduced parasite resistance may be a cost of reproduction for older males or a sign of senescence (VON HARDENBERG, 2005).

Discussion

Many ecological processes can only be fully understood if studied over long temporal scales. Also ecological changes, crucial for conservation, can only be detected with adeguate long term monitoring. Despite their importance, however, long-term ecological researches (LTER) are not common because they require the long-term commitment of human and financial resources. The lack if immediate short-term benefits of LTER may have further discouraged their implementation.

The LTERs and monitoring prjects on Alpine ibex in the GPNP are providing essential information on the factors influencing the population dynamics and life history of this species. We believe that this knowledge will be useful for ibex conservation and management beyond the borders of the GPNP. Protected areas in the Alps offer great opportunities for LTER. National and natural parks typically can rely on the long-term work of qualified park wardens. Furthermore parks generally have a tradition in the long-term monitoring of species and habitats.

References

BASSANO, B., VON HARDENBERG, A., PELLETIER, F., GOBBI, G., (2003). A method to weigh free-ranging ungulates without handling. Wildl. Soc. Bull. 31, 1205-1209.

JACOBSON, A.R., PROVENZALE, A., VON HARDENBERG, A., BASSANO, B. and FESTA-BIANCHET, M., (2004). Climate forcing and density dependence in a mountain ungulate population. Ecology 85, 1598-1610.

VON HARDENBERG A., BASSANO B., ZUMEL ARRANZ M.d.P., BOGLIANI G. (2004) Horn growth but not asymmetry heralds the onset of senescence in male Alpine ibex. Journal of Zoology, 263, 425-432

VON HARDENBERG A. (2005) Sénescence, sélection sexuelle et dynamique de population du bouquetin des Alpes (*Capra ibex*). Ph.D. Thesis, Université de Sherbrooke, pp.205.

Contact

Dr. Achaz von Hardenberg
fauna@pngp.it

Dr. Bruno Bassano
scientifico@pngp.it

Alpine Wildlife Research Centre
Gran Paradiso National Park
Via della Rocca 47
I 10123 Torino
Italy

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** | pages 75-78
September 15th to 17th, 2005, Castle of Kaprun

Toward a Guiding Principle "Recreational Use" The Protected Area Berchtesgaden National Park within the Region

Sabine Hennig [1], Michaela Künzl [2]

(1) Institut für Geographie FAU Erlangen-Nürnberg, (2) Nationalpark Berchtesgaden

Abstract

Nature conservation and recreation are two purposes of protected areas. The relationship is complex and sometimes adversarial. To avoid and minimize conflicts visitor guidance is relevant. According concepts must be based upon general conditions of e.g. natural landscape, cultural history, social-economy and human needs. Understanding of recreation is also relevant. Another aspect to consider, national parks can give drive to, is regional development. However, management objectives shall not only lead to singular visitor management concepts. Important is one guiding principle as a concrete picture of the desired future state. To concretise a guiding principle data and information about recreation e.g. infrastructure and visitors is essential. The acquisition needs support of institutions located in the surroundings of the protected area. In this context the importance of recreation within the region can lead to development and expansion of a culture of collaboration. An exemplary project is worked out for Berchtesgaden National Park. Although the park plan adopts guidelines focusing on recreation it includes no guiding principle. To achieve this, listings of recreational infrastructure and use as well as visitor numbers and characteristics must be acquired. As a part of the EuRegio Salzburg Berchtesgadener Land Traunstein the German Berchtesgaden National Park borders the Austrian Bundesland Salzburg. Thus it must be strived for international-regional collaboration.

Background: Changing Times, Demands and Concepts

The link between protected areas and tourism is as old as the history of protected areas: Protected areas need tourism tourism needs protected areas. This relationship is complex by the basic meaning of protected areas. Focusing on the two primary protected area purposes nature conservation and recreation, the last mentioned is a critical component to consider. In the management of protected areas it is a major issue (IUCN 2002, UNEP 2005).

In the last decades society changed towards a recreational society. With the growth of the touristic and recreational sector the demand for nature-related activities increased (IUCN 2002). Today pressure upon nature and landscape arising from recreation are among the most relevant. According changes and developments are also affecting large protected areas: For years they have observe visits by rising numbers (NELSON & SERAFIN 1997). Therefore, the importance of managing resources and visitors is even more a key message (IUCN 2002). To apply adequate measures it needs the guidance by one overall guiding principle. To concretize this vision of the desired future situation, including diverse singular concepts to get there, the understanding of protected area recreation is essential. General conditions and altered circumstances must be investigated. In the broader context of the natural and cultural environment it requires many different kinds of knowledge, interests and values. Toward this it is helpful to first identify and analyse existing linkages between recreation and the protected area in a broader sense. In a second step relevant data and information must be collected.

Recreational Use in Berchtesgaden National Park

For Berchtesgaden National Park (see figure 1) in recreational use is to be seen a major threat. This use is characterized by changes mentioned above. The park plan of this large protected area (STMLU 2002) adopts only guidelines focusing on recreation inside the park area. To incorporate management objectives adequate to changes and demands in recreation, an overall guiding principle should be elaborated. Right now the description of recreational use inside the park region is based on only few information (see park plan: STMLU 2002) and some (estimated) visitor number (e.g. compare JOB, METZLER & VOGT 2003: 1,13 visitors/a). The InterReg IIIa project "Euregional Recreational Area Berchtesgaden National Park / Salzburger Kalkalpen" (duration: 5/2005 - 12/2006) makes needed data and information available.

Contribution received at: 19.07.2005

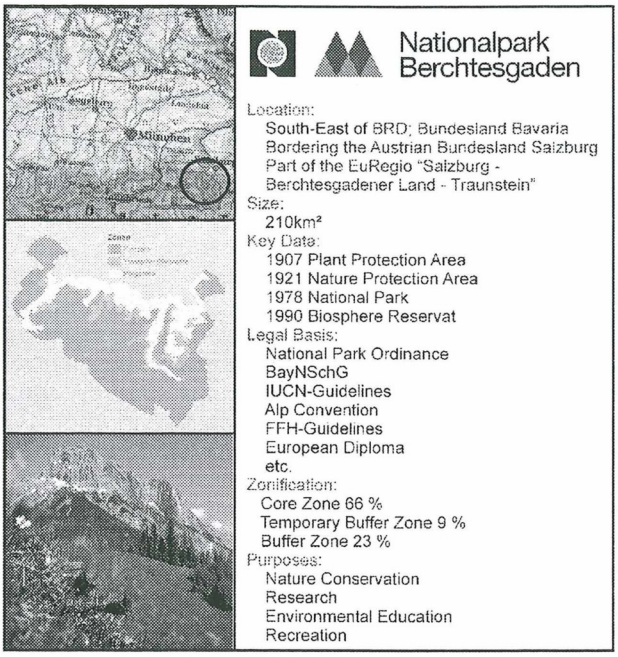


Fig. 1: Overview "Berchtesgaden National Park"

Relationship-Cube "Recreational Use"

As a starting point, must be established a better understanding of the recreational use concerning the park area. To achieve this it is helpful to analyse existing linkages between recreation and

activity (hiking, biking, skiing etc),
spatial areas (protected and surrounding area),
institutions (park administration and other stakeholder).

The different links can be illustrated as a relationship-cube (see figure 2).

Within park management the focus is frequently on the interrelated and overlapping concepts of recreation and nature conservation. It can be observed, that conventional management and planning procedures that focus on activities only within protected area boundaries are insufficient to content with the actual developments. Successes have been achieved by emphasizing linkages among protected areas, the surrounding areas and planning regions (NELSON & SERAFIN 1997). Protected areas are part of their region in ecological, economic, social, educational, infrastructural and other sense. They must be understood, planned, managed and decided upon as an integral part of the regional context in which they find themselves (NELSON & SERAFIN 1997). Existing dynamics must be incorporated in the different processes much more intensively. By communicating and working with a broad range of regional stakeholders much can be done much to ensure that recreation works for the park as well as for the people living in it or nearby (IUCN 2002).

In resume treating recreation for Berchtesgaden National Park the location of the protected area plays an important role: Being part of the EuRegio Salzburg - Berchtesgaden Land - Traunstein the German national park borders mostly the Austrian Bundesland Salzburg. Thus cross-border approaches are relevant: The park area, the German transition zone and the neighbouring Austrian area must be considered.

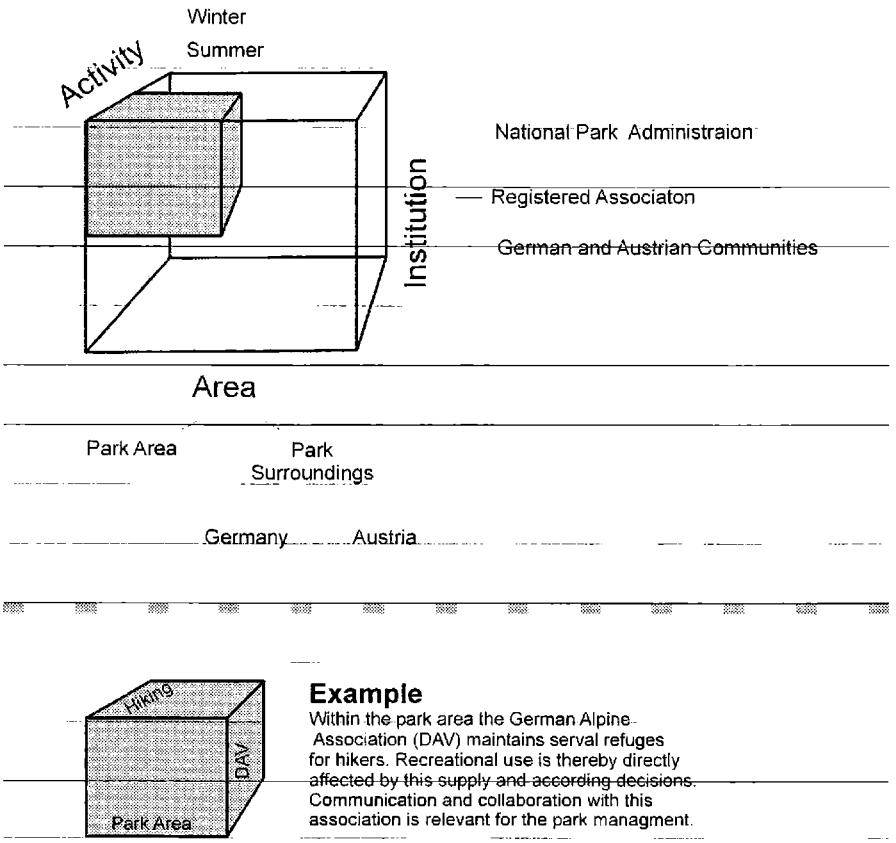


Fig. 2: Relationship-Cube "Recreational Use" for Berchtesgaden National Park

"Recreational Use"-Data

Recreation can be analysed by splitting this abstract object in relevant aspects. This illustrates the "Recreation-Model" in figure 3.

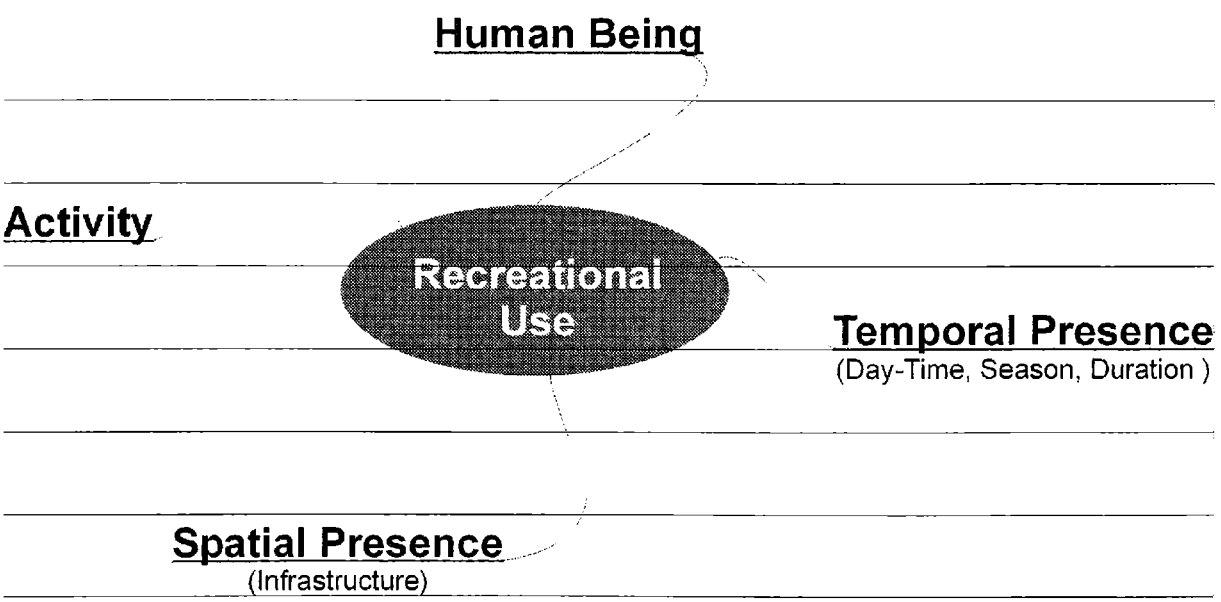


Fig. 3: Recreation-Model

Based on the recreation-model and the relationship-cube, relevant data can be identified and collected. Insight in to the relationship between the data is given by figure 4. All (spatial, temporal, attribute) data concerning stakeholders, recreational infrastructure and visitors is managed by databases. Thereby for all responsible within the region (park and surroundings), data use, analysis and availability is simplified. By the help of diverse software programs (e.g. GIS, Statistical applications, tools for simulation) all data and information can be brought together to give an exhaustive overall picture of recreation usage and utilization within the park area.

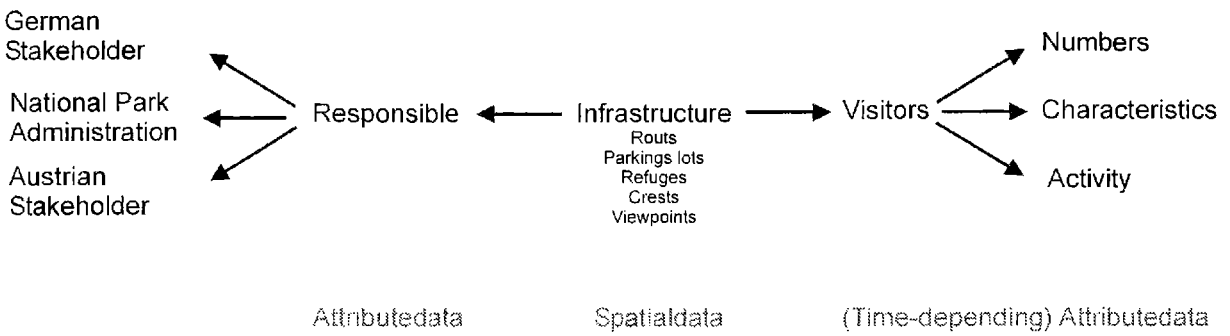


Fig. 4: "Recreational Use"-Data-Sources for Berchtesgaden National Park

Conclusion

Analysing relationships focusing on recreation can help to build up partnerships. All-embracing situation descriptions enable the elaboration of guiding principles for protected areas within its regions. To involve surrounding areas and other stakeholder can be looked upon favourably. This can give drive to a regional culture of collaboration and is definitely a factor for success in protected area management.

References

HENNIG, S. (2005): Monitoring-System „Recreational Use" – Das Beispiel Nationalpark Berchtesgaden. In, Schrenk, M. (Hrsg.): Tagungsband CORP 2005 Geo Multimedia 05, Wien.

IUCN (2002): Sustainable Tourism in Protected Areas. Guidelines for Planning and Management. World Commission on Protected Areas (WCPA). Best Practice Protected Area Guidelines Series No. 8.

JOB, H., METZLER, D. & VOGT, L. (2003): Inwertsetzung alpiner Nationalparke. Eine regionalwirtschaftliche Analyse des Tourismus im Alpenpark Berchtesgaden. Münchner Studien zur Sozial-/ Wirtschaftsgeogr., Bd. 43. Michael Lassleben Kallmünz, Regensburg.

NELSON, J.G. & SERAFIN, R. (1997): Keys of Life. In J.G. Nelson & Serafin, R., National Parks and Protected Areas, Keystones to Conservation and Sustainable Development, NATO ASI Series, Vol. G 40, Springer Verlag.

STMLU (Bayer. Staatsministerium für Landesentwicklung und Umweltfragen) (HRSG.) (2001): Nationalparkplan. http://www.nationalpark-berchtesgaden.de

UNEP (2005): Forging Links between Protected Areas and the Tourism Sector. How Tourism can benefit Conservation.

Contact

Dipl.-Geogr. Dr. Sabine Hennig
shennig@geographie.uni-erlangen.de

Institut für Geographie
FAU Erlangen-Nürnberg
Kochstr. 4/4
D 91054 Erlangen
Germany

Dipl.-Ing. (FH) Michaela Künzl
m.kuenzl@nationalpark-berchtesgaden.de

Nationalparkverwaltung, Sachgebiet Planung
Am Doktorberg 6
D 83471 Berchtesgaden
Germany

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 79-82

Building-dwelling bats in the Nationalpark Hohe Tauern (Carinthia, Salzburg, Tyrol)

Maria Jerabek, Ulrich Hüttmeir, Josef Kreuzberger, Anton Vorauer, Christoph Walder, Guido Reiter

Abstract

We studied the species composition of bats in the higher altitudes of the Nationalpark Hohe Tauern in the Austrian Alps in 1998 (Salzburg), 2002 (Carinthia) and 2003 (Tyrol). 457 buildings at altitudes between 1000 and 2000 m above sea level were surveyed. The following species were found: *Myotis brandtii, Myotis mystacinus, Eptesicus nilssonii, Vespertilio murinus, Pipistrellus pipistrellus/pygmaeus* and *Plecotus auritus/macrobullaris*. Bats were found in 7.6 % of the checked buildings, faeces of bats in 22.2 %. In Carinthia 37 % of the buildings had been used by bats, in Salzburg 32 %, in Tyrol only 12 %. Overall, whiskered bats dominated (*M. mystacinus/brandtii*), followed by *Eptesicus nilssonii*, and some individuals of *Pipistrellus sp.*, *Plecotus sp.* and *Vespertilio murinus. Myotis brandtii* was not recorded in Tyrol, whereas *Vespertilio murinus* was only found in Tyrol. Within a species, individuals were found at higher altitudes in the southern parts than in the northern parts of the national park. As the roosts in the national park predominantly hold single individuals the potential threats for the bats are not as eminent as in the surrounding valleys. The valleys and villages at the edge of the national park, however, are very important for the bats of the region, especially in Salzburg.

Keywords

Bats, altitudinal distribution, species composition, Nationalpark Hohe Tauern, Austria

Background and Project aims

The first systematic summer investigations of bats in the national park took place in Salzburg in 1986. In the 1990-ies the adjacent valleys of the national park region Hohe Tauern have been studied quite thoroughly in Salzburg, Carinthia and Tyrol, but not the higher altitudes of the national park. To investigate possible changes in the bat community of the Salzburg part, the national park valleys where reinvestigated in 1998. In 2002 the Carinthian part of the national park and in 2003 the Tyrolean part of the Hohe Tauern were surveyed.

The aim of the studies was to investigate the species composition of the bat fauna in the three parts of the national park, to assess the numbers of individuals and preferred roost types, and to investigate potential differences between the northern and southern slope of the central alps. Given these results we identify potential threats for the bat community and conservation measures to preserve the bat fauna of the protected area and its surroundings.

Study area

The study took place in the Nationalpark Hohe Tauern, a 1836 km² protected area in Carinthia (420 km²), Salzburg (805 km²) and Tyrol (611 km²), which has been nominated as a Natura 2000 site of the European Union in 1995. The national park extends 100 km in the east-west direction and 40 km in the north-south direction. Altitude ranges from 1.010 m to 3.798 (Großglockner, highest mountain of Austria). The area covered in the present study area comprised most of the important valleys of the national park in Carinthia, Salzburg and Tyrol, concentrating on elevations between 1000 and 2000 m. Most of the investigated area consists of forest in the lower parts and mountain pastures in the higher regions.

Methods

A total of 457 buildings was checked for the presence of bats by searching all potential roosts (all sorts of crevices, attics if possible) for faeces (indirect proof), living or dead animals (direct proof). In Salzburg 183 buildings were investigated in 1998 (13 days, mostly in July), in Carinthia 179 buildings were checked between June and August 2002 (11 days), and in Tyrol 95 buildings were

Contribution received at: 09.08.2005

controlled in July 2003 (2 days). The roost records were divided into roosts of single individuals and maternity roosts (juveniles, lactating females). When possible, living animals were caught for species identification. During the study we did not distinguish between *Pipistrellus pipistrellus* and *Pipistrellus pgymaeus* as well as between *Plecotus auritus* and *Plecotus macrobullaris*. The determination of *Myotis brandtii* and *Myotis mystacinus* was only possible, when the individual was caught, all the others are referred to as *Myotis mystacinus/brandtii*. Species identification from faeces was not attempted. Instead faeces were classified as coming from either small or medium-sized to large species (*Chiroptera indet*). In addition to the survey of the buildings some mist nettings took place.

Results

The vertical distribution of the checked buildings differed significantly between the three parts of the national park ($p < 0.0001$), with Salzburg reaching a mean altitude of 1426 m (ranging from 1030–1750 m), Carinthia 1612 m (1185-2030 m), and Tyrol 1753 m (1450-1975 m). We found no signs of bats in 70.2 % of the 457 buildings. Faeces only were found in 22.2 % and 7.6 % of the buildings held alive or dead individuals (Figure 1). These figures were highest for Carinthia, where in 37 % of the buildings signs of bats were detected. In Salzburg 32 % of the checks yielded bat records and in Tyrol only 12 %. The number of buildings with indirect or direct proofs of bat presence decreased with increasing altitudes (Figure 2). Preferred roost sites were alpine pasture cabins and hunting huts, where bats were using crevices in roofs, windows frames and shutters (HÜTTMEIR et al. 2003).

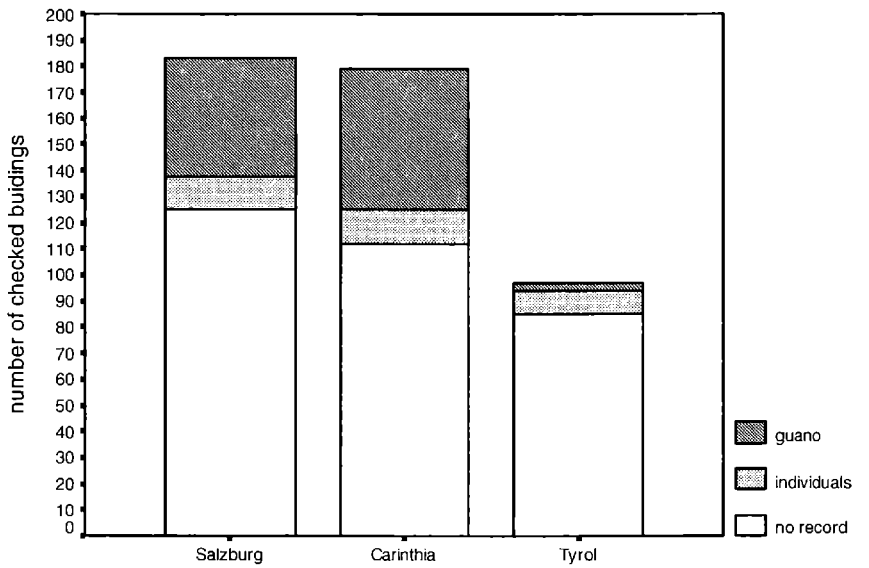


Fig. 1: Number of buildings with direct (individuals), indirect (guano) proof of presence of bats or no records

Six of the 25 Austrian bat species were found to occur in the national park: *Myotis brandtii*, *Myotis mystacinus*, *Eptesicus nilssonii*, *Vespertilio murinus*, *Pipistrellus pipistrellus/pygmaeus* and *Plecotus auritus/macrobullaris*.

A total of 52 roosting animals were determined, with the whiskered bats dominating the community (6 *Myotis mystacinus*, 4 *M. brandtii*, 20 *M. myst/brand*), followed by 13 *Eptesicus nilssonii*, 3 *Pipistrellus pip/pyg.*, 2 *Pipistrellus sp.*, 1 *Plecotus sp.*, 2 *Chiroptera indet* and 1 *Vespertilio murinus*. *Myotis brandtii* was not recorded in Tyrol, whereas *Vespertilio murinus* was only found in Tyrol. While *M. mystacinus* dominated in Salzburg, *M. brandtii* was more abundant in Carinthia, and *E. nilssonii* was observed as most abundant in Tyrol. When including faeces records, *Plecotus* species seem to be more abundant than expected from sightings only. Overall the roosts in the national park predominantly held single individuals. We only found one maternity roost in Carinthia (*Myotis mystacinus*, 1616 m), none in Salzburg and Tyrol.

The mist nettings in the national park yielded the following results: In Carinthia (4 mist netting sessions) 1 *M. brandtii*, 4 *M. mystacinus*, 5 *Eptesicus nilssonii* were caught, as well as 15 *M. brandtii*, 2 *M. mystacinus*, just outside the borders of the national park. In Salzburg 4 mist nettings just outside the national park borders yielded 13 *M. mystacinus*, 1 *E. nilssonii* and 1 *Plecotus sp.* As most of the above mentioned 15 individuals of *M. brandtii* and 13 *M. mystacinus* were lactating, we can assume maternity colonies.

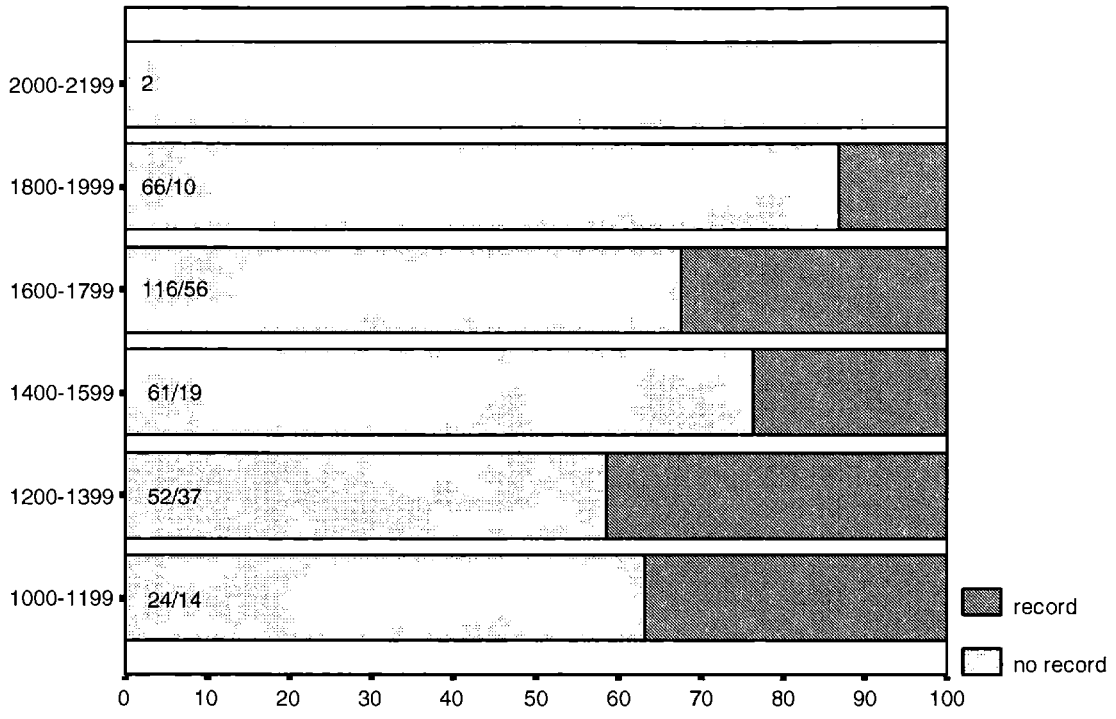


Fig. 2: Percentage of occupied buildings (record) at different altitudes (in metres), number of buildings without record / number of buildings with record

Discussion

The species composition and roost preference found in the three parts of the national park Hohe Tauern is quite similar and seems to be characteristic for subalpine and alpine areas of the alps (HOLZHAIDER & ZAHN 2001). It is – with 6 species - clearly less species-rich than the lower regions, such as the adjacent valleys in the surroundings of the national park (e.g. Salzburg 11 species, JERABEK et al. 2005).

The number of occupied roosts in buildings decreases with increasing altitude and most of the buildings at higher elevations just house single individuals rather than maternity colonies. The maximum recorded altitudes for single species are higher in the southern parts than in the northern part. This is probably due to climatic conditions and the availability of suitable roosts. The northern and southern slope of the central alps face different climatic conditions: at the northern slope the 0°C-July-Isotherm is situated about 100 m lower, precipitation is higher, strong winds and more cold spells are observed more frequently. Therefore the agriculturally used areas and hence buildings are found at higher elevations in the southern parts. This is mirrored in the distribution of bats. We only found one maternity roost inside the borders of the national park during the present study (*Myotis mystacinus*), but some maternity roosts of *Plecotus auritus/macrobullaris*, *Myotis mystacinus* and *Pipistrellus pipistrellus/pygmaeus* in Salzburg are known around 1250 m, whereas in Carinthia they reach 1600 m. However, records of single individuals can reach as high as 2300 m (AUSOBSKY 1970).

As the roosts in the national park predominantly house single individuals the potential threats for the bats are not as eminent as in the surrounding valleys. However, the traditional way of building favours crevices and should be kept up. The use of pesticides (including wood treatment) should be strictly forbidden in the national park. Overall, the conservation of roosts in the villages at the edge of the national park and the adjacent regions is essential for the long-term survival of the bats of the region. This is especially true for Salzburg, with two thirds of all maternity roosts of lesser horseshoe bats occurring in the villages adjacent to the national park. Hence, the public relations work should not stop at the borders of the protected area but help raising awareness for bats to be able to take long-term conservation measures.

References

AUSOBSKY A. (1970): Beobachtungen an der Nordfledermaus, Eptesicus nilssonii (Keys. et Blas., 1839) in den Hohen Tauern. Festschr. Naturw. Arbeitsgemeinsch. Haus der Natur Salzburg. 16-18.

HOLZHAIDER J., ZAHN A. (2001): Bats in the Bavarian Alps: species composition and utilization of higher altitudes in summer. Mamm. Biol. 66: 144-154.

HÜTTMEIR U., REITER G. (1999): Vorkommen und Gefährdung gebäudebewohnender Fledermäuse (Chiroptera: Rhinolophidae, Vespertilionidae) im Salzburger Anteil des Nationalparks Hohe Tauern und in den Nationalparkgemeinden des Pinzgaues. Wissenschaftliche Mitteilungen aus dem Nationalpark Hohe Tauern. Band 5: 161-184.

HÜTTMEIR U., KREUZBERGER J., JERABEK M., REITER G. (2003): Fledermäuse im Nationalpark Hohe Tauern – Kärnten. Unpubl. Endbericht im Auftrag der Nationalparkverwaltung Kärnten. 40 p. + 10 p. appendix.

JERABEK M., HÜTTMEIR U., REITER G. (2005): Die Fledermäuse Salzburgs. Naturschutz-Beiträge 22: 90 pages.

VORAUER A., WALDER C. (2003): Fledermäuse im Nationalpark Hohe Tauern – Tirol. Unpubl. Endbericht im Auftrag der Nationalparkverwaltung Tirol. 18 p. + 3 p. appendix.

Acknowledgements

We like to thank the administrations of the Nationalpark Hohe Tauern in Carinthia, Salzburg and Tyrol (provincial governments) for the financial support of the three investigations. The investigations were carried out with permits acquired from the Provincial Governments of Carinthia, Salzburg and Tyrol.

Contact

Mag. Maria Jerabek
maria.jerabek@fledermausschutz.at
Holzbachweg 2
A 5061 Elsbethen
Austria

Mag. Ulrich Hüttmeir
ulrich.huettmeir@fledermausschutz.at
Georg-Kropp-Straße 16
A 5020 Salzburg
Austria

Mag. Josef Kreuzberger
josef.kreuzberger@pgliefering.at
Unterlangenberg 93
A 5431 Kuchl
Austria

Mag. Anton Vorauer
anton.vorauer@fledermausschutz.at
Karl-Innerebnerstr. 54
A 6020 Innsbruck
Austria

Mag. Christoph Walder
christoph.walder@aon.at
Eschenweg 6
A 6063 Rum
Austria

Mag. Dr. Guido Reiter
guido.reiter@fledermausschutz.at
Bäckerstraße 2a/4
A 4072 Alkoven
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 83-89

The IPAM-Toolbox: An Expert System for Integrative Planning and Managing of Protected Areas

Michael Jungmeier, Hanns Kirchmeir, Martin Kühmaier, Iris Velik, Johann Wagner

Abstract

"Experience is growing by sharing it". The paper presents a newly developed expert system that shall support planners, managers and consulters of Protected Areas (PAs) by a system of self-assessment, focused recommendations and a comprehensive knowledge base. The interactive "toolbox" provides substantial information on integrative management of PAs by means of new information technologies. Developed in cooperation with international partners and organisations this expert system aims to be an important backbone for the future development of PAs in Middle and Eastern Europe.

Background

The protection of areas and sites is one of the most important instruments of modern, anticipating strategies in nature conservation and planning for sustainable rural development. The enormous increase of number and acreage as well as the number of types, respectively categories of sites has been pointed out repeatedly.

Since planning and managing Protected Areas (PAs) hit many different legal administrative and technical realities, the experts in charge have to face an unmanageable variety of tasks.

- Integration of different interests
- Diversity of categories
- Diversity of technical issues
- Diversity of approaches
- International requirement and regional demands
- Permanent lack of resources
- Permanent need of deciding, communicating, marketing, financing and creating benefits

That´s why the demand for highly skilled and highly motivated personalities has steadily increased within the last years. Many of these PAs´ managers and planners see themselves drowning in (ir)relevant information, but moan about a significant lack of knowledge. The IPAM-Toolbox intends to bridge this gap and has been developed in order to provide focused information for the question "what to do, when and how?"

The Toolbox was developed in a large-scale Interreg III B CADSES project, involving partners from Austria, Croatia, Czech Republic, Italy and Slovenia. The toolbox is based on explicit demands by IUCN (International Union for Conservation of Nature and Natural Resources), Man and Biosphere-Program of UNESCO (United Nations Educational, Scientific and Cultural Organisation) and the CBD (Convention on Biological Diversity). The development was prepared by an international inquiry among some 150 PAs in Middle and Eastern Europe and on expert interviews (Europarc, IUCN, Ramsar, MaB, WWF and many practitioners from different PAs).

Being substantially co-financed by European funds the toolbox is free of charge and provides up-to-date information that is based on an internationally accepted concept. It is applicable for all relevant international categories of PAs. The toolbox can be accessed on the IPAM-Homepage (www.ipam.info). Furthermore, a detailed technical documentation (Expert System booklet) and a demo-version are available. The technical solution is composed by a large variety of IT-tools (MySQL, PHP, eZ-publish, performed by a Linux-Server) and is not to be described in this context.

Contribution received at: 19.07.2005

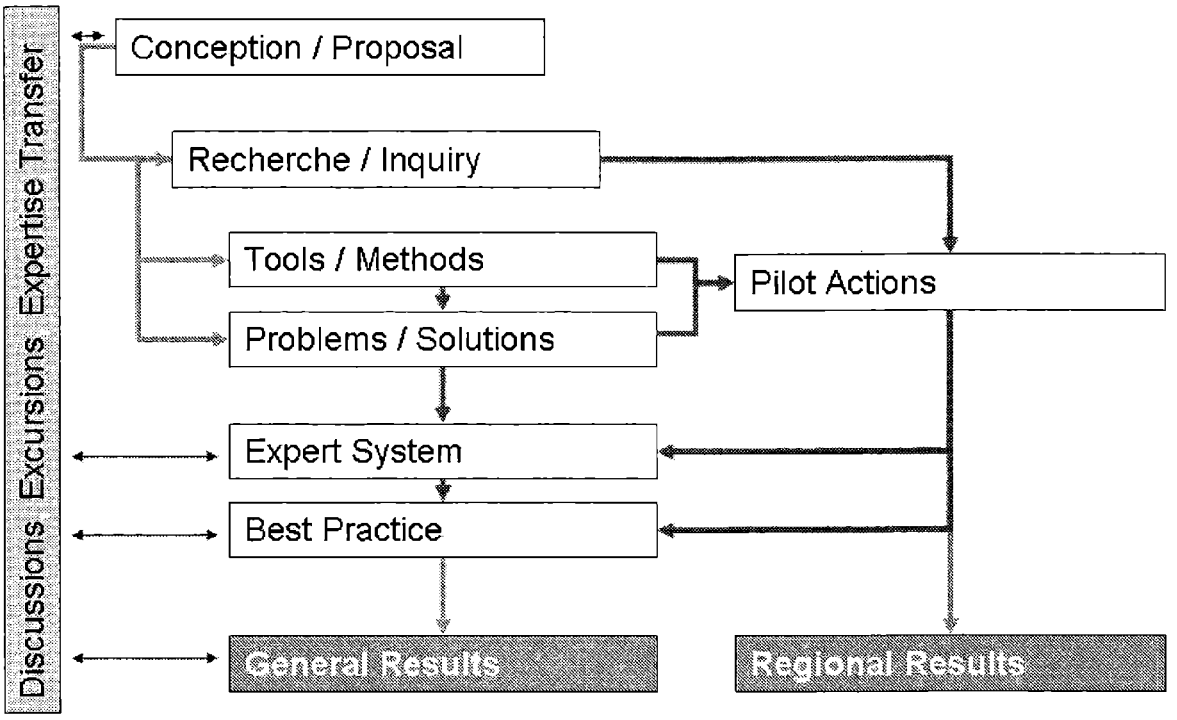


Fig. 1: The project IPAM – an overview.

Conceptual Solution

As pointed out above, the mass, sometimes the mess of available information is to get clobbered over the head. Therefore, expert systems in general, and the IPAM expert system in specific are built up in order to reduce complexity and provide focused information only. The IPAM-Toolbox consists of three components:

- Self-Assessment. In a procedure of self-assessment filters are set up in order to primarily eliminate information being irrelevant for the situation and to (later) rank information by importance. A major "side result" of this self-assessment is a clear positioning of the PA in different "fields of activities" (FoA). Along the life-cycle of a PA 25 FoAs were identified and described. By running through an ideal life-cycle (Preparing, Basic Planning, Detailed Planning, Implementation and Management) all FoAs are covered and therefore provide a helpful framework to determine the PA´s position. In an interactively guided process the user of the expert system answers a bundle of key questions to identify the recent position and the evident problems.
- Recommendations. On a general level, of course, but highly corresponding to the recent situation of the PA the expert system provides a set of recommendations. These are automatically generated by the system. The conceptual structure behind these recommendations is the analysis of the difference between FoAs needed in the very situation and the FoAs that really have been executed (well) so far. The recommendations are provided in standardised reports. So, they also allow reporting on the progress of the development or management of the PA (time series). The systems information are illustrated by some examples of "best practice" and furthermore lead to the most detailed information that is provided in the knowledge base.
- Knowledge Base. In a comprehensive database various examples of "best practice", in-depth information about literature, projects and available data as well as links and further expertises are proposed. The information is automatically ranked by requirements deriving from the self-assessment, but also can be selected individually. The content of the knowledge-base focuses geographically on Middle and Eastern Europe, but also provides international standards and approaches.

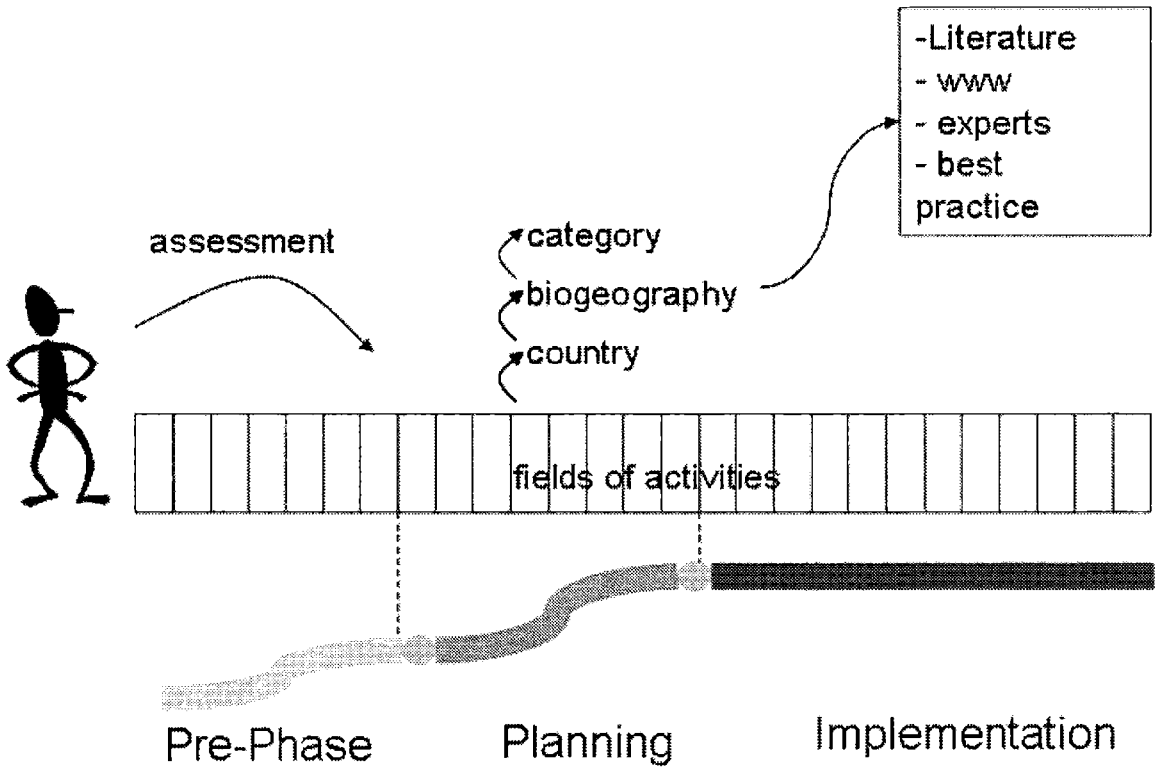


Fig. 2: Concept of the Toolbox – assessment by life-cycle of the Protected Area (Phases/Fields of Activities) and the knowledge base.

Pre-phase:	Development of Idea and Vision Feasibility Check Communication and Participation I Incorporation into PA-Systems
Basic Planning:	Planning Handbook Participative Planning Communication and Participation II Basic Investigation Implementation Plan Designation and Establishment
Detailed Planning:	Mission Statement and Basic Concepts Ecosystem-based Management Plans Design of (Regional) Economic Programs Specific Planning (Subsidiary Plans)
Implementation Phase:	Personnel and Organisational Development Development of Protected Area´s Region Evaluating Management Effectiveness Research Setting and Monitoring Data and Information Management Optimising Financial Situation (Business Plan) Information, Interpretation and Education Visitor Management, Services and Infrastructure Marketing and Public Relations Co-operation Design Communication and Participation III Impact Assessment and Limitation

Fig. 3: The Fields of Activities (FoA) in PA management – an Overview.

Interfaces of the IPAM-Toolbox

The technical solution of the IPAM-Toolbox is composed by a large variety of IT-tools. The chosen programming language PHP is embedded in HTML and supported by Apache Web Server, a widely-used HTTP Server for the internet. SQL is the used query language for relational databases. The technical background is supported by a content management system, called eZ-publish, and a LINUX operating system.

After the login into the IPAM-Toolbox the Self-Assessment and the Knowledge Base will be available. Additional information like a glossary, best practice examples, recommendations and the help area with the virtual assistant called IPAM Joe can be queried during the whole consulting process.

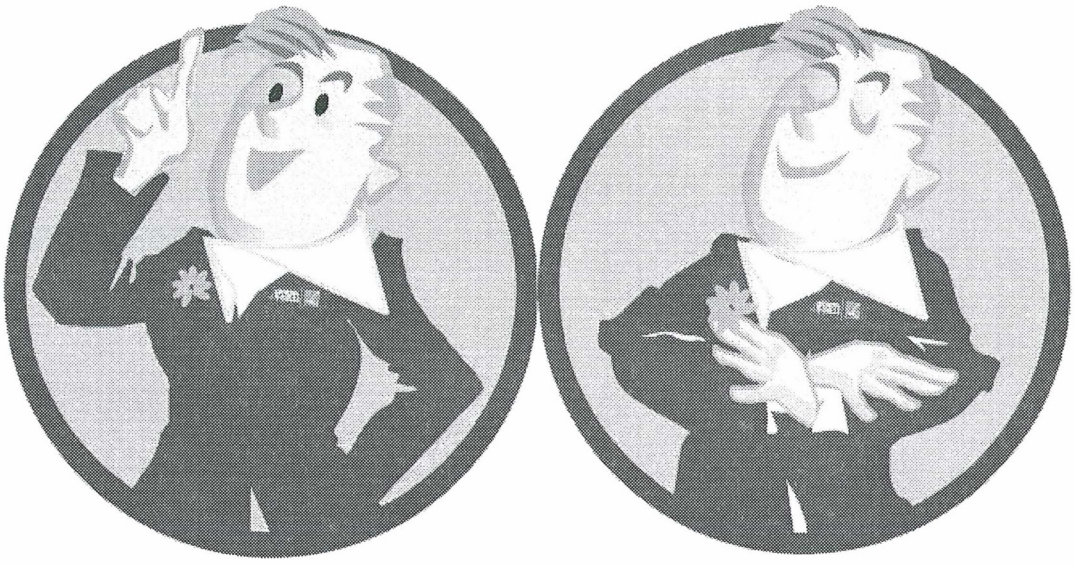


Fig. 4: IPAM Joe – the virtual assistant for the users of the Toolbox.
IPAM Joe, the virtual assistant welcomes the user and supports in running through the expert system.

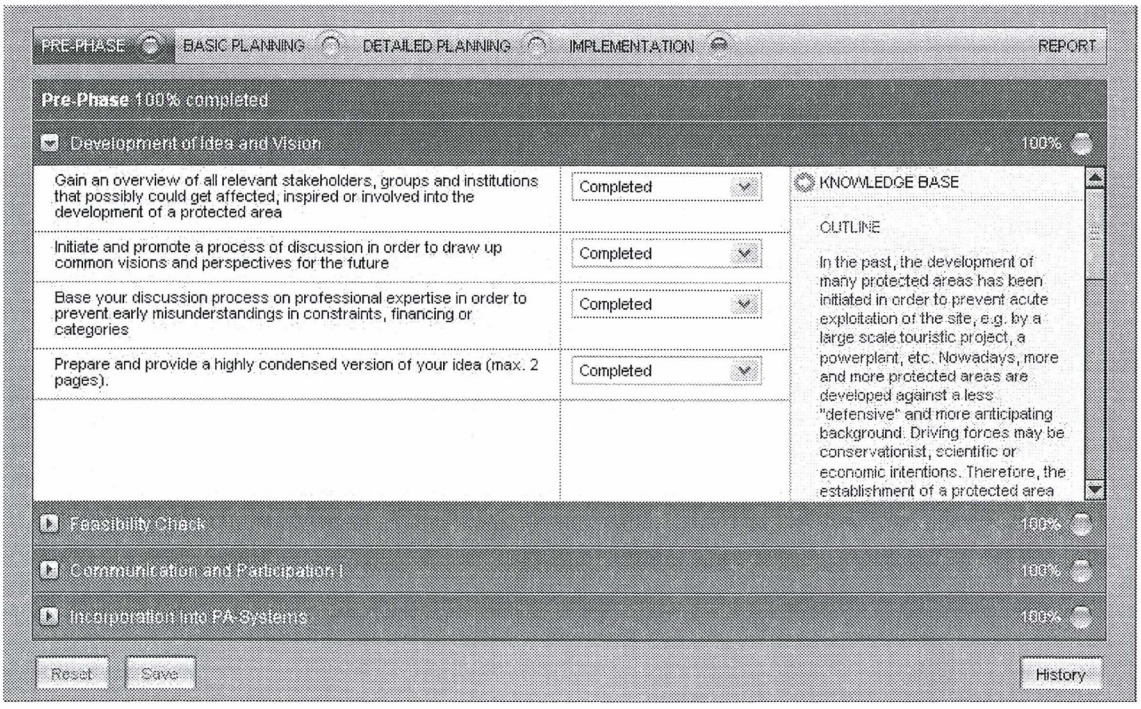


Fig. 5: Screenshot – Self-Assessment.
The visualisation of the processing status of the phases and fields of activity is prepared in a user-friendly way.

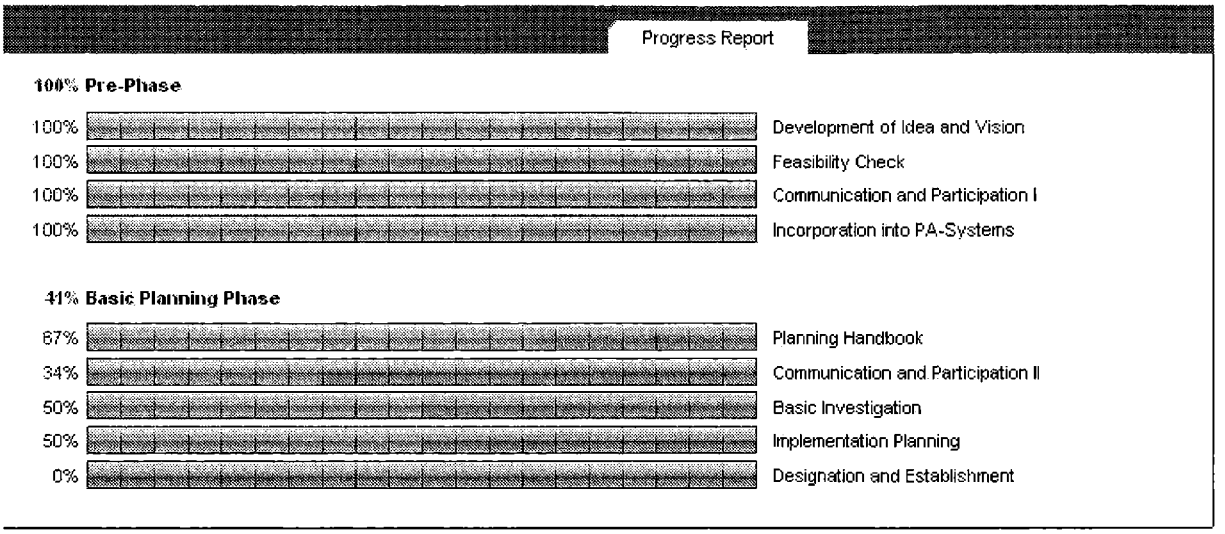
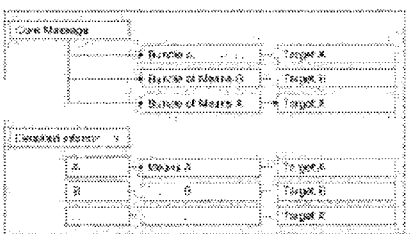


Fig. 6: Screenshot – progress report.
The progress report shows an overview of the processing status of the phases and fields of activity.

Communication and participation I

Communication design

Specify the target groups (check completenes at least three times) and make up order and mode of communication (you cant overestimate personal meeting

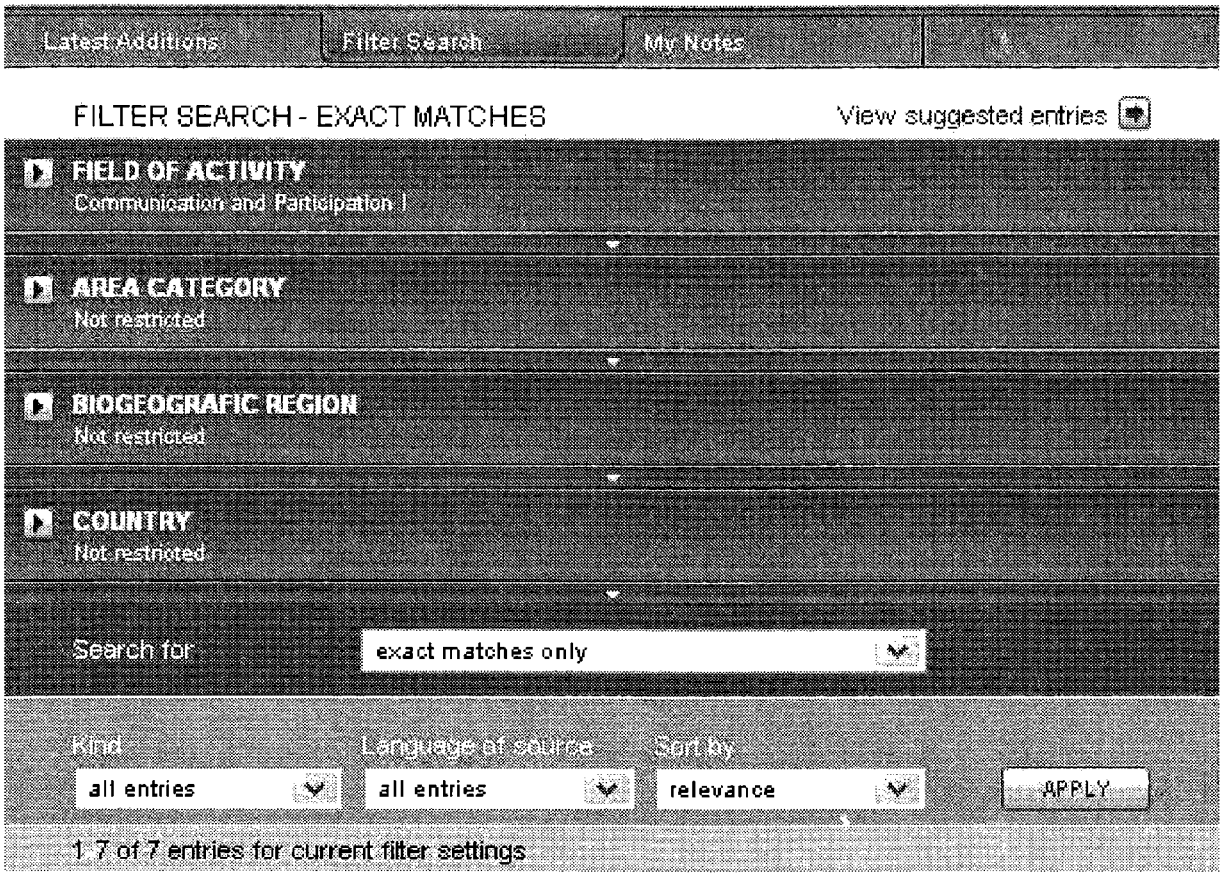


Visualisation of communication design.

To enlarge click on the picture...

The means / bundle of means have to be chosen with regards to the target groups. At this state of discussion it is better to use existing networks, structures and media than to establish new. A clear distinction has to be made between a core message relevant for all and specific information only relevant for specific interests. People should not be drowned in information. The detailed information may be distributed by sectoral or regional requirements.

Fig. 7: Screenshot – recommendation.
For each field of activity recommendations for managing protected areas are suggested.



DOCUMENT/REPORT/LITERATURE 2005/-0/4-
Co-management of Natural Resources. Organising, Negotiating and Learning-by-Doing.

DOCUMENT/REPORT/LITERATURE 2005/-0/4-
Indigenous and Traditional Peoples and Protected Areas.

DOCUMENT/REPORT/LITERATURE 2005/-0/4-
Public Participation in Protected Area Management - Best Practice.

DOCUMENT/REPORT/LITERATURE 2005/-0/4-
Detailplanung zum BiosphÄ¤renpark Wienerwald - Bereich Wald.

DOCUMENT/REPORT/LITERATURE 2005/-0/4-
Guidelines for Marine Protected Areas.

DOCUMENT/REPORT/LITERATURE 2005/-0/4-
Naturparkstudie Karawanken. Teil 1: Machbarkeitsstudie.

DOCUMENT/REPORT/LITERATURE 2005/-0/4-
Machbarkaitsstudie Trilateraler BiosphÄ¤renpark Moravien.

Fig. 8: Screenshot – knowledge base (ranking).
Examples in the form of best practice, literature, projects, links and further expertises are contained in the knowledge base.

References

JUNGMEIER, M. 1996: Ziele, Probleme und Strategien von Nationalparken Ergebnisse einer internationalen Umfrage. UBA Monographien Bd. 77.

JUNGMEIER, M., VELIK, I. 2005: IPAM Toolbox. Final Report. Study commissioned by: Office of the Carinthian Government, Dept. 20, Execution: E.C.O. Institute for Ecology Ltd., Klagenfurt.

JUNGMEIER, M., KIRCHMEIR, H., KÜHMAIER, M., VELIK, I. & ZOLLNER, D. 2005: IPAM-Toolbox. Transnational Results: An Expert System for Integrative Planning and Managing of Protected Areas – Office of the Carinthian Government, Dept. 20 (Ed), Execution: E.C.O. Institute for Ecology Ltd., Klagenfurt.

PHILLIPS, A. (ed.) 2000: Evaluating Effectiveness. A Framework for Assessing the Management of Protected Areas. Best Practice Protected Area Guidelines Series No. 6, IUCN, Cambridge.

STOLTON, S. & DUDLEY, N. 1999: Partnerships for Protection New Strategies for Planning and Management for Protected Areas. Earthscan Publications Ltd., London.

THOMAS, L., MIDDLETON, J. & PHILLIPS, A. 2003: Guidelines for Management Planning of Protected Areas. World Commission on Protected Areas (WCPA) No. 10.

WALKEY, M., & SWINGLAND, I. 1999: Integrated Protected Area Management. Kluwer Academic Publishers, Boston.

Contact

Mag. Michael Jungmeier
jungmeier@e-c-o.at
He is CEO of E.C.O. Institute for Ecology Ltd. and works in the fields of regional and ecological consulting and research.

Dr. Hanns Kirchmeir
kirchmeir@e-c-o.at
He is project manager at E.C.O. Institute for Ecology Ltd. and works in the fields of regional, ecological and forestry consulting and research.

Dipl. Ing. Martin Kühmaier
kuehmaier@e-c-o.at
He is project manager at E.C.O. Institute for Ecology Ltd. and works in the fields of ecological and forestry consulting and research.

Mag. Iris Velik
velik@e-c-o.at
She is consulter at E.C.O. Institute for Ecology Ltd. Her fields of activities are international project management, organisational development and mediation.

E.C.O. Institute for Ecology Ltd.
Kinoplatz 6
A 9020 Klagenfurt
Austria

Dipl. Ing. (FH) Johann Wagner
johann.wagner@ktn.gv.at
He is project manager of IPAM-Toolbox. His fields of work are transnational co-operations, protected area management, GIS (Geographic Information Systems) and Natura 2000.

Office of the Carinthian Government
Dept. 20 – Subsection for Nature Conservation
Wulfengasse 13-15
A 9020 Klagenfurt
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 91-95

Glacier monitoring by means of terrestrial photogrammetry: A case study in the Hohe Tauern National Park

Viktor Kaufmann, Richard Ladstädter

Abstract

Glaciers respond to changes in climate. Mass gain and loss change the geometrical and also the kinematic properties of a glacier. Their monitoring and quantification are of great interest to glaciologists, because these properties, i.e. glacier area, surface elevation, position of terminus and surficial flow velocity, can be linked to mass balance. During the first half of the 20th century terrestrial, i.e. ground-based, photogrammetry was the only means to efficiently map glaciers and their changes in space and time. Modern remote sensing techniques, i.e. airborne and spaceborne photogrammetry, airborne and terrestrial laser scanning, and differential SAR-interferometry, have pushed away terrestrial photogrammetry. In this paper we want to show that the availability of low-cost high resolution digital (consumer) cameras opens up new perspectives in glacier monitoring. A case study was carried out at Goessnitzkees, which is a small debris-covered glacier located in the Schober group of the Hohe Tauern range, Austria. Terrestrial photographs (stereo pairs) of three different periods (1988, 1997, 2003) were evaluated by means of digital photogrammetric techniques. As a result, glacier retreat could be mapped and quantified numerically. The potential of a fully digital approach using a low-cost digital consumer camera is highlighted.

Keywords

Glacier monitoring, terrestrial photogrammetry, digital photogrammetry, Zeiss TAL phototheodolite, Rolleiflex 6006 réseau camera, Nikon D100 digital camera, Goessnitzkees, Schober group, Hohe Tauern National Park.

Introduction

Goessnitzkees is a small (1997: 0.75 km²) debris-covered cirque glacier located in the Schober group, Hohe Tauern range, Austria. The course of deglaciation has already been documented for the time period 1850-1997 within a research project funded by the Hohe Tauern National Park (LIEB 2000).

Data Acquisition

The Institute of Remote Sensing and Photogrammetry additionally carried out three terrestrial (ground-based) photogrammetric surveys of the central part of the glacier showing also the glacier terminus: A first survey was done in 1988 using a Zeiss TAL (German "Terrestrische Ausrüstung Leicht") phototheodolite obtaining a stereo pair of glass plates. The endpoints of the baseline were marked by cairns. The photogrammetric survey was repeated in 1997, this time using a semi-metric Rolleiflex 6006 réseau camera, since photographic glass plates for the TAL phototheodolite were no longer available on the market. During the second survey a third camera position was introduced in the middle of the baseline of 1988 for obtaining an appropriate stereo triplet. Finally, the third photogrammetric survey took place in 2003. At this time we used two camera systems, i.e. the Rolleiflex 6006 of 1997 and a digital Nikon D100 still camera, which is a lost-cost SLR digital camera with an image resolution of 6 megapixels. See Figures 1-3, 5 and 6.

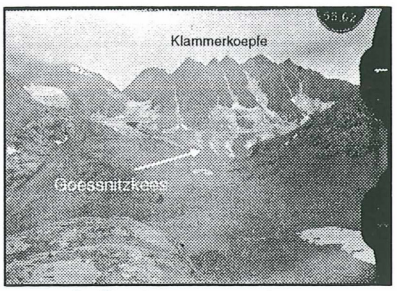
For the photogrammetric evaluation process the parameters of inner orientation must be known accurately. The calibrated focal length of TAL is 55.62 mm, the optical distortion is assumed to be negligible. Both cameras, however, the Rolleiflex 6006 (150mm lens) and the Nikon D100 (50mm lens) had to be calibrated using photogrammetric test fields.

Geodetic Measurements

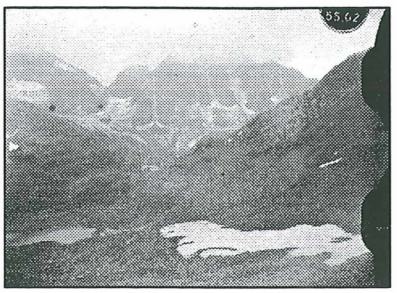
Geodetic measurements using a total station were carried out during the photographic documentations in 1997 and 2003 (KIENAST & KAUFMANN 2004). 3-dimensional data was captured:

Contribution received at: 12.07.2005

(1) The outline of the terminus of the glacier, (2) the shoreline of the proglacial lake, (3) additional points of the glacier surface (= velocity markers), and (4) a longitudinal profile. Additionally, photogrammetric control points which had been temporarily signalized were measured during the field campaign of 2003.



left stereo partner


right stereo partner

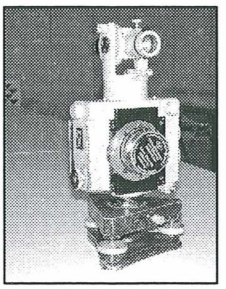
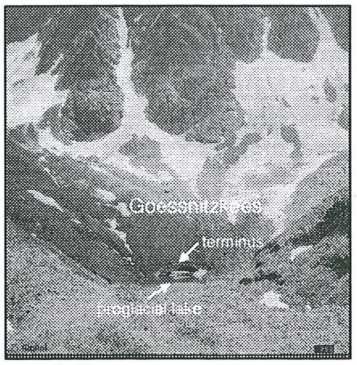
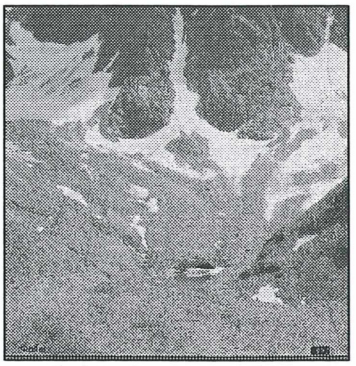

Zeiss TAL phototheodolite

Fig. 1: Goessnitzkees: Zeiss TAL stereo pair taken on 7 September 1988.

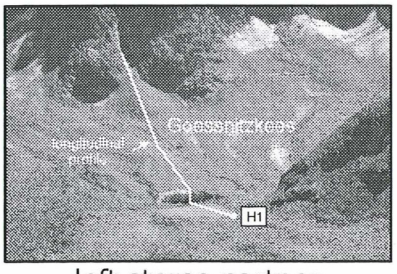


left stereo partner

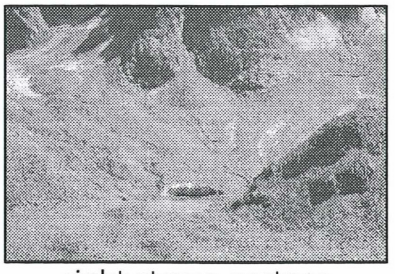

right stereo partner


Rolleiflex 6006 réseau camera

Fig. 2: Goessnitzkees: Rolleiflex 6006 stereo pair taken on 11 August 1997.



left stereo partner


right stereo partner

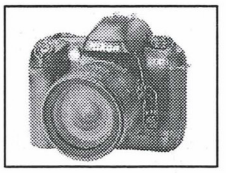

Nikon D100 digital camera

Fig. 3: Goessnitzkees: Nikon D100 stereo pair taken on 23 August 2003.

Photogrammetric Mapping

In order to facilitate a fully digital data flow in the photogrammetric evaluation process, all analogue photographs were digitized at 10 µm scanning resolution using the UltraScan 5000 photogrammetric scanner of Vexcel Imaging Austria. In a preprocessing step the many réseau crosses of the digitized Rolleiflex 6006 images were removed digitally, and furthermore, color fringes visible in the digital Nikon D100 photographs due to chromatic aberration of the optics used were minimized by appropriate scaling of the red and blue spectral bands in respect to the green one.

Photogrammetric orientation of all image data and subsequent 3D data collection were carried out using an ImageStation of Z/I Imaging. Absolute orientation of the multi-temporal stereo models was done as follows: A Rolleiflex stereo model of 2003 was selected as a reference model for obtaining tie points which could be used as control points in the other models. Such tie points were selected in areas of the deglaciated forefield of the Goessnitzkees and in the steep back walls of the cirque glacier.

Digital elevation models were obtained for all four stereo pairs through manual measurement of a regular grid of surface points. The terminus of the glacier was also mapped for the three glacial stages. From these data numerical values quantifying the glacier retreat were obtained, i.e. change

of ice thickness and horizontal recession of the terminus. Mean annual flow velocities of selected points of the glacier surface could also be estimated.

Results

The geometric quality of both DEMs derived from the Rolleiflex stereo models 1997 and 2003 were checked independently by means of the geodetic measurements. A comparison along the longitudinal profile showed that the photogrammetrically and the geodetically derived surfaces fit with an RMS (root mean square) value of ±22 cm for 1997, and ±13 cm for 2003. In both cases significant positive offsets of the photogrammetrically derived profiles in vertical direction in the order of 10 cm were observed. Furthermore, the DEM of 1997 was compared with another DEM, which was derived from aerial photographs taken three weeks after the terrestrial photographs. After elimination of a constant height offset between both data sets, which was inherent to the aerial case, an RMSE (root mean square error) of ±15 cm was computed for the whole mapping area. It was possible to visually verify this high quality by overlaying the respective contour lines.

In a further analysis the longitudinal profiles interpolated from both DEMs of 2003 were compared with each other. The height differences obtained have an RMS value of ±12 cm. No significant offset between the surfaces was observed.

Numerical values quantifying the glacier retreat are shown in Tab. 1. Moreover, various graphs and thematic maps were produced for visualization purposes (see Fig. 4 and also KAUFMANN & LADSTÄDTER 2004).

Change of ice thickness:	**Change of glacier length:**	**Equilibrium line altitude (ELA):** 2708 m (time period 1988-2003)
1988 – 1997: -13.6 m (= -1.51 m/year)	1988 – 1997: -85.2 m (= -9.47 m/year)	**Ablation gradient:** [100 m] 0.969 m w.e.
1997 – 2003: -12.2 m (= -2.03 m/year)	1997 – 2003: -61.5 m (= -10.26 m/year)	**Mean annual horizontal flow velocity:** 30-60 cm/year
valid for elevation range [2530 m - 2560 m]		

Tab. 1: Change of ice thickness and glacier length change of Goessnitzkees.
Vertical mass balance profiles (1988-1997, 1997-2003, 1988-2003) were computed for the longitudinal profile. Assuming a linear function between altitude and the mean specific mass balance, the mass balance gradient (the rate at which the specific balance changes with altitude) and the equilibrium line altitude (ELA) were numerically computed. For the time period 1988-2003 the mean annual mass balance gradient amounts to 0.00969 mwe m^{-1} yr^{-1} (meters of water equivalent per 1 m height interval per year) and the mean equilibrium line altitude was estimated at 2708 m. This means that nearly the whole glaciated area mapped has been affected by ablation (mass loss) throughout the last 15 years.

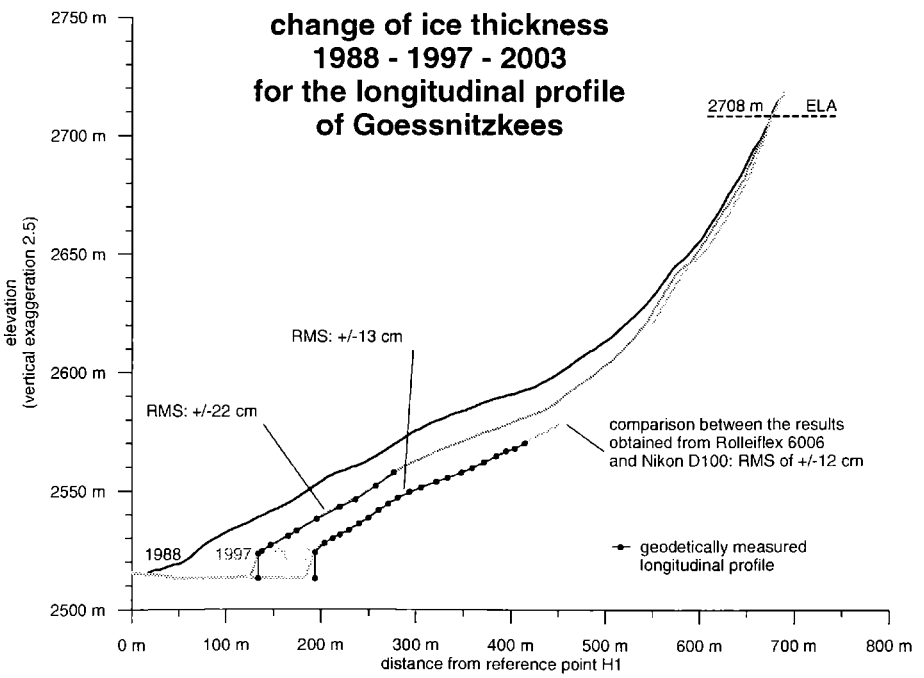


Fig. 4: Change of ice thickness along the longitudinal profile of Goessnitzkees for the time period 1988-1997-2003.

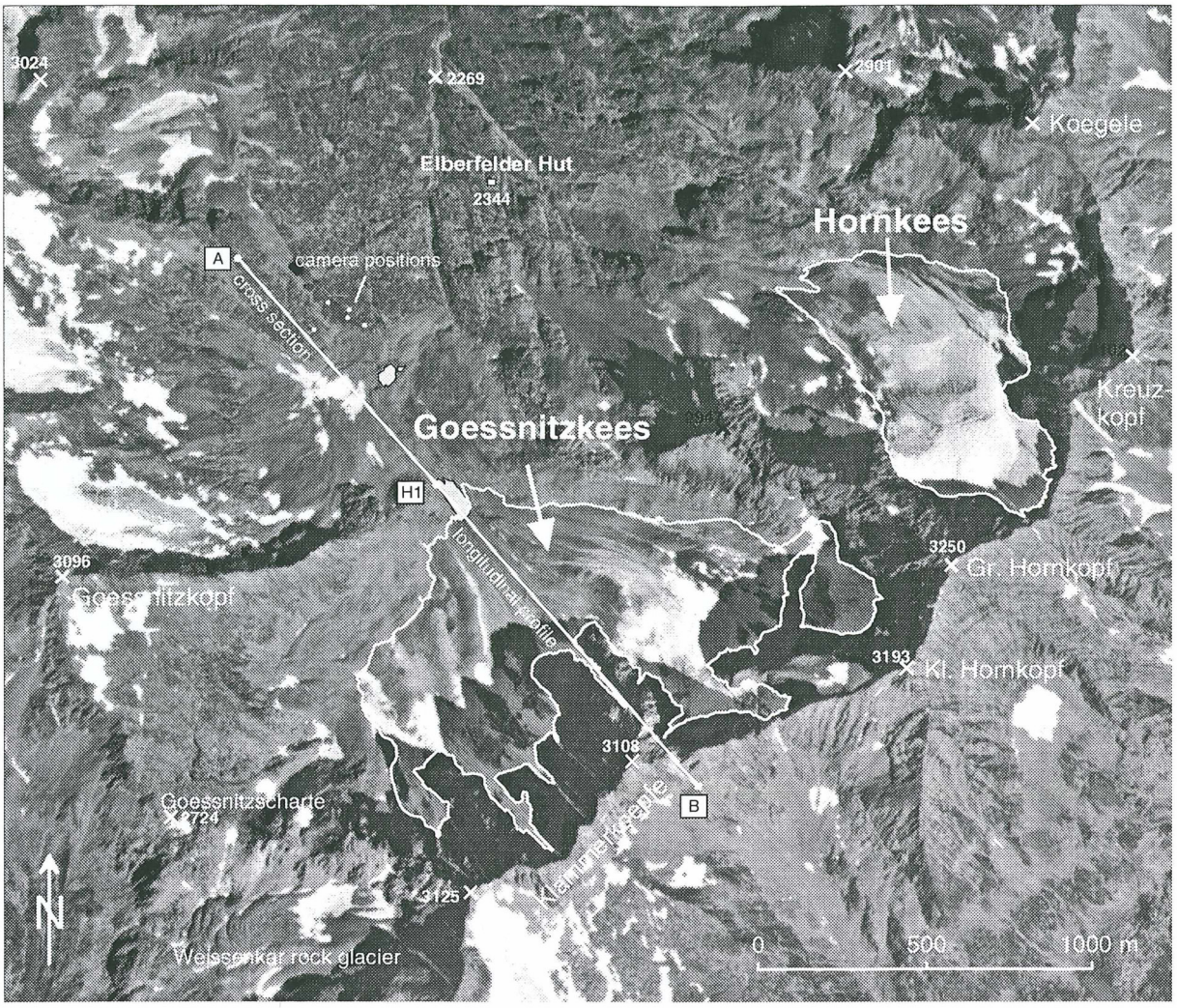


Fig. 5: Orthophoto of 1 September 1997 showing the camera positions and the position of the cross-section.

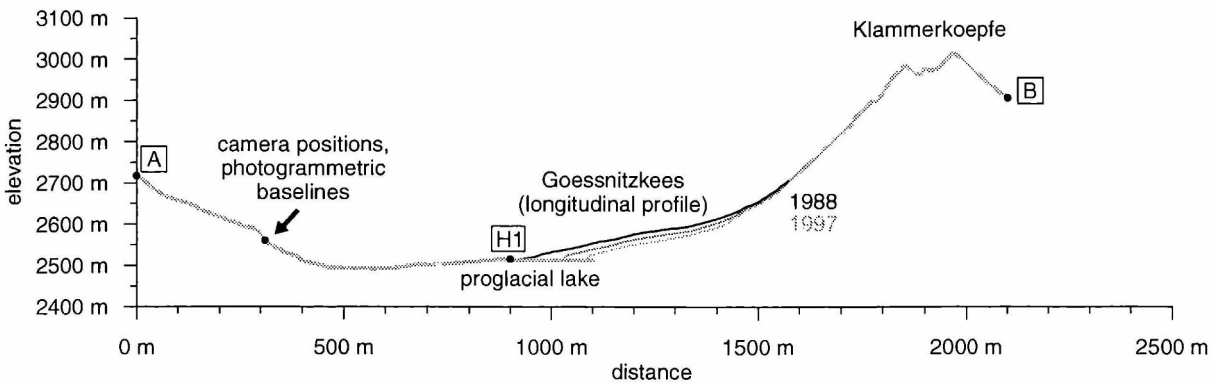


Fig. 6: Cross-section of Fig. 5 showing the longitudinal profiles of Goessnitzkees.

Discussion

The usefulness of low-cost SLR digital consumer cameras for terrestrial photogrammetric glacier surveys was demonstrated. The comparatively low imaging resolution of the digital cameras compared to large format photographic cameras, however, is still a problem. 8-Megapixel digital cameras are currently available on the market, and Kodak has recently introduced a 14-Megapixel SLR digital (consumer) camera. The authors believe that it is only a matter of time (2-3 years from now) until that camera will be available for the same price as the 6- or 8-Megapixel cameras today.

In respect to Goessnitzkees we conclude that the annual change of ice thickness can probably be computed with an accuracy of ±20 cm using the Nikon D100 digital camera. Assuming a mean annual surface lowering of about 2 m, a relative measurement error not worse than ±10 % can be expected. In August 2004 and 2005 follow-up field campaigns were carried out. The results obtained will be published elsewhere.

In summary, it can be said that terrestrial photogrammetry, as described in this paper, can be applied successfully in long-term monitoring projects for small glaciers or selected areas of a glacier, e.g. outline of the terminus, if a sufficient number of stable points (natural control points) is available in the vicinity of the area of interest.

Acknowledgements

The authors are grateful to K. Kienast from the Institute of Navigation and Satellite Geodesy of TUG for supervision of the geodetic measurements. The support of W. Krämer during field work is much appreciated. The present study could not have been carried out without the help of numerous students of the Institute and volunteers from the Hohe Tauern National Park. Their contribution is gratefully acknowledged. High quality image scanning was provided free of charge by VEXCEL Imaging Austria.

References

KAUFMANN, V. & LADSTÄDTER, R., 2004: Documentation of the retreat of a small debris-covered cirque glacier (Goessnitzkees, Austrian Alps) by means of terrestrial photogrammetry. Proceedings of 4th ICA Mountain Cartography Workshop, Vall de Núria, Catalonia, Spain, Monografies tècniques 8, Institut Cartogràfic de Catalunya, 65-76.

KIENAST, G. & KAUFMANN, V., 2004: Geodetic measurements on glaciers and rock glaciers in the Hohe Tauern National park (Austria). Proceedings of 4th ICA Mountain Cartography Workshop, Vall de Núria, Catalonia, Spain, Monografies tècniques 8, Institut Cartogràfic de Catalunya, Barcelona, 101-108.

LIEB, G.K., 2000. Die Flächenänderung von Gößnitz- und Hornkees (Schobergruppe, Hohe Tauern) von 1850 bis 1997. In: Festschrift für Heinz Slupetzky zum 60. Geburtstag, Salzburger Geographische Arbeiten, 36, 83-96.

Contact

Ass.-Prof. Dipl.-Ing. Dr.techn. Viktor Kaufmann
viktor.kaufmann@tugraz.at

Univ.-Ass. Dipl.-Ing. Dr.techn. Richard Ladstädter
richard.ladstaedter@tugraz.at

Institute of Remote Sensing and Photogrammetry
Graz University of Technology
Steyrergasse 30
A 8010 Graz
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 97-106

Terrestrial laser scanning for glacier monitoring: Glaciation changes of the Gößnitzkees glacier (Schober group, Austria) between 2000 and 2004

Andreas Kellerer-Pirklbauer [1,2], Arnold Bauer [1], Herwig Proske [1]

[1] JOANNEUM Research, Institute of Digital Image Processing, Graz, Austria
[2] Department of Geosciences, University of Oslo, Norway

Abstract

Monitoring of glacier behaviour is an important task in environmental research. For detailed detection of glacier surface and volumetric changes terrestrial laser scanning is a very effective and cheap observation method, due to the ability to acquire high-resolution 3D data. Since summer 2000 this method is applied at the Gößnitzkees glacier, a small debris-covered glacier located in central Austria (12°45'E, 46°58'N; size *c.*0.75km²). More than 60% of the glacier is covered by a prominent debris mantle. So far, five terrestrial laser scanning campaigns have been carried out focusing on the central part of the glacier including the glacier terminus (07-2000, 08-2000, 07-2001, 08-2001, 08-2004). These measurements allow the comparison of three different time scales (intermonthly, interannual, four years). The results demonstrate that accumulation and ablation (snow/firn/ice) can be monitored very accurately. The debris cover reduces net ablation at the glacier surface by up to 75% whereas the amount of incoming solar radiation is less important. A highly active feature is the retreating steep ice wall at the glacier terminus. Supraglacial meltwater causes further increase of local net ablation due to heat exchange at the meltwater-ice interface. It is shown that by use of this method it is easily possible to detect small changes on a glacier surface (clean and debris-covered) relevant for glacier-climate modelling but also for aspects in hydrology and natural hazard management.

Keywords

Gößnitzkees; Debris-mantled glacier; Glacier mapping and monitoring; Terrestrial laser scanning; Glacier surface and volumetric changes - intermonthly, interannual and four years.

Background and objectives

Advancing or retreating glaciers have a complex impact on their neighbouring environment, as e.g. on permafrost, geomorphic processes (thus natural hazards) or vegetation. In Austria, monitoring of glacier behaviour is an important task in environmental research. Since many decades the Austrian Alpine Association (OeAV) coordinates annual glacier measurement campaigns. Of the 925 Austrian glaciers according to the first Austrian glacier inventory from the year 1969 (PATZELT 1980) 107 glaciers are currently monitored on an annual basis by this program (PATZELT 2005); the majority of them only in a very general way (e.g. change of glacier terminus). In addition to these activities, annual mass balance measurements are carried out at a much smaller number of Austrian glaciers (Hintereisferner, Jamtal Ferner, Kesselwandferner, Sonnblickkees, Vernagtferner and Wurten Kees) within the framework of the World Glacier Monitoring Service (WGMS). Currently, a new Austrian glacier inventory is in progress. This inventory will also include for the first time volume and ice thickness data. For this purpose, 49 glaciers of different types have been surveyed between 1995 and 2003 with the aid of ground penetrating radar (WÜRLÄNDER & KUHN 2000, FISCHER & SPAN 2005, LAMBRECHT et al. 2005). Knowledge of glaciation changes is essential for the interpretation of glacier-climate interaction and glacier-climate modelling studies. Furthermore, the total volume of a glacier body is an interesting parameter for water resource management, in particular in areas where glacier water is essentially used for irrigation during the summer period (e.g. Hunza valley, Pakistan) or used for hydropower production (e.g. Kaprun, Austria). Numerical requirements on the quality of glaciological data are high in order to allow reliable predictions for all these issues. A number of different methods on a local, regional and global scale for glacier monitoring are available. For detection of glacier surface and thus volumetric changes in a very high spatial resolution terrestrial laser scanning is a very effective and cheap observation method, due to the ability to acquire high-resolution 3D data in a very short period of time. This paper describes first monitoring results of recent glaciaton changes (2000 to 2004) of the Gößnitzkees,

Contribution received at: 14.07.2005

the largest glacier in the Schober Group, Austria. The explanations refer to a research project which is carried out by the Institute of Digital Image Processing, Joanneum Research, Graz, with logistic assistance from the Hohe Tauern National Park Service. The scope of this ongoing project is to monitor surface and structure changes of glaciers and rock glaciers of different sizes with a very high accuracy by means of terrestrial laser scanning.

Study area

Gößnitzkees is located to the south of the main crest of the Hohe Tauern range in the central part of the Schober group at the valley head of the Gößnitz valley and is thus in the inner zone of the Hohe Tauern National Park at 12°45' E and 46°58' N (fig. 1). 'Kees' is the regional term for glacier. Gößnitzkees was included into the network of the mentioned annual glacier measurements of the OeAV in 1982. Due to the unsuitable topographic (steep rock faces, narrow crests, lack of flat surfaces at high elevations above the regional ELA) and climatic conditions (continental climate: low precipitation *c.*1500mm at 2000m asl., 0°C at 2300m asl.) of the Schober group, the glaciation is limited to a few positions at the foot of rock faces in northern expositions. The mean size of the glaciers does not exceed 0.18km² (N=29) and making Gößnitzkees with its *c.*0.75km² in 1997 the largest glacier of this mountain group (LIEB 2000, KAUFMANN & LADSTÄDTER 2004a). The general exposure of the glacier is NW with high crests and mountain tops to the S. The accumulation area of the glacier is very small. A high amount of snow accumulation originates from avalanches, in particular at the western head of the glacier at the foot of some pronounced couloirs (fig. 2). More than 60% of the glacier is covered by a prominent debris mantle with variable thickness. The rock material originates from the rock faces to the S consisting of crystalline rocks such as gneisses, amphibolites (Hornkopf peaks) and in particular schists (Western Klammerköpfe). The uppermost parts of the glacier – as e.g. the more-or-less separate glacierette just below the cirque on the W-facing slope of Großer Hornkopf (*cf.* fig. 1) – feature no pronounced bergschrunds, thus hinting a warm based glacier even at the uppermost limit. The overall appearance of the Gößnitzkees indicates a very inactive glacier also expressed by low mean annual flow velocities of 30-60cm/a (KAUFMANN & LADSTÄDTER 2004b). Due to the described topographic and climatic situation in the Schober group the entire area favours permafrost conditions. In NW-, N- and NE-aspects discontinuous permafrost can be expected above 2600 m with frequent occurrence of creeping permafrost features, i.e. active rock glaciers. The existence of the 77 intact rock glaciers is further enhanced by the mentioned lithologies; some of them may also contain some glacier ice (LIEB 1991, KRAINER et al. 2000, LIEB et al. 2004, AVIAN et al. 2005a). Summing up, relief and geoecological elements of the Schober group are highly representative for the Central Alps and thus for the National Park Hohe Tauern.

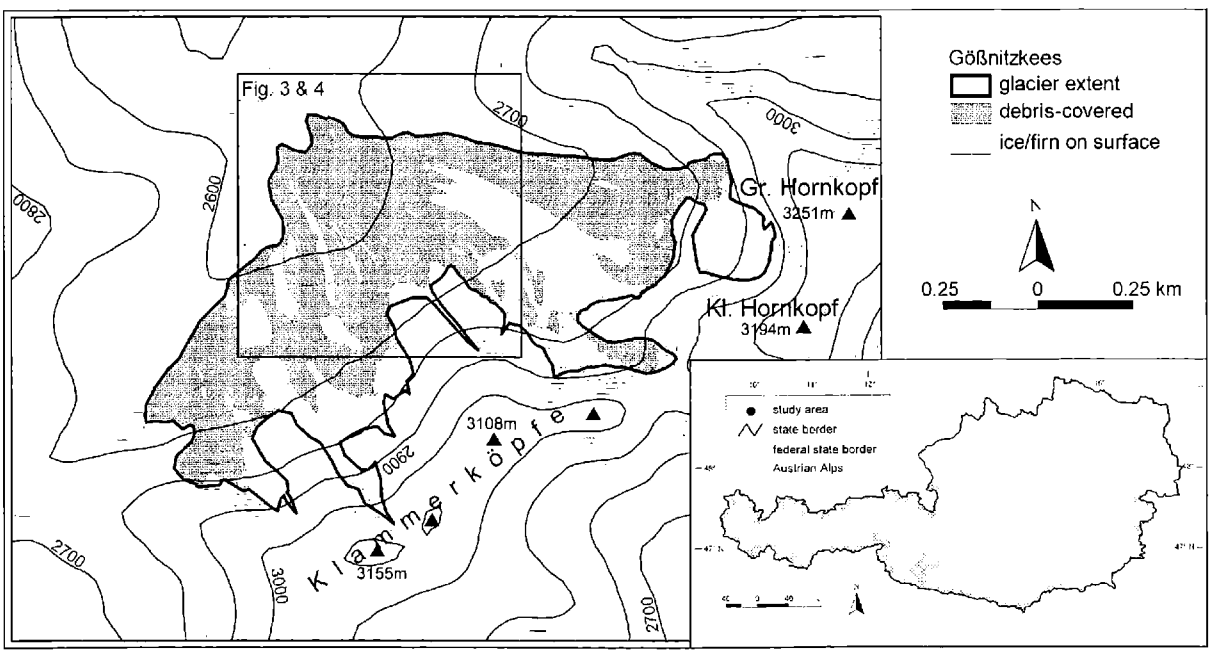


Fig. 1: Location and setting of the study area Gößnitzkees. The delineation of the glacier and the distribution of debris-covered and clean surfaces are based on the aerial photographs from the year 1998. The square in the main map indicates the location of the maps shown in figures 3 and 4.

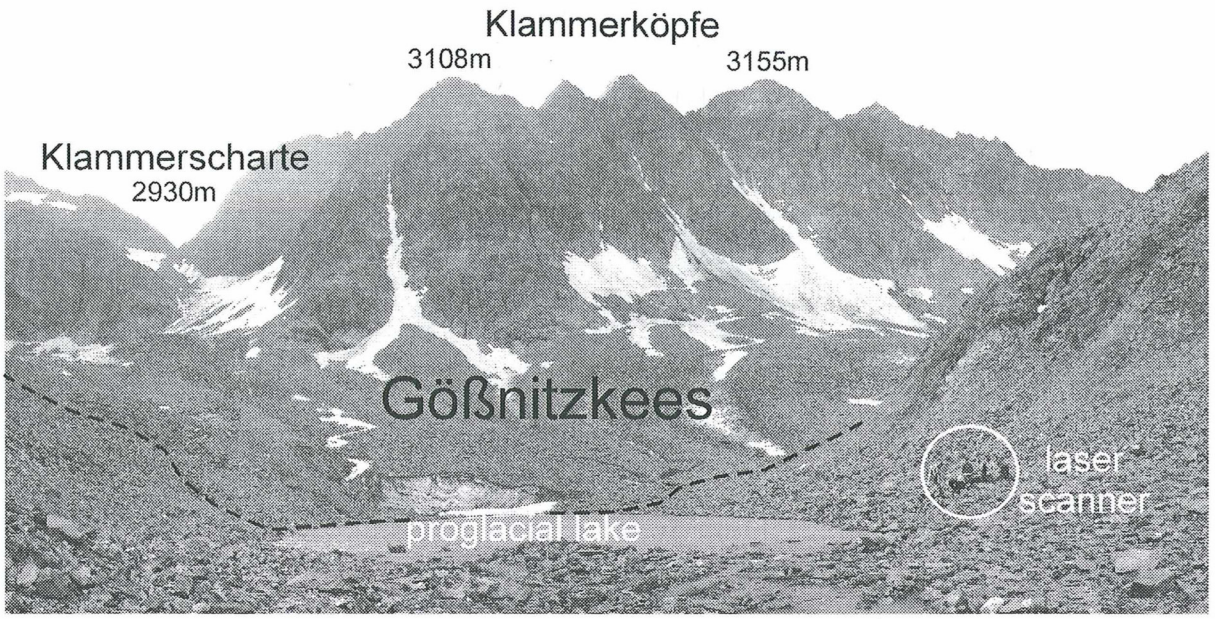
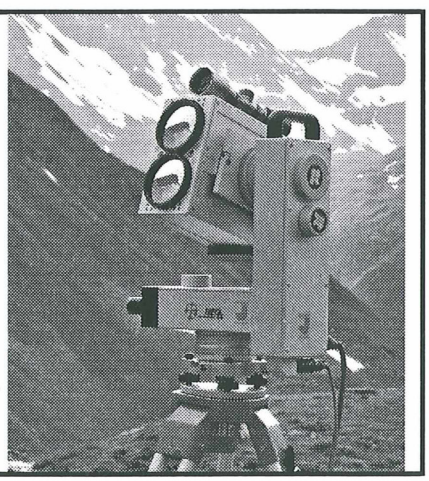


Fig. 2: Terrestrial overview of the study area. Note the steep ice front of the mostly debris-covered glacier adjacent to the proglacial lake and the group of people standing next to the location of the laser scanner; view towards SE (Photo: Kellerer-Pirklbauer 20-08-2004).

Methods and experimental setup

For the past few years, terrestrial 3D laser scanning systems have been employed very successfully in the design and manufacturing industries as well as in industrial surveying (PFEIFER et al. 2004). Further development of long range scanners with high precision allows them to be applied in terrain surveying. 3D laser scanners produce point clouds, sampled representations of 3D scenes, from range and angle measurements that are converted into accurate 3D models. The ability to acquire high-resolution 3D data of surface structures makes this technique a very interesting instrument for measuring glacier (AVIAN et al. 2005b; this volume) as well as rock glacier dynamics (BAUER et al. 2003, 2005). The integrated measurement system is capable of describing 3D motion and deformation of glacier surface within a single day's measurement campaign including logistics and evaluation. Table 1 gives technical information concerning the used instrument Riegl LPM-2k Long Range Laser Scanner.

Scanner parameter	*Value (range)*
Measuring range for: - good diffusely reflective targets - bad diffusely reflective targets	 up to 2500m >800m
Ranging accuracy	±50mm
Positing accuracy	±0.01gon
Measuring time / point	0.25s to 1s
Measuring beam divergence	1.2mrad
Laser wavelength	900nm
Scanning range - horizontal - vertical	 400gon 180gon
Laser safety class	3B, EN 60825-1
Power supply	11-18V DC, 10VA
Operation temperature range	-10 to +50°C



Tab. 1: Scanner parameters and values of the used instrumentation Riegl LPM-2k Long Range Laser Scanner.

Between July 2000 and August 2004 five terrestrial laser scanning campaigns have been carried out (11.07.2000, 22.08.2000, 27.07.2001, 25.08.2001, 20.08.2004) covering the central part of the Gößnitzkees including the glacier terminus. The area that has been investigated during each laser scanning campaign covers 0.09 to 0.13km² or 11.8 to 17.1% of the entire glacier surface. Figure 3 gives the spatial coverage during the 5 campaigns as well as the locations of the laser scanner and the reflective reference targets relevant for sensor orientation. During each of the 5 campaigns a high-resolution geo-referenced digital elevation model (DEM) in form of a regularly grid has been generated. The resulting DEM for each measurement campaign represents a dated state of the region covered by the sensor measurements. Since the data is geo-referenced, simple differences between the DEMs reflect the changes in surface elevation (volume) between the campaign dates. This has been performed for three different time scales (intermonthly, interannual, four years). Postprocessing and visualisation has been fulfilled by the house-own software GeoScanner and ArcGIS (data resampled to a 1m grid for visualisation in fig. 3, 4 & 6). Further description of measurement procedure and data processing is found in BAUER et al. (2003). To compare the potential short-wave solar radiation (PSWR) highly relevant for glacier ice melting and the measured glacier net ablation rates at the Gößnitzkees, a map of PSWR for each month and inferred from that for the summer season (June-July-August) was modelled using a 25m-DEM and the Solar Analyst extension (FU & RICH 2000) in ArcView.

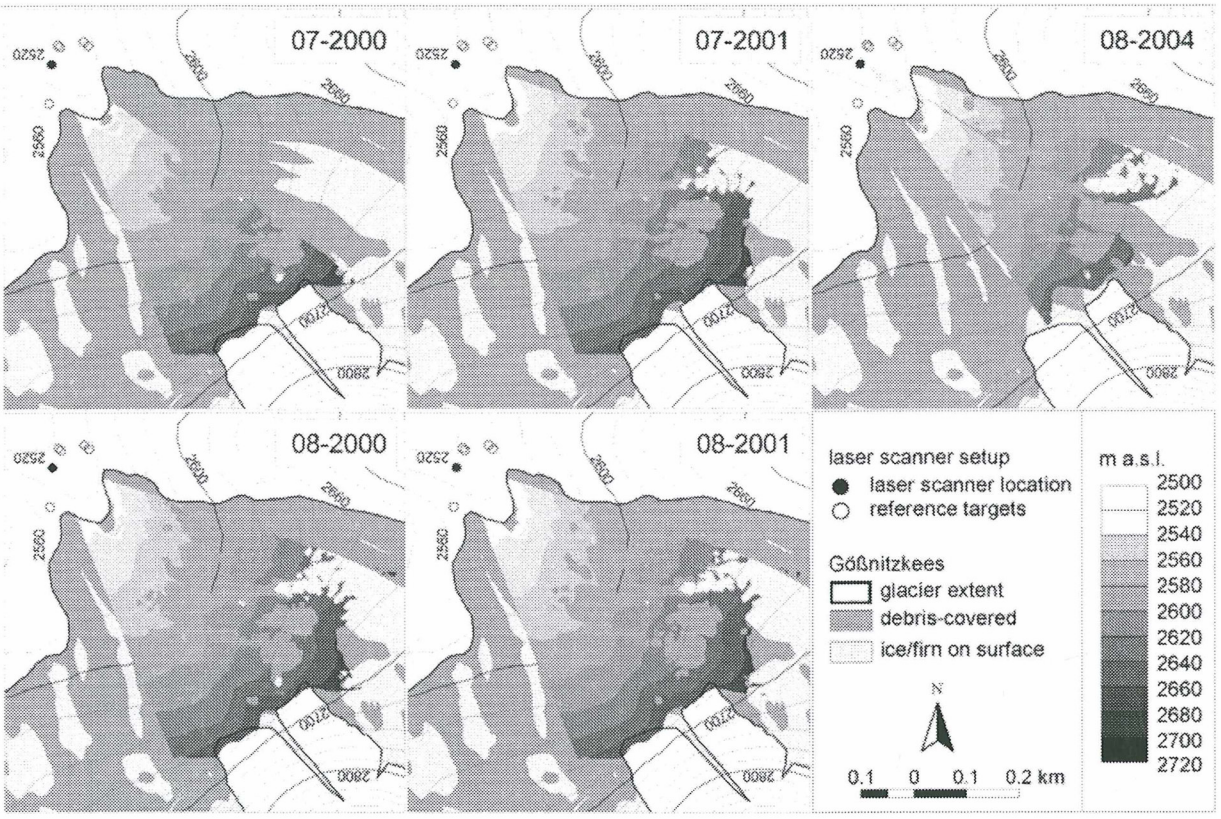


Fig. 3: Spatial extent of the five terrestrial laser scanning campaigns at the central part of the glacier including the glacier terminus: open circles mark the used reference targets for sensor orientation; the dot indicates the location of the laser scanner illustrated in table 1 (*cf.* fig. 1).

Results

Based on the measured terrain data glaciation changes over 3 different time scales have been calculated: 2 x intermonthly – 07 to 08-2000, 07 to 08-2001, 2 x interannual – 07-2000 to 07-2001, 08-2000 to 08-2001, and 1 x over four years – 08-2000 to 08-2004. The results are presented in figure 4. Table 2 gives a numerical overview of the calculated results and an estimation of volume changes for the total glacier for each time interval. The scanned area covers a profile sector from the cirque headwall to the glacier terminus and is representative for the entire area. Thus, it is assumed that the detected changes are not only valid for the measured sector but also can be – more or less - extrapolated on the entire glacier.

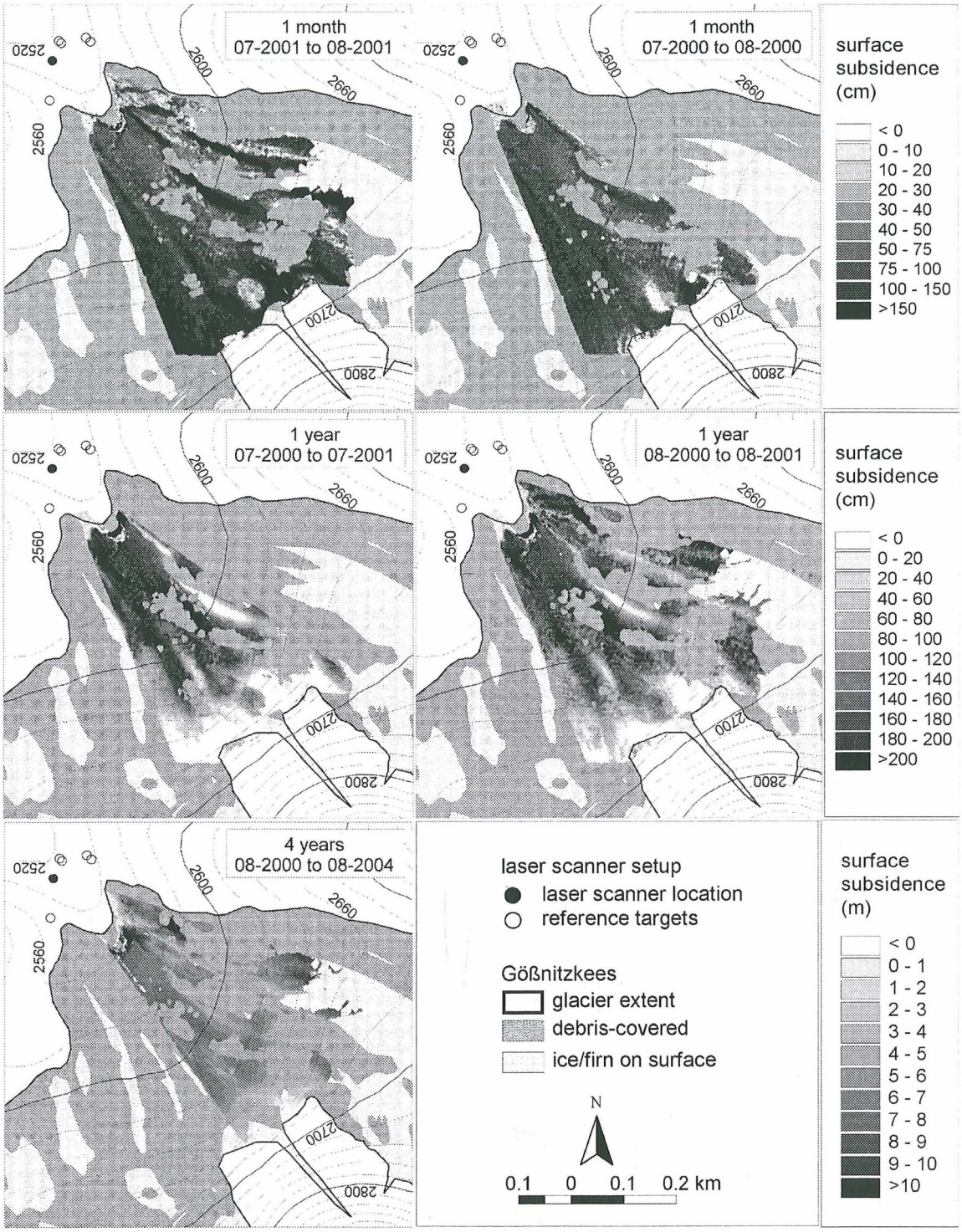


Fig. 4: Glacier surface changes during three different time scales (intermonthly, interannual, four years). Positive values indicate areas of thinning and <0 values indicate areas of thickening respectively (i.e. accumulation of snow/firn). Note the increase in thickness in some areas at the 1 year time scales due to a favourable glaciological year 2000/2001.

Difference calculations	Area considered in the difference calculations				Area considered on the entire glacier * (%)	Mean change in elevation (m)	Measured volume change at the monitored glacier section (m^3)	Estimated volume change for the entire glacier* (m^3)
	total [a] (m^2)	on the glacier [b]		δ of a & b (%)				
		(m^2)	(%)					
1 month: 07 to 08-2000	87,763	85,262	97.2	2.8	11.4	-0.971	-82,789	-728,250
1 month: 07 to 08-2001	120,241	118,175	98.3	1.7	15.8	-1.113	-131,529	-834,750
1 year: 07-2000 to 07-2001	86,262	84,224	97.6	2.4	11.2	-0.829	-69,822	-621,750
1 year: 08-2000 to 08-2001	119,962	117,896	98.3	1.7	15.7	-1.179	-138,999	-884,250
4 years: 08-2000 to 08-2004	63,083	62,894	99.7	0.3	8.4	-5.755	-361,955	-4,316,250

*glacier size 0.75km²

Tab. 2: Numerical overview of the calculated and estimated results for each time interval.

Discussion

The results shown in figure 4 clearly demonstrate non-uniform and peculiar retreat behaviour of the Gößnitzkees during all three studied time scales. This extremely uneven change pattern is related to a number of factors acting unequally at different areas on the glacier. These factors are: (i) temperature and (ii) PSWR during summer, (iii) distribution and characteristics of debris cover on the glacier, (iv) heat exchange at the meltwater-ice interface in supraglacial meltwater channels, and (v) specific accumulation and/or ablation history of snow/firn/ice between two compared time periods.

Temperature and PSWR during summer (modelling results in figure 5) are of minor importance for the unequal distribution of net ablation. Note the homogeneity of modelled PSWR at the relevant, central part of the glacier indicating the low influence of PSWR on the difference of glacier surface changes over short horizontal distances. The distribution and characteristics of the debris cover plays a crucial role in the behaviour of the Gößnitzkees. During all three time scales, glacier surface changes are greatly influenced by the presence or absence of a debris mantle (*cf.* fig. 4 & 6). In some areas the debris cover reduced net ablation at the glacier surface by up to 75% compared to clean ice surfaces in close neighbourhood. Glaciers mantled by a pronounced debris-cover behave differently to normal or 'clean' glaciers. First, debris-covered glaciers may deposit massive ridges of morainic debris around their snouts, which are capable of ponding large volumes of meltwater, but lack the mechanical strength to impound the water for more than a few decades. The breakage of such a dam may cause dangerous and catastrophic glacier lake outburst floods (GLOF) causing massive destruction of property and loss of live. Second, by insulating ice from solar radiation and daily temperature fluctuations, a thick debris cover effectively insulates the underlying ice and greatly reduces rates of ablation relative to that of uncovered ice, thus delaying the response of the glacier to atmospheric warming. During periods of climatic warming, debris-covered glaciers slowly melt down, until closed hollows and lakes begin to form on the glacier surface or at the margin (Benn & Evans 1998, Benn et al. 2001). A further important aspect in this context is the increasing input of debris on glaciers; lower glaciation causes a higher input of debris on the remaining glacier body due to pressure release and paraglacial instabilities on adjacent slopes and the cirque headwall. Such an increase in debris input in combination with inefficiency of sediment transfer from the glacier ice to the meltwater may cause even complete debris coverage of a once 'clean' glacier and eventually the transformation into a glacier-derived or ice-cored rock glacier (Krainer & Mostler 2000, Shroder et al. 2000, Berger et al. 2004, Nakawo et al. 2000). Meltwater draining sub-, intra- or supraglacially enhances melting of ice due to heat exchange at the meltwater-ice interface ('thermo-erosion'; *cf.* Benn et al. 2001). At the Gößnitzkees this effect is most effective along supraglacial meltwater channels (fig. 6c). Finally and obviously, the specific accumulation and/or ablation of snow/firn/ice between two compared time periods greatly influence the calculated results.

As it is shown in figure6a-b, the accumulation of snow over a period of 1 year can be quantified in depressions close to glacier terminus, i.e. supraglacial meltwater channels still filled with wind-drifted winter snow, but also at the avalanche cones at the foot of the cirque headwall. This net accumulation results due to a very favourable glaciological year 2000/2001 at the Gößnitzkees with large areas of snow coverage even in late summer (LIEB et al. 2001). High ablation can also be quantified at different locations on the glacier as e.g. at the same supraglacial meltwater channel as mentioned before but over a different time scale (fig. 6c), at the glacier terminus (very active feature; retreat of 7-15m/a) and at the foot of the cirque headwall (fig. 6c-d). Figure 6b and d also shows nicely that on the lower part of this particular avalanche cone surface dynamics are lower as in the close vicinity due to a wind exposed and less avalanche prone location (*cf.* fig. 2).

The values given in table 2 reflect the recent glaciological history of the Gößnitzkees: unfavourable glaciological year 1999/2000 (LIEB et al. 2000), favourable glaciological year 2000/2001 (LIEB et al. 2001), unfavourable glaciological year 2001/2002 (LIEB et al. 2002), very unfavourable glaciological year 2002/2003 (KROBATH 2003), and unfavourable glaciological year 2003/2004 (KROBATH 2004). For the 1-month period 07 to 08-2000 the mean change in elevation over the entire glacier and the measured and estimated volume change is due to snow and ice melting; for 07 to 08-2001 mainly due to snow melting. Values for the 1-year periods are relatively low due to a favourable glaciological year 2000/2001. The difference between these two periods is mainly based on higher snow ablation in summer 2001 (due to snow availability!) compared to summer 2000. The results measured and calculated for the entire monitoring period give a mean elevation change of about *c.*-5.8m (-1.45m/a) and an estimated total volume loss of more than 4.3 Mio. m^3 (1.08 Mio m^3/a) strongly indicating once more a retreating glacier. It has to highlighted that if no debris cover would protect the glacier, the rates of glacier ice retreat would have been much higher. As an example of utilizing high resolution laser scanner data only a few glaciological aspects are pointed out in this paper. Further analysis and interpretations are in progress.

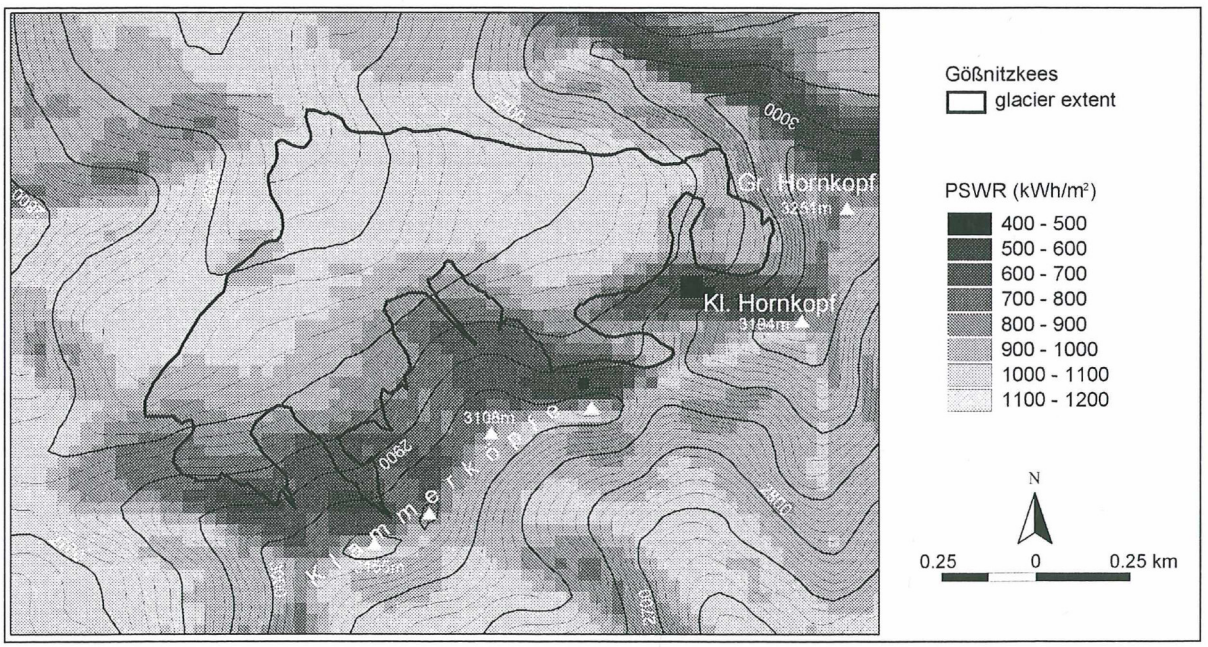


Fig. 5: The spatial distribution of the potential short wave radiation (PSWR) during summer (June-July-August) at the study area. Note the homogeneity of modelled PSWR at the relevant, central part of the glacier indicating the low influence of PSWR on the difference of glacier surface changes within short horizontal distances.

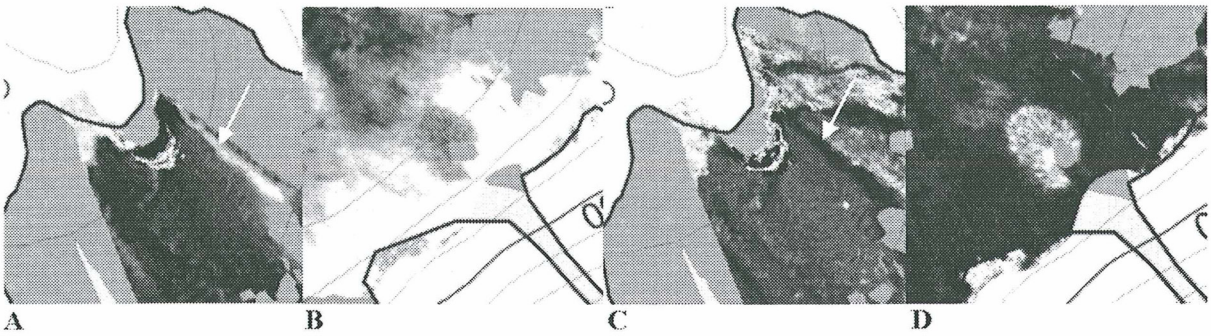


Fig. 6: Section examples of figure 4 showing surface changes both increase and decrease - at the glacier at different time scales and at different locations; (A and B): sections of 1-year change maps (07-2000 to 07-2001), bright areas indicate accumulation of snow – A: in the supraglacial meltwater channel (white arrow), B: at the foot of cirque headwall; (C and D): sections of 1-month change maps (07-2001 to 08-2001); dark areas indicate enhanced ice melting – C: at the supraglacial meltwater channel (white arrow) at the glacier terminus and in areas with a minor debris cover, D: melting of winter snow at the foot of the cirque headwall.

Technical and glaciological conclusions

- Monitoring of glacier surface changes with high temporal and spatial resolution in alpine terrain is feasible.
- Operational system is available as mobile or stationary unit.
- Results are available immediately after measurement.
- Accuracy depends on viewing geometry and footprint size of the laser beam.
- 3D high resolution surface change data (accumulation of snow and debris; ablation of snow/firn/ice) is obtained by DEM analysis.
- The same method can be applied to rock glaciers, snow cover thickness determination and rock slide monitoring.
- Both large scale (e.g. estimation of total glacier volume change) and small scale (e.g. quantification of supraglacial meltwater channel incision) glaciological features can be quantified.
- PSWR during summer plays a minor role in different ablation and accumulation behaviour on a heavily debris-covered glacier.
- An existing debris cover causes a striking difference in net ablation at areas mantled by debris relative to clean ice surfaces within close distance (up to 75%) , in particular at the debris-free vertical glacier terminus. A detailed analysis of the debris cover on the glacier (e.g. thickness of layer, spatial distribution, clast size) is planned in the near future.
- Obviously, the principal factor causing an uneven distribution of surface changes within a short horizontal distance between two compared time periods is the specific accumulation/ablation history.
- It is clearly shown that multi-temporal terrestrial laser scanning analyses provide a high potential for mass balance estimates and thus glacier dynamics studies.
- Detailed monitoring of retreating debris-covered glaciers helps to identify growing natural risks (e.g. GLOFs), thus may have a very high social relevance in terms of natural hazard prevention.

References

AVIAN M., KAUFMANN V., LIEB G.K., 2005a: Recent and Holocene dynamics of a rock glacier system: The example of Langtalkar (Central Alps, Austria). Norwegian Journal of Geography, 59, 149-156.

AVIAN M., BAUER A. & LIEB G.K., 2005b: Monitoring modification of alpine environments: New techniques and perspectives. 3rd Symposium of the Hohe Tauern National Park for Research in Protected Areas, Kaprun, Salzburg, 15-17 September 2005 (this volume).

BAUER A., PAAR G. & KAUFMANN V., 2003: Terrestrial laser scanning for rock glacier monitoring. Phillips M., Springman S.M. & Arenson L.U. (eds.) Proceedings of the 8th International Permafrost Conference, Zurich, 55-60.

BAUER A., KELLERER-PIRKLBAUER A., AVIAN M. & KAUFMANN V., 2005: Five years of monitoring the front slope of the highly active Hinteres Langtal rock glacier using terrestrial laser scanning: A case study in the Central Alps, Austria. Terra Nostra, 2nd European Conference on Permafrost, Potsdam, 91.

BENN D.I. & EVANS D.J.A., 1998: Glaciers and Glaciation. Arnold, London, 734.

BENN D.I., WISEMAN S. & HANDS K.A. 2001: Growth and drainage of supraglacial lakes on the debris-mantled Ngozumpa Glacier, Khumbu Himal, Nepal. Journal of Glaciology, 47, 159, 626-638.

BERGER J., KRAINER K. & MOSTLER W., 2004: Dynamics of an active rock glacier (Ötztal Alps, Austria). Quaternary Research, 62, 233– 242.

FISCHER A. & SPAN N., 2005: A volume inventory of glaciers in the Austrian Alps. European Geosciences Union (EGU), Second Assembly, Vienna, 24-29 April 2005. CD-ROM.

FU P. & RICH P.M., 2000: The Solar Analyst 1.0. User Manual. Helios Environmental Modeling Institute, LLC, Vermont.

KAUFMANN V. & LADSTÄDTER R., 2004a: Documentation of the retreat of a small debris-covered cirque glacier Goessnitzkees, Austrian Alps by means of terrestrial photogrammetry. Proceedings of the 4th ICA Mountain Cartography Workshop, Vall de Nuria, Catalonia, Spain, 30th September 2nd. October 2004.

KAUFMANN V. & LADSTÄDTER R., 2004b: Terrestrisch-photogrammetrische Dokumentation des Gletscherrückgangs am Gößnitzkees (Schobergruppe, Nationalpark Hohe Tauern). Pangeo 2004, Graz, 24-26 September 2004, Beitrags-Kurzfassungen, Erdwissenschaften und Öffentlichkeit, 9, 240-242.

KRAINER K. & MOSTLER W., 2000: Reichenkar rock glacier: a glacier derived debris-ice-system in the Western Stubai Alps, Austria. Permafrost and Periglacial Processes 11, 267– 275.

KRAINER K., MASSIMO I. & MOSTLER W., 2000: Blockgletscher im Gößnitztal, Schobergruppe (Nationalpark Hohe Tauern, Österreich). Unveröff. Bericht Nationalparkverwaltung Kärnten, Institut für Geologie und Paläontologie, Universität Innsbruck, 123.

KROBATH M., 2003: 22. Bericht über die Gletscherbeobachtungen und -messungen in der Schobergruppe 2003. Unpubl. Annual Glaciological Report, Graz, 7

KROBATH M., 2004: 23. Bericht über die Gletscherbeobachtungen und -messungen in der Schobergruppe 2004. Unpubl. Annual Glaciological Report, Graz, 6.

LAMBRECHT A., WÜRLÄNDER R. & Kuhn M., 2005: The new Austrian glacier inventory: a tool for the analysis of modern glacier change. European Geosciences Union (EGU), Second Assembly, Vienna, 24-29 April 2005. CD-ROM.

LIEB G.K., 1991: Die horizontale und vertikale Verbreitung von Blockgletschern in den Hohen Tauern (Österreich). Zeitschrift für Geomorphologie N.F., 35, 3, 345-365.

LIEB G.K., 2000: Die Flächenänderung von Gößnitz- und Hornkees (Schobergruppe, Hohe Tauern) von 1850 bis 1997. Festschrift für Heinz Slupetzky zum 60. Geburtstag, Salzburger Geographische Arbeiten, 36, 83-96.

LIEB G.K., KROBATH M. & SULZER W. 2000: 19. Bericht über die Gletscherbeobachtungen und -messungen in der Schobergruppe 2000. Unpubl. Annual Glaciological Report, Graz, 8.

LIEB G.K., KROBATH M. & SULZER W. 2001: 20. Bericht über die Gletscherbeobachtungen und -messungen in der Schobergruppe 2001. Unpubl. Annual Glaciological Report, Graz, 9.

LIEB G.K., KROBATH M. & SULZER W. 2002: 21. Bericht über die Gletscherbeobachtungen und -messungen in der Schobergruppe 2002. Unpubl. Annual Glaciological Report, Graz, 9.

LIEB G.K, KAUFMANN, V. & AVIAN, M., 2004: Das Hintere Langtalkar (Schobergruppe, Nationalpark Hohe Tauern) ein Beispiel für die komplexe Morphodynamik in der Hochgebirgsstufe der Zentralalpen. Mitt. d. Österr. Geogr. Gesellschaft, Wien, 146, 147-164.

NAKAWO M., RAYMOND C.F. & FOUNTAIN A. (eds.), 2000: Debris-covered glaciers: proceedings of an international workshop held at the University of Washington in Seattle, Washington, USA, 13-15 September 2000, IAHS publication 264, 288.

PATZELT G., 1980: The Austrian glacier inventory: status and first results. Workshop Proceedings IAHS, Riederalp, 126, 267-280.

PATZELT G., 2005: Gletscherbericht 2003/2004: Sammelbericht über die Gletschermessungen des Österreichischen Alpenvereins im Jahre 2004. Mitteilungen des Österreichischen Alpenvereins, 60, 2, 24-31.

PFEIFER N. & LICHTI D., 2004: Terrestrial Laser Scanning: Developments, Applications and Challenges. GIM International, December 2004, 50-53.

SHRODER J.F., BISHOP M.P., COPLAND L. & SLOAN V.F., 2000: Debris-covered glaciers and rock glaciers in the Nanga Parbat Himalaya, Pakistan. Geografiska Annaler, 82A, 1, 17– 31.

WÜRLÄNDER R. & KUHN M., 2000: Zur Erstellung und Anwendung der Produkte des neuen Österreichischen Gletscherkatasters. Festschrift für Heinz Slupetzky zum 60. Geburtstag, Salzburger Geographische Arbeiten, 36, 57–67.

Contact

Mag. Mag. Andreas Kellerer-Pirklbauer[1,2]
main author and corresponding author
andreas.kellerer@gmx.at

DI Arnold Bauer [1]
co-author
arnold.bauer@joanneum.at

Mag. Herwig Proske [1]
co-author
herwig.proske@joanneum.at

(1) Joanneum Research
Institute of Digital Image Processing
Wastiangasse 6
A 8010 Graz
Austria

(2) Department of Geosciences
University of Oslo
Sem Sælands vei 1
P.O. Box 1047 Blindern
NO 316 Oslo
Norway

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 107-112

Ecological Network and NATURA 2000

Yann Kohler, Guido Plassmann

Spatial network of protected areas

The subject of transboundary protected areas and spatial connections (common surfaces, ecological corridors) between the protected areas in the Alps has a central place in the implementation of the Nature Protection Protocol of the Alpine Convention. Several articles refer directly or indirectly to such connections between protected areas (article 3, 11 and 12). The article 12 foresees the creation of an ecological network. Based on this article the Alpine Network of Protected Areas has contributed since 1995 to the application of the Alpine Convention as thematic network, involving the Alpine protected areas in joined actions and creating a common identity. Now, based on the work of this thematic pool, a network with a higher spatial dimension should be realised.

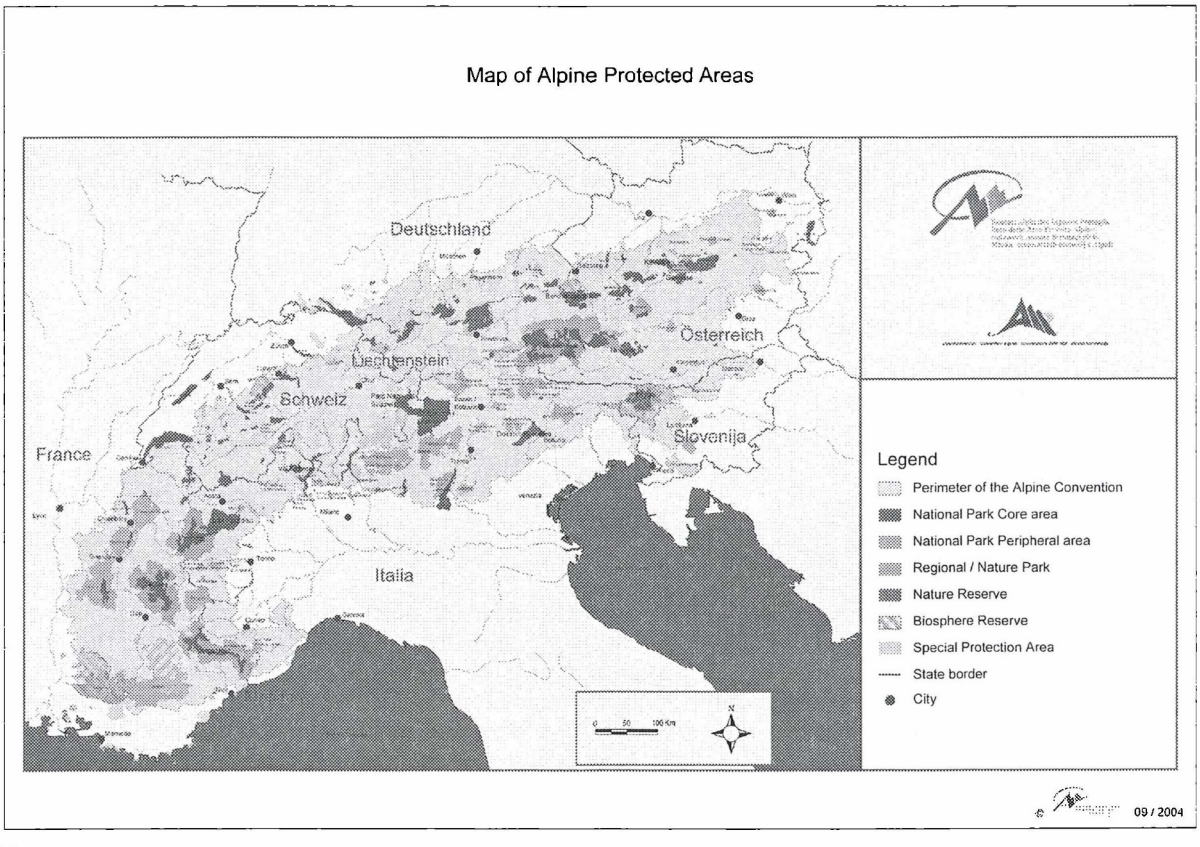


Fig. 1

Situation in the Alps

The Alps shelter a rich diversity of nature and landscape, which offers a habitat to a large number of plants and animals. The protected areas of the Alps give an important contribution to the protection and preservation of this biodiversity offering a refuge to wildlife.

For plants and animals the landscape is a broad spatial system with which they have interactions at different levels. This system is of special value when it offers a large number of big size habitats as well as a diversity of natural structure elements that are connected at small scale.

Contribution received at: 12.07.2005

This connections are important for natural life, specially for animals, because they need to move and use several types of different landscape parts. Most species are adapted to such a diversity of the landscape and use different environments during there development, in different seasons or during daytime. These spatial requirements vary according to the different species, therefore each specie has its own requirements.

For the long term survival of a species the possibility of genetic exchange between different populations is of major importance, otherwise the threat of degeneration and a accumulation of genetic defaults may lead to extinction.

The fragmentation of landscape and habitats as well as the intensive use of the land threatens the natural life. In the Alps this fragmentation due in priority to concentration of human activities in the valleys, the roads network, intensive agriculture, industrial activity, etc. has continuously reduced and isolated the habitats for animal and plants in the last years. The habitat fragmentation has important consequences for diversity since it is recognized as one of the most important factors for species extinction. Without large habitats the possibilities of survival for many species and populations decrease.

This is the reason why the protection of wildlife and biodiversity can not only relay on the protected areas. Many animals need more space to live than these areas can provide. Scientists agree on the fact that only large and ecological adjoining protected areas can ensure a sustainable and long term protection of the biotic and abiotic nature resources of the Alps and guarantee the natural processes. Therefore large protected areas should be created even beyond national boarders.

This could be done by connecting the surfaces of existing protected areas in different states across the frontier. An other possibility is the creation of large complexes inside the different Alpine states through spatial connections between the protected areas where these links are of ecological importance and in accordance with the technical and social conditions. Through these connections the protected areas would not be isolated "islands" any more, but allow the exchange between each other. NATURA 2000 sites as well as the effective protection Priority Areas detected by the WWF in cooperation with other institutions can help to create such connections. In this way, the NATURA 2000 network could be completed and a unity of contiguous surfaces between the alpine protected areas could be developed.

Network concept

A ecological network is composed of different elements:

- core zones (for example the protected areas), as static components and
- connection elements between these zones, as dynamic components of the network.

These connection elements can be linear (rivers, forest boarders, ...) and facilitate movements of the flora and fauna or punctual like small biotopes (stepping stones) with the function of migration stations and dispersion pools.

Towards an alpine Network

Large protected areas and joined groups of areas with different protection status are important. They will represent the core zones of an alpine network and are the shelter for wildlife. But the network cannot be based only on protected areas or single elements as nodes between ecological corridors – the network needs a sustainable long term policy, which is based on spatial planning tools. The permeability of the cultural land between the biotopes is also an important element of the network to allow movements of the flora and fauna. Therefore sustainable and ecological adapted land use (extensive land use methods, adapted landscape planning, ...) is important to create effective connection possibilities between the nodes.

The Alps do not only possess a large natural diversity but also a important cultural diversity and the landscape often revels the old traditional living forms. Many of the traditional structures and use forms have given a habitat to special adapted species. In the cultural land there can be found a diversity of its own. This is why cultural land and tradition extensive methods should be forced not only as couloirs or corridors but also as living space.

Every alpine country offers a large variety of different measures and programs in various domains to improve the connectivity of habitats. The existing possibilities of the different countries (measures and programs – for example in agriculture, forestry, infrastructure development,...) have to be applied more efficiently. This means for example, that this measures should be regroupt by local or regional initiatives and projects to improve the interactions between the concerned surfaces and to join the efforts in a common way. Furthermore, the different strategies have to be concerted internationally.

In this context, it is important to underline and to analyse the measures of protection and the possibilities of more intense cooperation between adjoining protected areas. This cooperation can be on a special theme with defined aims such as, for example, the protection of a certain species, the cooperation for sustainable regional development, etc. The analysis of the possibilities to create connections between protected areas which are in the same time composed of selective measures and regional management measures has to take into account the actual spatial distribution of protected areas.

In the Alps a considerable number of associations of protected areas can be detected: complexes of two or more transboundary areas, associations of two or more national areas and also large protected areas with a rigorous protection policy and a surface of several 1000 ha. Those elements play an important role for conservation. The established connections and the common action programmes between such complexes can serve as example for further national and especially international cooperation and facilitate the migration and exchange between habitats even across country boarders.

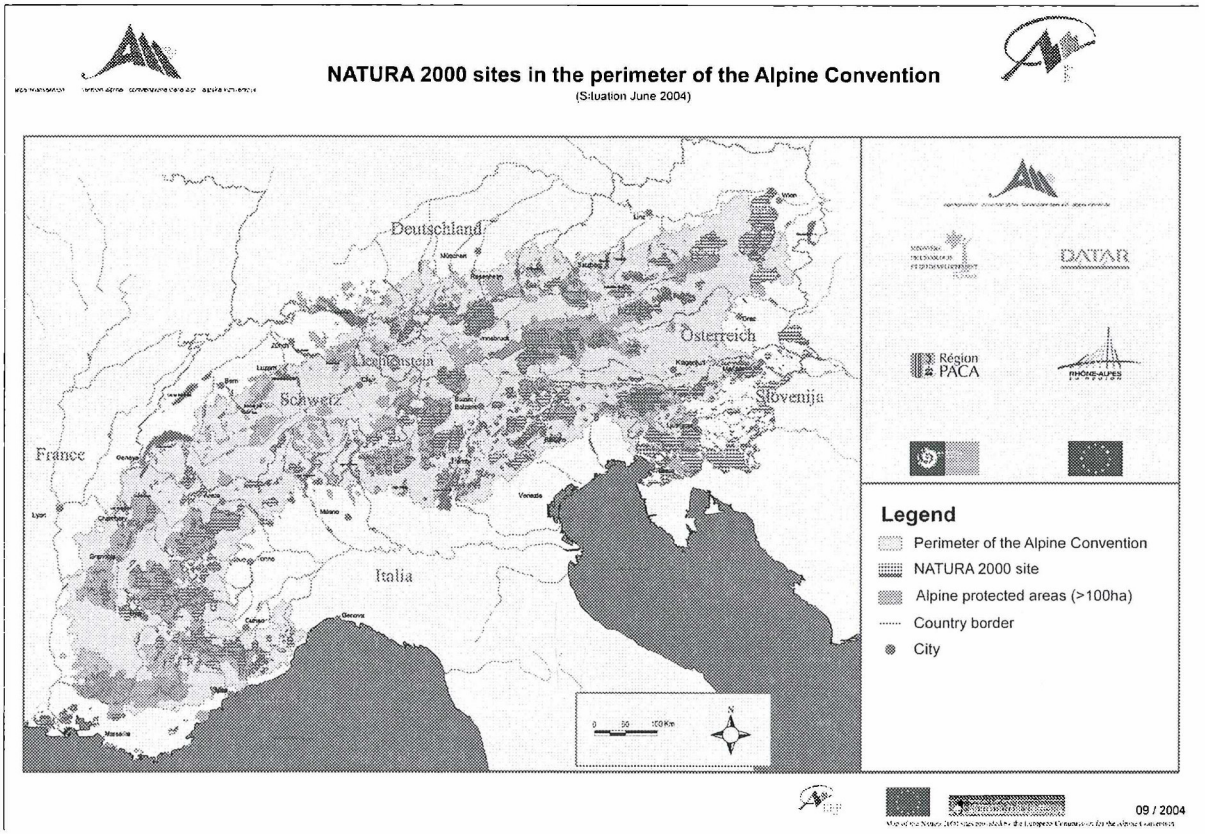


Fig. 2

Methodology

Different approaches can be chosen for the implementation of an ecological network. One of them is the analysis of the actual situation of habitats, their quality and the existing connections between these biotopes. The following model could be applied to analyse the actual connections between protected areas: the analysis of satellite images and aerial photographs to determine the limits of different types of habitats and to show the actual connections between different zones of the same habitat by mapping and GIS methods. These results also with information from national and regional inventories of flora and fauna, the knowledge of biologists and naturalists and the valorisation of the information by field trips allow the illustration of the actual continuity of habitats. This method was used for the detection of corridors and continuums for the National Ecological Network in Switzerland.

This method makes the detection of existing continuums easier and even more important, the isolation of areas where these continuums are interrupted and where measures have to be taken to improve the connection situation. The knowledge of established wildlife corridors as well as further information from statistics of accidents caused by animals, obvious barriers in the landscape and areas of special biodiversity have to be taken in account.

The situation of several areas can also be evaluated by using indicators or criteria, if the work with satellite images or aerial photographs is not possible. Because of time restrictions and of the large surface that had to be covered (the hole surface of the Alpine Convention), the Alpine Network of Protected Areas has chosen this approach for its project about an ecological network in the Alps. Indicators such as surface and altitude of protected areas, density of habitants, land use type, infrastructure density, etc. can allow some interpretation of the ability for a landscape to fulfil the role of corridor. After the general evaluation of the situation by this method, the different zones where problems may be detected that where isolated have to be analysed more in details, in order to be able to find a solutions of the problems on a local level.

The practical work of establishing corridors and creating connections between habitats has to be done at a local scale, by defining projects for a determined zone, specie or habitat. The approaches have to be chosen in accordance with the needs and aims of the subject and the project. By initiating the juristic and financial basis for such local projects and by sustaining and helping the shareholders in their approach, the first step towards a coherent network can be made.

Aims

The creation of a network of protected areas with ecological connection elements and an adequate minimum protection of surfaces in-between has to be a long term aim. The general purpose has to be the creation of dynamic processes between the different protection forms and the implementation of the different possible measures that have an impact on the whole territory. The existing areas have to be group and connected in small associations to create in this way larger unites for wildlife refugee. Since the creation of new large protected areas is not to expect due to the political and economic circumstances in the Alps, the existing areas have to be connected in a way that they could take to role some large areas had to play. The so formed complexes improve the situation and the network can be enlarged by the time according to the changing situation.

The article 12 requires a network on a national and a transboundary level. This means connections between protected areas including elements which are not under protection yet but are important for the network. The expectations go further than the limits of the protected areas. And it way to go: the coordination of aims and measures of transboundary protected areas.

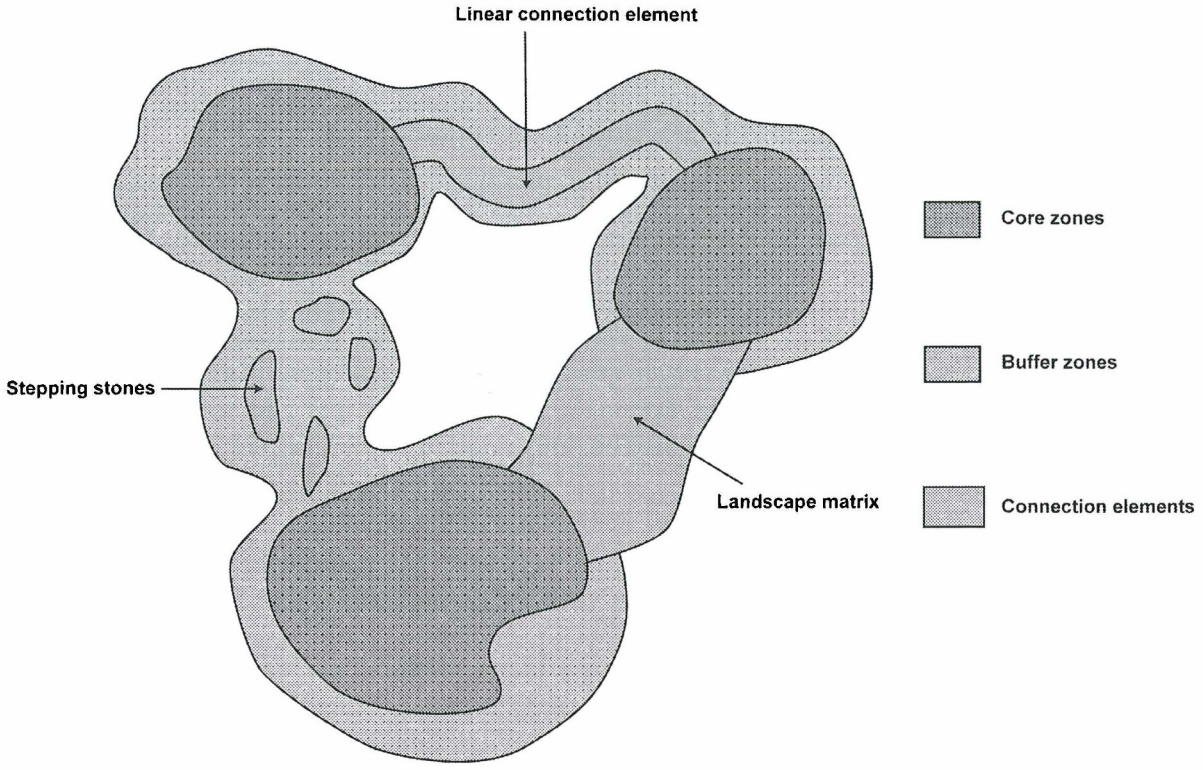
It is important to notify that the experiences made in protected areas in the fields of special species management, measures of sustainable development of land use and cooperation between different stakeholders can be useful in non-protected areas and contribute to the creation of an ecological network.

For the long term implementation of such a concept that represents a fundamental point of the Alpine Convention, further efforts have to be done. First of all, the existing measures and planning instruments in the different Alpine countries have to be synchronised. This can only be realised in large spatial units to reduce the expanding fragmentation and to reinstall a living landscape. The different protocols of the Alpine Convention propose a common way as they are the only ones that are valuable beyond boarders of the protected areas for the whole alpine territory. This naturally in combination with the national and regional legislations and t he general rules for nature protection.

Perspectives

The Alpine Network of Protected Areas promotes the creation of a alpine ecological network between protected areas by proposing suggestions of possible corridors in places where these makes sense. Create connections and corridors where this seem appropriated in reason of different criteria, such as special migrations routes for wildlife, geographic proximity, extensive land use, low human impact. Focus efforts on this zones, concentrating the application of measures and programs, using NATURA 2000 site protection programs to establish the network.

The thematic network of protected areas exists and cooperates with success in many different domains. The creation of a spatial network creating connections between the different alpine protected areas is a challenge for the future. An big defy but also a major chance for the preservation of the alpine landscape and the biodiversity in the Alps bringing profit to every involved protected area.



Elements of an ecological network

Fig. 3

References

ALPENKONVENTION (2003): Alpenkonvention – Nachschlagewerk. Alpensignale 1. Ständiges Sekretariat der Alpenkonvention, Innsbruck.

BAYRISCHES STAATSMINISTERIUM FÜR LANDESENTWICKLUNG UND UMWELTFRAGEN (1999) Biotopverbund. 58 S.

BIEDERMANN, J. (2002) Tun und Unterlassen – Vernetzung ökologisch bedeutsamer Flächen. Leben in den Alpen. Liechtenstein im Internationalen Jahr der Berge 2002. Regierung des Fürstentums Liechtenstein, S.80-81.

BILLION, V.; CARSIGNOL, J.(2003): COST-Transport- Action 341. Fragmentation de l'habitat due aux infrastructures de transport. Rapport de la France.

BISCHOFF, N.T.; JONGMAN, R.H.G. (1993). Development of rural areas in Europe: the claim for nature. Netherlands Scientific Council for Government Policy Preliminary Report V79, 206 S.

BROGGI, M.F.; STAUB, R.; RUFFINI, F.V. (1999): Großflächige Schutzgebiete im Alpenraum. Daten, Fakten, Hintergründe. Europäische Akademie Bozen, Fachbereich Alpine Umwelt.

BUNDESAMT FÜR UMWELT, WALD UND LANDSCHAFT (BUWAL) in Zusammenarbeit mit der Schweiz. Gesellschaft für Wildtierbiologie und der Schweiz. Vogelwarte (2001): Korridore für Wildtiere in der Schweiz. Schriftreihe Umwelt Nr. 326, 116 S.

BUNDESAMT FÜR UMWELT, WALD UND LANDSCHAFT (BUWAL) (2004): Grundlage für neue Schweizer Walpolitik. Medienmitteilung. 3 S.

BUNDESAMT FÜR UMWELT, WALD UND LANDSCHAFT (BUWAL) (2004): Lebensraum für bedrohte Arten. Faktenblatt Biodiversität. Internationaler Tag der Umwelt. 4 S.

COMITE POUR LES ACTIVITES DU CONSEIL DE L'EUROPE EN MATIERE DE DIVERSITE BIOLOGIQUE ET PAYSAGERE (2000) Lignes directrices générales pour la constitution du réseau écologique paneuropéen. Sauvegarde de la nature, Nr. 107. Editions du Conseil de l'Europe.

CORSI, F. ; BOITANI, L. SINIBALDI, I. (2002) Corridors écologiques et espèces grands carnivores dans la région alpine. Comité pour les activités du Conseil de l'Europe dans le domaine de la diversité biologique et paysagère. Sauvegarde de la nature, Nr. 127. Editions du Conseil de l'Europe.

ECONAT, CONSEIL GENERAL DE L'ISERE (2001): Les corridors écologiques en Isère. Projet de réseau écologique départemental de l'Isère (REDI). Conseil général de l'Isère.

JONGMAN, R. H. G.; KRISTIANSEN I. (2001): Approches nationales et régionales pour les réseaux écologiques en Europe. Comité pour les activités du Conseil de l'Europe dans le domaine de la diversité biologique et paysagère. Sauvegarde de la nature, Nr. 110. Editions du Conseil de l'Europe.

JONGMAN, R.H.G. and TROUBIS, A.Y. (1995). The wider Landscape for Nature Conservation: ecological corridors and buffer zones. MN2.7 project Report 1995, submitted to the European Topic Centre for Nature Conservation in fulfilment of the 1995 Work Programme. European Centre for Nature Conservation, Tilburg. 78 S.

NETZWERK ALPINER SCHUTZGEBIETE (2003): Pädagogisches Dokument d. Netzwerks Alp. Schutzgebiete.

NETZWERK ALPINER SCHUTZGEBIETE (2002): Typologie der alpinen Schutzgebiete. Gesetzliche Grundlagen und Schutzformen. Die Dossiers des Alpinen Netzwerks, Nr. 8.

SCHWARZEL, B.; HECKL, F. (2000): Schusswechsel zwischen Zäunen (BOKU-Workshop über Wildökologische Standards für das hochrangige Straßennetz). Österreichische Forstzeitung 111, Heft 1, S. 5-7

SERVICE ROMAND DE VULGARISATION AGRICOLE (SRVA) (1998) Nature et Agriculture ; Classeur thématique. SRVA, Lausanne.

WWF (2004) Die Alpen das einzigartige Naturerbe. Eine gemeinsame Vision für die Erhaltung ihrer biologischen Vielfalt. Broschüre. WWF Deutschland, Frankfurt am Main. 31 S.

ZULKA, P.; LEXER, W. (2004): Auswirkungen der Lebensraumzerschneidung auf die biologische Vielfalt. Natur Land Salzburg 11. Jahrgang, 1/2004. S. 30-34.

Contact

Yann Kohler
yann.kohler@gmx.net

Guido Plassmann
guido.plassmann@alparc.org

Alpine Network of Protected Areas
Micropolis Isatis
F 05000 Gap
France

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 113-115

A lab above the clouds (I) NO_2 measurements at the Sonnblick Observatory

Martin Koller, Anne Kasper-Giebl

Abstract

A discontinuous method for measuring nitrogen dioxide (NO_2) on a daily average basis is to be adapted to the background ambient at the Sonnblick Observatory. 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).

Keywords

Background measurements, nitrogen dioxide, Sonnblick Observatory, daily average, air chemistry

Introduction

With its location in the remote mountainous regions of the Alps, the meteorological observatory on Mt. Sonnblick (SBO) offers a great opportunity for scientific research. Built in 1896, the station's main task was monitoring the weather. But since 1980 it also became one of the most important platforms for atmospheric chemistry, hosting a large number of projects. A high elevation background site, with a full infrastructure, situated in a region of negligible local emissions in central Europe is unique and of great value.

With the introduction of the Global Atmosphere Watch program (GAW) by the World Meteorology Organization (WMO) in 1989, and the DACH-association, a cooperation between the German stations of Hohenpeissenberg (MOHp) and Zugspitze, the Swiss Jungfraujoch (JFJ), the Sonnblick observatory has proven itself on international standards.

Because of the high altitude (3106m) the site is not affected by changes in the boundary layer but only by long-distance transport of pollutants. This allows monitoring of emissions, cloud formation, acid rain and aerosols, with the information obtained being a true indicator on the background situation in central Europe.

The collected data is used for research on climate change and the anthropogenic greenhouse effect.

Aim of the project

The aim of the project is to determine the concentration of nitrogen dioxide on a daily average basis at the Sonnblick Observatory, using the NaI-method based on the findings of FERM et al. (1984) and SALTZMANN (1954).

A method for continuous measurement is in planning. As this method is only able to detect NOy (the sum of NO_2 and other nitrous components that can be oxidized), there is the need for a reference method, which selectively monitors the NO_2 concentration.

Also included are a validation of the NaI method, the determination of its analytical parameters, especially the level of detection, and finally the evaluation of its usefulness on Mt. Sonnblick.

Methods

Before the usage of continuous monitors, the first reliable method for measuring NO_2 was the Saltzmann technique (SALTZMANN, 1954), which is a wet chemical method. It uses a bubble flask with a cylindrical frit containing the Saltzmann solution, a mixture of N-(Naphtyl-1-)ethylendiammoniumdichlorid (NEDA) and Sulphanilamin. Air is pumped through the frit and NO_2 reacts with the fluid, forming a purple azo dye. The concentration is determined through photometrical analysis.

FERM et al. (1984) separated the sampling from the analytical part by introducing a method using a solid sorbent.

Contribution received at: 15.07.2005

This not only evades the problems of evaporation of fluid, and mailing, but also reduces the interference of ozone because it shortens the contact time between air and sorbent.

A 3mm thick sintered glass filter with a diameter of 25 mm and a porosity of 40-60 µm is enclosed in a glass tube with hose olives at both ends. It is coated with a mixture of sodium hydroxide (NaOH) and sodium iodide (NaI) which is more sensitive to lower humidity than potassium iodide (KI).

Air is pumped through the vessel and the NO_2 is absorbed by the NaI and converted to sodium nitride ($NaNO_2$). The iodide also prevents the nitride (NO_2^-) from oxidizing to nitrate (NO_3^-).

After sampling the glass vessels are sealed and sent back to laboratory in Vienna. There the coating is washed off and turned into the azo dye by adding NEDA and Sulphanilamin. The absorption of light at 540 nm is proportional to the concentration of NO_2 and can be measured in a photometer.

The Setup

The whole setup is placed indoors. A 6x4 Teflon tube is attached to the main manifold of the station followed by a prefilter (Whatman 40), which is used to separate particulate matter. Next to the glass vessel (frit) the pump is placed followed by a gas meter. Temperature and pressure of the exhaust are measured and used for the calculations. (see Fig. 1)

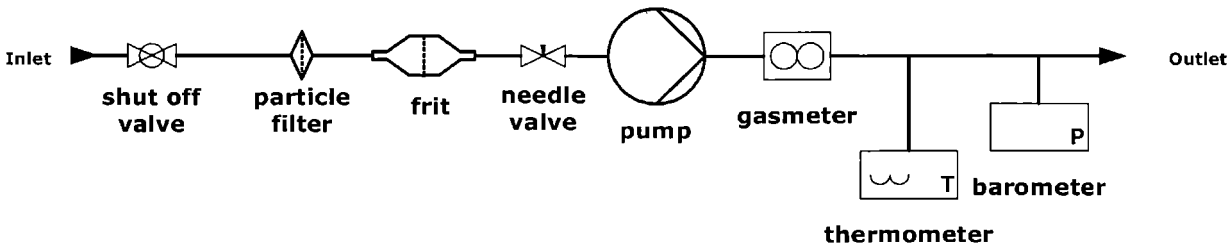


Fig. 1: The sampling setup used on Mt. Sonnblick

Results and discussion

Sampling on Mt. Sonnblick commenced in the end of September 2004, continued in November, December and January 2005 until the most recent series, which lasted through the whole month of March.

In city sites in Salzburg, for example at the Hagerkreuzung in Hallein NO_2, concentrations are at about 55 ppb daily average, in contrast to more rural areas like Hallein Winterstall or Vienna Schafbergbad (both ~5 ppb). In central Vienna they usually range up to 80 ppb, but have also reached maximum levels of 120 ppb.

On Mt Sonnblick 78% of the time measured the NO_2 concentration is below 0.3 ppb and 35% of the time even below 0.1 ppb, which is next to nothing (~$1/1000^{th}$) compared to the values found in city areas. (see Fig. 2)

And even though the numbers lie near to the limit of detection (0,028 ppb), which is obtained through field blanks, nearly all of them are above it.

During the whole time a lot of effort has been taken to improve the performance of the method; on one hand by trying to increase the flow rate, and on the other hand by enlarging the resolution of the photometric analysis. The increase of the flow rate in order to sample more of the NO_2 would very much improve the signal to noise ratio.

Low ambient pressure (~700 mbar) at this altitude hampers sampling to some extent, since the flow rate has to be increased by approximately 1.45 times in order to sample the same amount of analyte as on sea level.

Especially the flow rate seems to be one of the limiting factors, due to the fact that the absorption efficiency decreases, if the rate is too high. Tests on absorption efficiency have been performed at each series and gave very good results.

Only during the sampling period in March, where the flow was increased greatly, the absorption efficiency decreased to an average of 70% (+/-20%).

And since the concentration can even drop under the current limit of detection, it is necessary to perform further tests on absorption efficiency at higher low rates which are currently in progress.

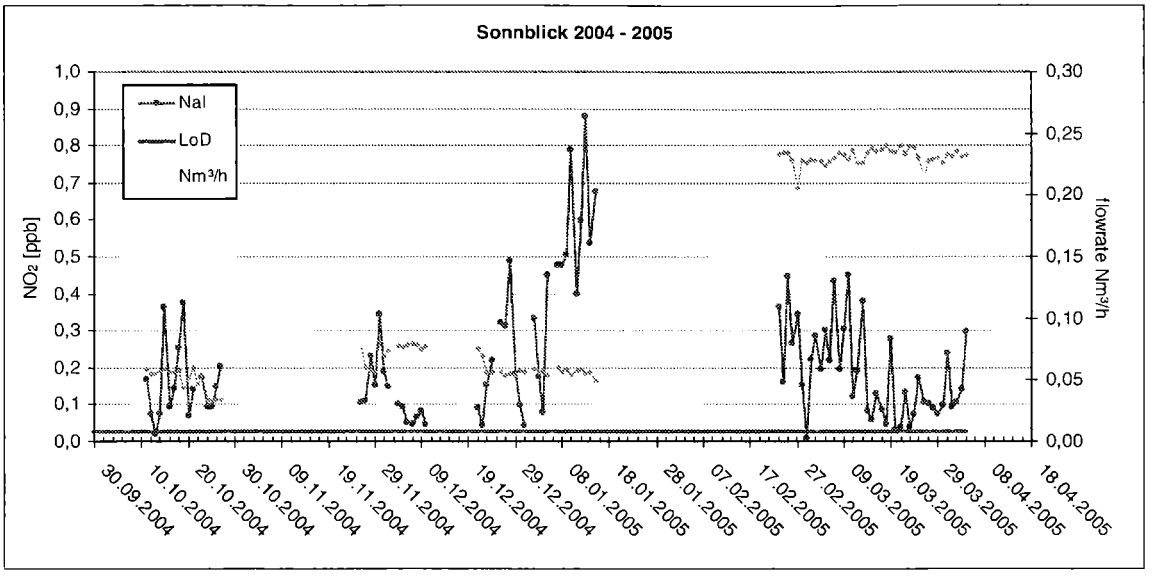


Fig.2: The measurement series on Mt. Sonnblick

Acknowledgements

Thanks go to the weather observers Friedl, Hans, Lug and Toni for sample change and support at the site.

The project 'NO_2 measurements at Sonnblick' was financed by the Austrian Ministry for Environment.

References

FERM, M and SJÖDIN, Å. (1993) Proposal of an impregnated filter technique for monitoring of NO_2 at EMEP stations. (EMEP/CCC-Report 1/93)

VDI-Richtlinien, Messen der Stickstoffdioxid-Konzentration, VDI 2453, November 1983

ZELLWEGER, C., AMMANN, M., BUCHMANN B. et al. (March 16. 2000) "Summertime NO_y speciation at the Jungfraujoch, 3580 m above sea level, Switzerland", (Journal of Geophysical Research, Vol. 105, No. D5, pages 6655-6667)

Contact

Martin Koller
mkoller@mail.tuwien.ac.at

Institute for Chemical Technologies and Analytics
Vienna University of Technology
Getreidemarkt 9/164-AC
A 1060 Vienna
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 117-120

Nature conservation evaluation of alpine pastures in the Gesäuse National Park (Styria, Austria) by means of the bioindicators spiders, leaf- and planthoppers (Arachnida: Araneae; Insecta: Auchenorrhyncha)

Christian Komposch, Werner Holzinger

Abstract

Faunistic investigations in alpine grasslands in the Styrian "Gesäuse National Park" (Ennstaler Alps, Austria) should show the effects of grazing for nature conservation aims. The two bioindicator groups Araneae and Auchenorrhyncha were collected by means of pitfall traps and a G-Vac suction sampler in the vegetation period 2004: a total of 9.100 specimens were recorded, belonging to 82 epigeic spider and 53 leaf- and planthopper species. Twenty percent of the spider species are more or less endangered, one Auchenorrhyncha is new to Austria, and remarkably 10 spider- and 4 Auchenorrhyncha-species are new to Styria. The densities (G-Vac suction samples) varied from 2 to 30 specimens per square metre in spiders and 7 to 100 adults in leaf- and planthoppers. Suggested measures in nature conversation management include, among other things, a continuation of extensive grazing in selective meadows, the reduction of the densities in intensively grazed meadows, the cessation of grazing in sensitive wetland-biotopes and the increased consideration of biotopes without plant cover.

Introduction and aim of the study

The Gesäuse National Park lies within the Northern Calcareous Alps in Styria, Austria. Among some nearly natural forests, wide natural alpine meadows and rocky biotopes, there are quite large areas retaining a traditional form of grazing up to the present day.

This study is part of a broad interdisciplinary research study (coordination: Mag D. Kreiner). It deals with the nature conservation value of selected mountain pastures. An investigation of bioindicators, namely spiders, leaf- and planthoppers, should help answer the question whether the extraordinary expense of cattle grazing in barely-reachable areas during summer is worthwhile from a nature conversation point of view. In other words, we want to know if the effects of grazing are predominantly positive or negative for nature conservation purposes.

In addition, we used this project for the first recorded comparison of two widely used field research techniques, namely pitfall traps and a G-Vac suction sampler, in alpine grasslands. We wanted to learn something about the difference between recorded and estimated "real" biodiversity gained from these two techniques.

Study area and methods

The study area comprised four mountain pastures in the Gesäuse National Park, called Sulzkaralm, Haselkar, Hüpflinger Alm and Scheuchegg (47°32-34' N, 14°40-42' E; Ennstaler Alps, Styria, Austria), situated between 1.300 and 1.800 m a.s.l. Within these pastures, 10 areas with different biotope types (fenland, sedge swamps, oligotrophic grasslands, fresh and moist meadows) and different grazing intensities were marked and studied. The spider-, leafhopper and planthopper fauna was investigated (semi)quantitatively by means of 36 pitfall-traps (Barber traps) and a G-Vac suction sampler from July until September 2004. The registered datasets will be stored in the biodiversity database (BioOffice) of the national park.

Acknowledgements

We are grateful to Mag MSc Daniel Kreiner and Mag Dr Lisbeth Zechner, both Gesäuse National Park for realising this project and various support and Dr Jason Dunlop, Berlin for improving the English of the manuscript.

Contribution received at: 09.08.2005

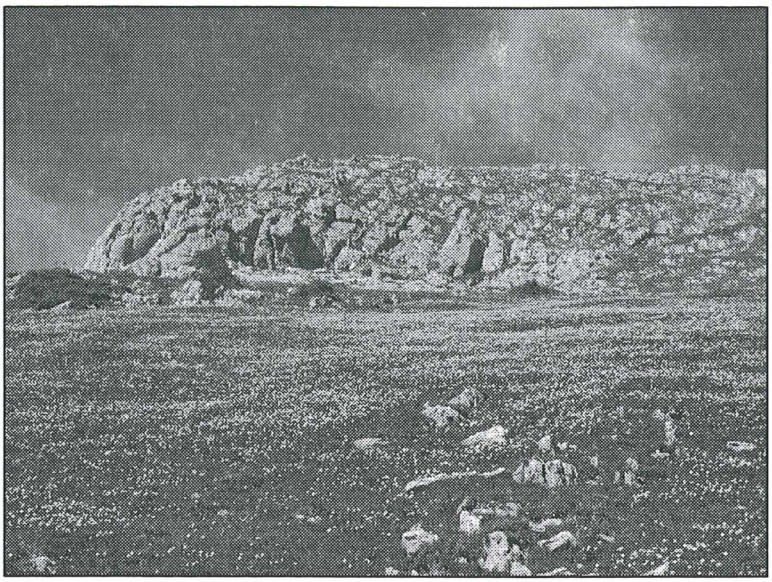


Fig. 1: The *Trollius*-dominanted grassland "Haselkar Lugauer" in the Gesäuse National Park, Ennstaler Alps. [photo: Ch. Komposch / ÖKOTEAM; 8.7.2004]

Results and discussion

The **spider fauna (Araneae)** is represented by 82 epigeic species from 15 families (3.500 specimens). The spider-coenoses are dominated by the lycosids *Pardosa amentata* (25.3 %), *P. riparia* (5.6 %), *P. oreophila* (3.0 %) and *Alopecosa pulverulenta* (2.9%). 19 species were caught in just one single specimen. On an average 17 species and nearly 250 specimens per locality could be reported; maximum values reached 30 species and 880 specimens. The densities (G-Vac suction samples) varied from 2 to 30 specimens per square metre with an arithmetic mean of 9.

The high number of 10 first species-records for Styria is remarkable. This state of affairs is due to three reasons: 1) the occurrence of rare taxa and the incomplete faunistic investigation of alpine biotopes (*Agyneta cauta*, *Erigonella subelevata*, *Evansia merens, Leptorhoptrum robustum*, *Meioneta affinis*, *Metopobactrus prominulus*, *Talavera monticola*), incorrect identification by former authors (*Erigone cristatopalpus, Lepthyphantes jacksonoides*; cf. KROPF & HORAK 1996) and the lack of formal publication of known records (*Xysticus secedens*; JANTSCHER 2001).

Oligotrophic dry and semi-dry grasslands and fens, bogs and moist meadows are rich in spider species. A high relevancy of special biotopes and structures like erosion-areas, uprooted root systems, stones and rocks could be documented via spiders. These biotope types bear very discrete spider coenoses and lead to a much higher diversity, even in intensively pastured meadows. Twenty percent of the spider species can be found in the red data list (cf. KOMPOSCH & STEINBERGER 1999), 11 species are assigned to the high-ranking categories "very rare" (R) and "endangered" (G, 3).

Non or extensively grazed meadows normally contain more valuable spider coenoses than intensive pastures. A significant correlation between an increasing intensity of grazing and a decreasing number of endangered species could be shown.

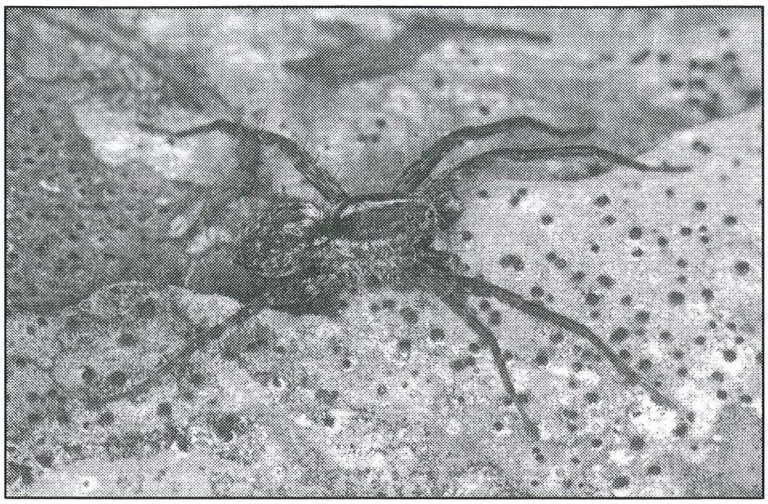


Fig. 2: The wolf spider *Pardosa oreophila* is a charakteristic species of alpine meadows and pastures. [photo: Ch. Komposch / ÖKOTEAM]

5.600 **Auchenorrhyncha** specimens from 53 species were recorded; the densities varied from 7 to 100 adults per square metre. Some records were remarkable from a faunistic point of view; one species was new to Austria, another four were new to Styria. The leaf- and planthopper densities were almost constant during the whole vegetation period in extensively grazed meadows, while intensive grazing lead to a significant reduction of Auchenorrhyncha densities from spring to autumn. The "nature conservation value" of meadows decreases with increasing grazing intensity. This effect seems correlated to soil moisture; wet areas are more sensitive to intensive grazing than dry biotopes.

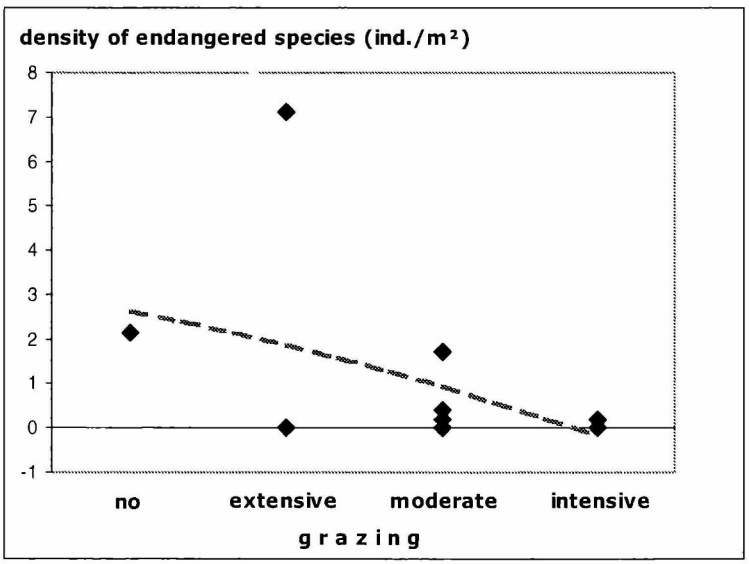


Fig. 3: Correlation (broken trendline) between the intensity of grazing and the density of endangered and valuable Auchenorrhyncha species in alpine pastures of the Gesäuse National Park.

Derived proposals for management and conclusions

A long-term protection of characteristic, stenotopic and highly-diverse arachnid- and insect-coenoses in alpine biotopes in the Gesäuse National Park requires the implementation of certain measures:

- ♦ continuation of extensive grazing in secondary meadows
- ♦ no grazing in primary woodless areas
- ♦ reduction of cattle-densities in intensively grazed meadows

- no grazing (fencing) of sensitive special biotopes like fens, raised bogs and spring horizons (endangered by eutrophication and trampling); indeed shrub invasion should be prevented by special tree-clearing measures
- further research studies in shrubbed alpine-areas, alpine mowed pastures and primary woodless alpine meadows (reference areas)
- increased consideration of biotopes and structures without plant cover (including their precious arachnid- and insect-coenoses) in nature conversation management

The study has shown, that on the one hand the recommendation of general measures for future projects is possible; on the other hand, a closer botanical and zoological examination of the management areas and proposals is useful and in many cases indispensable. In the present case precise packets of measures are offered for every biotope type of the investigated alpine pastures. Deficits exists concerning the interdisciplinary combination of botanical and the particular zoological results. Furthermore, the outstanding relevance of insects and arachnids in all biotope types of Central Europe is not being reflected neither in the number of research projects on national parks nor in the amplitude and extent of applied nature conservation work.

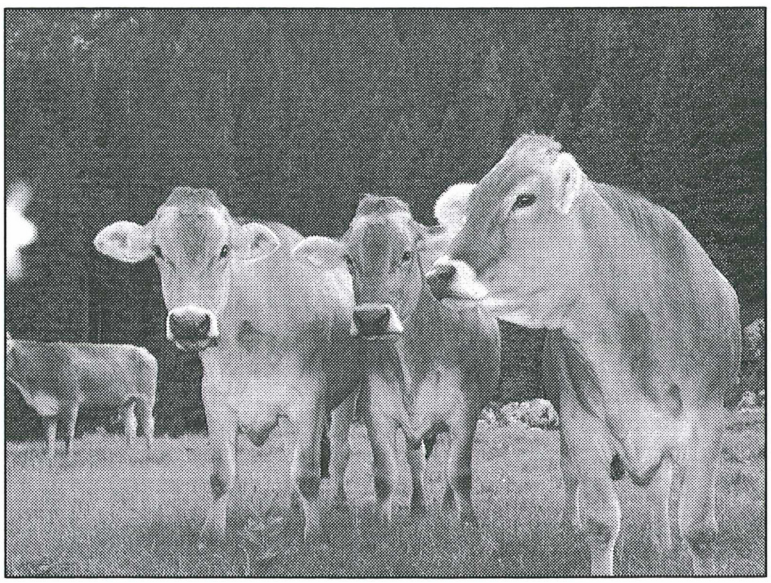


Fig. 4: Sensitive biotopes should be fenced against cows. [photo: Ch. Komposch / ÖKOTEAM; 8.7.2004]

References

JANTSCHER, E. (2001): Revision der Krabbenspinnengattung *Xysticus* C. L. Koch, 1835 (Araneae, Thomisidae) in Zentraleuropa. – Unpublizierte Dissertation, 328 pp. & 81 Tafeln, Karl-Franzens-Universität Graz.

KOMPOSCH, Ch. & K. H. STEINBERGER (1999): Rote Liste der Spinnen Kärntens (Arachnida: Araneae). – Naturschutz in Kärnten, 15: 567-618.

KROPF, Ch. & P. HORAK (1996): Die Spinnen der Steiermark (Arachnida, Araneae). – Mitteilungen des Naturwissenschaftlichen Vereines für Steiermark, Sonderheft, 112 pp.

Contact

Mag. Dr. Christian Komposch
c.komposch@oekoteam.at

Mag. Dr. Werner Holzinger
holzinger@oekoteam.at

ÖKOTEAM – Institute for Faunistics and Animal Ecology
Bergmanngasse 22
A 8010 Graz
Austria

http://www.oekoteam.at

The medium-term management plan for the Berchtesgaden National Park

Volkmar Konnert

Abstract

In the years 2002 to 2004 the Berchtesgaden National Park elaborated a medium-term management plan for the forests with the help of the Geographical Information System (ArcGIS), the CIR-mapping of the biotopes based on aerial photographs, the site mapping, the data of the forest inventory and other digital data available. The geometry of the CIR-Map served as basis for the geometry of the forest management map.

The project derives from the collaboration between the "Fachhochschule Weihenstephan" (departments of forestry and landscape architecture), the department of forestry of the National Park Administration and the Forest Planning Unit of the Regional Forest Office of the State Forest Administration.

The forest management database and the description of measures was compiled from the forest management map, the stand description and the results of the recent forest inventory.

Contact

Dr. Volkmar Konnert
v.konnert@nationalpark-berchtesgaden.de

Nationalpark Berchtesgaden
Doktorberg 6
D 83471 Berchtesgaden
Germany

Contribution received at: 18.07.2005

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** | pages 123-124
September 15th to 17th, 2005, Castle of Kaprun

Multifunctional Assessment of Alpine Pastures

Daniel Kreiner, Lisbeth Zechner

The National Park Gesaeuse in Styria (Austria) with an area of 110 km² includes 8 pastures which are still grazed, and 4 pastures which have been abandoned since the 1960es. In 2003 we started with the area-wide assessment of the quality and quantity of pastures and the first zoological and vegetation surveys in the "Sulzkaralm", which, with 180 ha, is the biggest pasture in the National Park. In 2004 we continued with two additional pastures (Haselkar, Scheuchegg) and one occasionally grazed pasture (Hueflinger alm). In 2005 three abandoned pastures are being investigated in cooperation with the BAL Gumpenstein (BOHNER A.) within the frame of an EU-project which analyses the effects of abandonment on biodiversity.

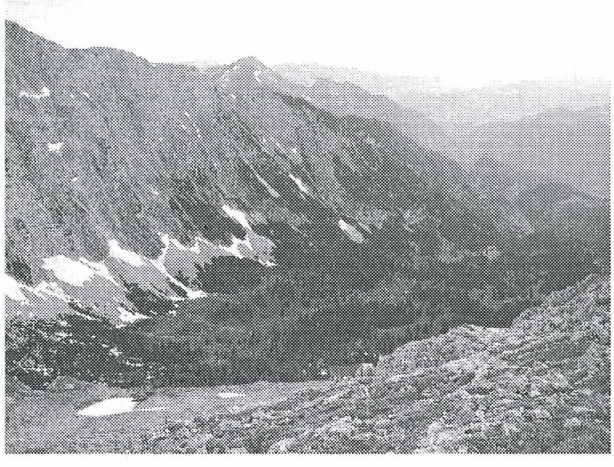


Fig. 1: Alpine Pasture "Sulzkaralm"

Data collection concerning the intensity of grazing is done with a digital evaluation system. The data is collected with PDA and GPS-module in the field and gets implemented in Arc View 3.2 (HÜTTENBRENNER K., EGGER G., BAL GUMPENSTEIN, BERGLER F., SCHWAB M.). Data of special habitats in alpine pastures (i. e. FFH-habitats, forests, wetlands, special structures, karst formations etc.) is gained area-wide. Analysis of vegetation is the basis for the assessment of nature conservation quality. Springs, wetlands, bogs and small ponds belong to the extremely sensitive habitats and are therefore mapped intensively. The main focus is placed on selected animal groups, i.e. Plecoptera, amphibians and reptiles (HASEKE H., NHMW, WEIGAND E.).

Fig. 2: Insect trap

Information on biodiversity of selected study areas with different pasture types is collected for selected animal groups (bugs, cicadas, spiders, grasshoppers and small mammals).

Contribution received at: 05.08.2005

The suitability of these groups for the assessment of open habitats at this altitude and the survey methods are evaluated within this project. Additionally, a census of breeding birds in the investigation areas completes the information on diversity. The results are the basis for the formulation of management measures (KREINER D., Ökoteam, FRIEß T., DERBUCH G., ZECHNER L.).

Fig. 3: Investigation on grasshoppers and other insects.

Furthermore in 2005 intensive investigations concerning habitat parameters and vegetation have begun (analyses of nutrient quality and soil, indicator values etc.). The study areas are part of a long term investigation system, which should allow the long term assessment of measures in alpine pastures (BOHNER A., KREINER D.).

The investigation of the historical use of pastures brings important knowledge concerning the development of cultivation of alpine areas. The basic economic conditions were reasons for the varying intensity of grazing (HASITSCHKA J.). In the EU-project concerning the abandonment and effects on biodiversity, data of the Gesaeuse is also included (KREINER D.).

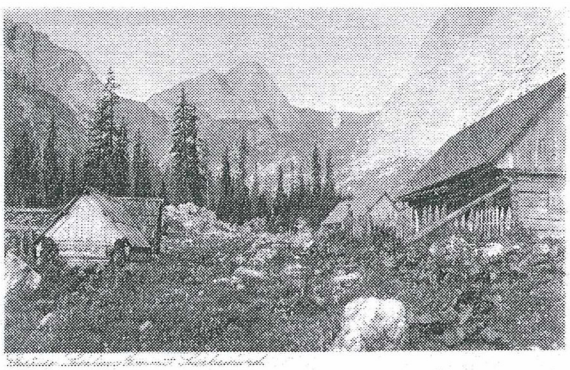


Fig. 4: Historical picture of the Sulzkaralm.

The data of these studies should bring important basic information on biodiversity of alpine pastures, also in connection with abandonment of pastures. Apart from the basic research the implementation of the results, i.e. changes in intensity of grazing or protection of sensitive habitats, is also important and will be done in cooperation with the farmers. This approach to a manifold and difficult issue could be a model for other regions or protected areas in the Alps. In addition, intensive public relations with presentations, excursions with farmers etc. should inform the farmers and the public about the objectives and aims of the project.

Contact

Mag. Daniel Kreiner
daniel.kreiner@nationalpark.co.at

Dr. Lisbeth Zechner
lisbeth.zechner@nationalpark.co.at

Nationalpark Gesäuse GmbH
A 8913 Weng im Gesäuse 2
Austria

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 125-128

Interdisciplinary monitoring project of subalpine mountain hay meadows in Hohe Tauern National Park (Carinthia)

A model for extensive cultivation and preservation of these endangered ecosystems, their biodiversity and their species interactions

Werner Kreisch, Mona Abl

Abstract

This paper presents a management concept for the subalpine mountain hay meadows "Pockhorner Wiesen" developed for the Carinthian Administration of Hohe Tauern National Park. It consists of a proposal for their cultivation by a maintenance plan and a long-term interdisciplinary monitoring concept. A comparison of different mowing intervals is designed to establish how often the meadows should be cut to ensure a maximum of biodiversity with a minimum of labour and to sustain the existing interspecific relationships. The monitoring employs vegetation-ecological and pollination-biological methods. The former document the dynamics in the various phytocoenosis of the ecosystem. The latter are – due to the high numbers of flowers and the great variety of pollinators – perfect parameters for the study of animal-plant relationships in mountain hay meadows.

The ideal conditions for research in Hohe Tauern National Park promote the development of innovative methods for advanced environmental management. The direct application of scientific results in a management concept provides a resource that can be of use both theoretically and practically in the cultivation and conservation of these endangered ecosystems.

Keywords

Mountain hay meadows, monitoring, vegetational ecology, floral ecology, Hohe Tauern National Park, Austria

Project aims and duration

The Pockhorner Wiesen, traditionally cultivated mountain hay meadows of high biodiversity, are at risk from progressive abandonment and forest encroachment. On behalf of the Administration of the Carinthian section of the National Park, a management concept was developed to guarantee the long-term survival of the meadows. It provides for their targeted cultivation within the framework of a maintenance plan and the evaluation of the results through interdisciplinary vegetation- and flower-ecological monitoring. The aim of the project is to determine how often the plant communities characteristic of this area should be mowed to preserve the diversity of the plant species and flower-visiting insects and to maintain their manifold interspecific relationships. This shall help to explain the succession processes in abandoned mountain hay meadows in the Alps.

The project has a duration of 7 years and includes subsequent evaluations at intervals of several years. The pilot phase was carried out in 2003.

Area of study

Location

The Pockhorner Wiesen are located on the southern slopes of the Alps in the buffer zone of Hohe Tauern National Park. The area is inclined up to 35° and comprises around 100 hectares at 1950-2400 m above sea level (fig. 1).

Contribution received at: 18.07.2005

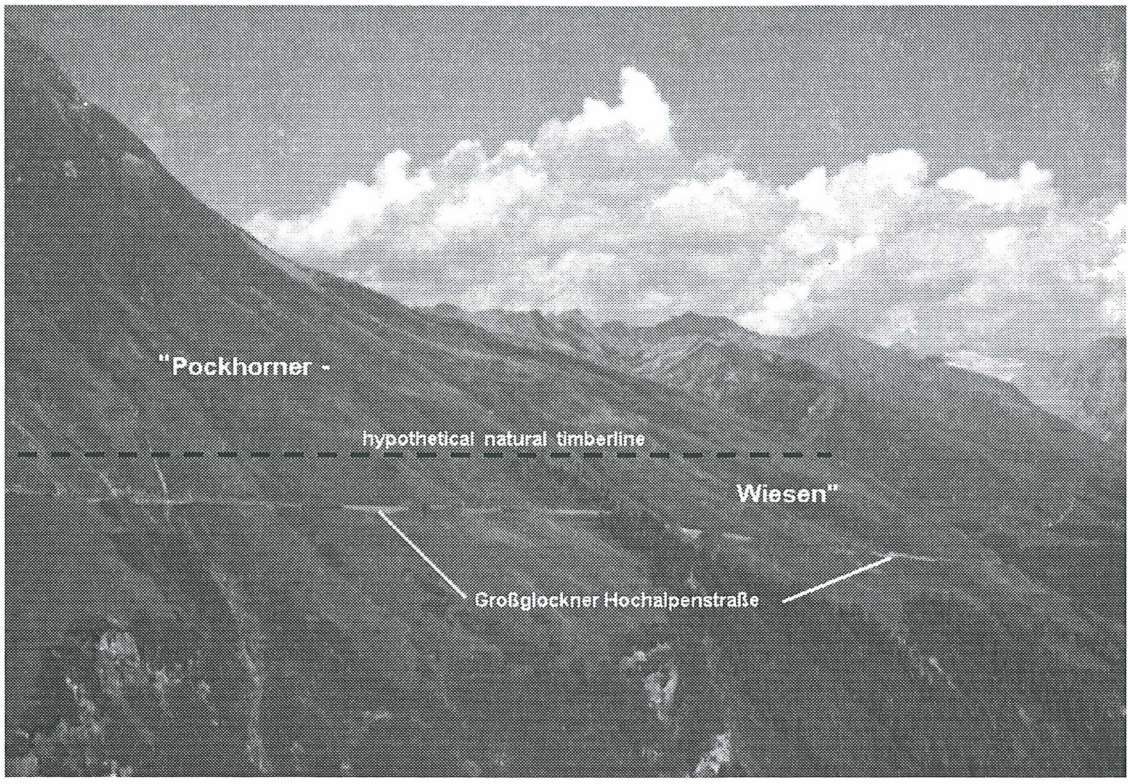


Fig. 1: Location of the mountain hay meadows "Pockhorner Wiesen" directly above the Großglockner Hochalpenstraße highway with actual and hypothetical natural timberline, marked by the dashed horizontal line.

Flora and vegetation

With their 208 vascular plant species (ABL 2003), the meadows are probably among the most species-rich ecosystems of the Park. This author also identified eight plant-communities here, including meadow communities like *Hypochoerido uniflorae-Festucetum paniculatae*, *Campanulo scheuchzeri-Festucetum noricae*, *Trifolio nivalis-Seslerietum albicantis* or heaths like *Junipero-Arctostaphyletum*. The bi-annually mowed subalpine-alpine *Sieversio-Nardetum strictae* includes up to 61 Species per 25m².

Pollination ecology

The high number of blossoms, a prominent feature of the Pockhorner Wiesen, is the basis for the impressive diversity of flower-visiting insects and for the multifold plant-pollinator relationships (KREISCH 2001a). 140 anthophilous insect species belonging to 4 orders and 34 families have been identified on their visits to 130 entomophilous plant species. Diptera were more abundant than hymenoptera and lepidoptera, while coleoptera make up only a small percentage in the pollinator fauna.

Risk from progressive abandonment

Today, less than 20% of the area is mowed either bi-annually or more sporadically. In areas that have lain fallow for more than 20 years, the biodiversity of the flora is up to 25% lower than in the areas that are mowed bi-annually. The presence of flowers even decreases twice as fast with progressive abandonment. The lower section of the mountain hay meadows, which is situated on ground originally covered by forests (cf. fig. 1) and which today contains the most species-rich and therefore most precious part of the ecosystem, is further threatened by the renewed encroachment of shrubs and trees into the meadows (KREISCH 2001b).

Maintenance plan

A maintenance plan based on ABL (2003) applies three concurrent agricultural strategies in three altitudinal zones to stop succession in a large portion of the hay meadows (fig. 2):

1. continued bi-annual to sporadic mowing of the lots directly above the Großglockner Hochalpenstraße mountain road
2. regular mowing alternating with short fallow periods in the middle section
3. wilderness area in the highest lots

Monitoring design

The objective of the inter-disciplinary monitoring is to determine the effects of different mowing rhythms on the phytocoenosis and their pollinator communities. For that purpose, permanent plots of 25 m² size each will be established in the five selected plant communities mentioned above and mowed at intervals of two, four and six years (tab. 1). An unmowed plot serves as a control area (cf. KREISCH & ABL in print).

To document the development of plant communities relevés of the vegetation will be taken. Additionally the vertical and horizontal structure of the vegetation will be examined in detail. Changes in the availability of blossoms for anthophilous insects will be determined by counting the numbers of flowers and measuring the production of nectar (standing crop). The continuity of the plant-pollinator relationships will be ascertained by examining the spectrum of visitors to each plant species and their behaviour while on the blossoms.

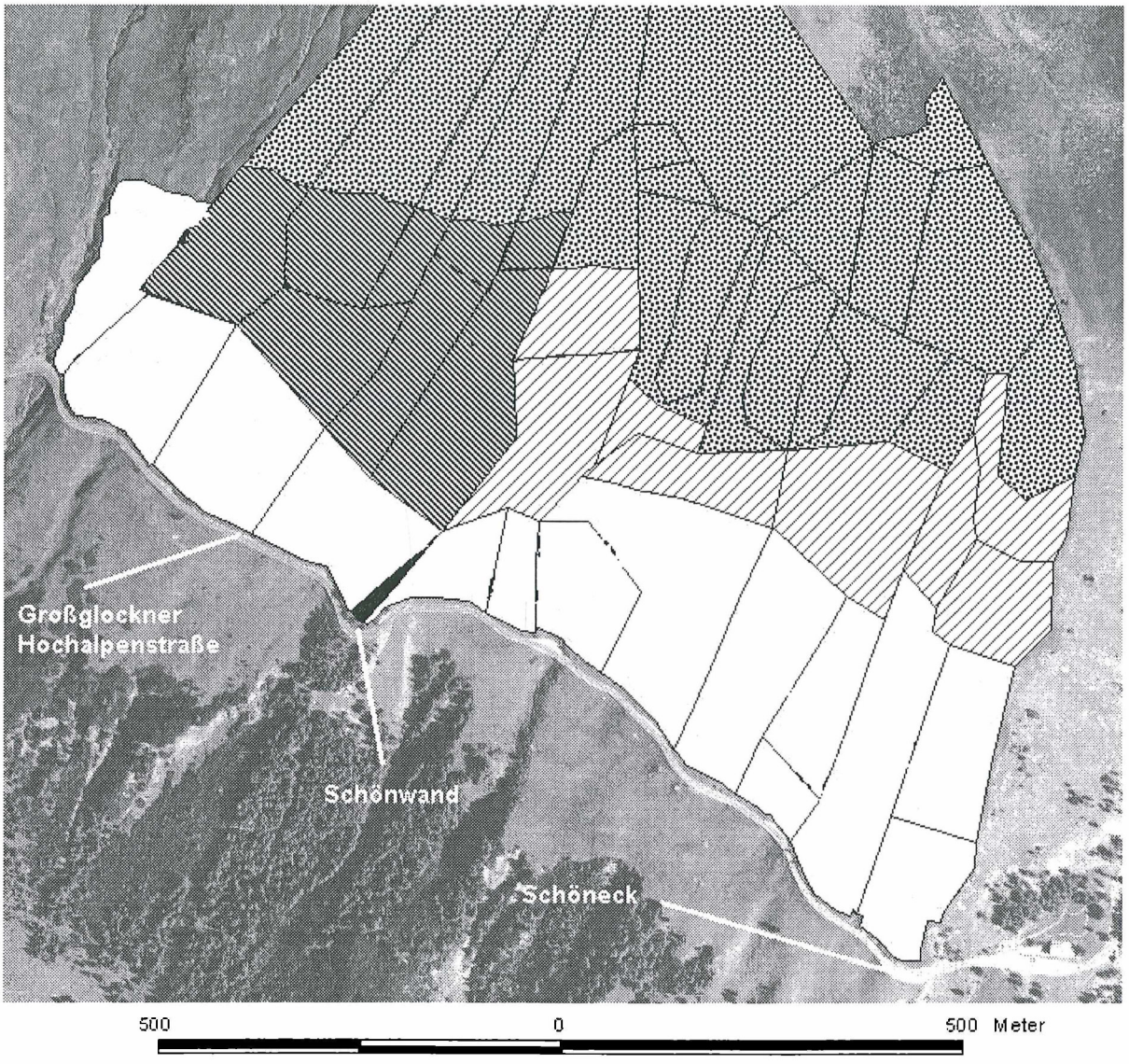


Fig. 2: Maintenance plan for the Pockhorner Wiesen. White zone: continued bi-annual to sporadic mowing. Hatched area: regular mowing alternating with short fallow periods in the middle section. Dotted area: Wilderness area with natural succession.

Source: Digital Orthofoto Nr. 4122.5301, reproduced with the authorization of BEV-Bundesamt für Eich- und Vermessungswesen in Vienna. Cartographie and arrangement: Abl 2004, Kreisch 2005.

Year of project	1	2	3	4	5	6	7	8	9
Year of field evaluation	1		2		3		4		5
Mowing Interval									
Bi-annual	mowing		mowing		mowing		mowing		mowing
Every four years	mowing				mowing				mowing
Every six years	mowing						mowing		
Fallow									-

Tab. 1 Schedule of correlation between mowing patterns and years of field evaluation conducted at bi-annual intervals.

Discussion

For the monitoring of flower-rich meadow communities, the biodiversity of which is based to a high degree on plant-pollinator relationships, the interdisciplinary biocoenological approach proposed here appears extremely promising. It allows the development of innovative methods for the advanced environmental management of extensively cultivated mountain hay meadows and can in this way help to preserve this endangered landscape. The direct implementation of the monitoring results within an operational maintenance plan guarantees practice-tested results. This management-concept thus provides an effective method for the cultivation and preservation of mountain hay meadows – both within and beyond Hohe Tauern National Park.

In the particular case of the Pockhorner Wiesen, the presentation of the results of our initial research attracted much interest among the local population. This promoted a sense of pride among the owners and users of the meadows, which in turn motivated them to continue or resume mowing and gained them the respect of their communities. This local acceptance is a decisive factor for the conservation of the traditional landscape.

References

ABL, M. (2003): Vegetation und Management der Bergmähder „Pockhorner Wiesen" im NP Hohe Tauern/Kärnten. - Diplomarbeit, Universität Wien.

KREISCH, W. F. (2001a): Blumen-Bestäuber-Systeme in der subnivalen Pioniervegetation und in traditionell bewirtschafteten, subalpinen Bergmähdern der Glocknergruppe. Symposion Forschung NP Hohe Tauern, Tagungsband: 133-138.

KREISCH, W. F. (2001b): Flora und Vegetation der Pockhorner Wiesen, subalpiner Goldschwingel-Bergmähder (Hypochoerido uniflorae-Festucetum paniculatae) im Nationalpark Hohe Tauern (Glocknergruppe, Kärnten). – Wiss. Mitt. NP Hohe Tauern 6: 85-118.

KREISCH, W. F. & ABL, M. (in print): Monitoring des Bergmähder-Ökosystems der „Pockhorner Wiesen" im NP Hohe Tauern (Kärnten). – Sauteria 14.

Contact

Mag. Mona Abl
mona_abl@yahoo.com

Amt der Kärntner Landesregierung
Abt.20 – Raumplanung
Uabt. Naturschutz
Maximilianstraße 10/8
A-9020 Klagenfurt
Austria

Dr. Werner F. Kreisch
wfk@zedat.fu-berlin.de

Botanischer Garten und Museum Berlin-Dahlem
Freie Universität Berlin
Königin-Luise-Str. 6-8
D-14191 Berlin
Germany

www.bgbm.fu-berlin.de/bgbm/staff/staff.htm

Conference Volume | **3rd Symposion of the Hohe Tauern National Park for Research in Protected Areas** *September 15th to 17th, 2005, Castle of Kaprun* | pages 129-131

The mire „Gradenmoos" in the Schobergruppe (National Park Hohe Tauern, Carinthia, Austria)

Robert Krisai, Wolfgang Mayer, Christian Schröck, Roman Türk

Abstract

During the summer 2003 the vegetation, lichens and bryophytes in the mire Gradenmoos were investigated on behalf of the administration of the National Park Hohe Tauern. Also the history of the mire was studied.

The dominant plant communities are *Caricetum nigrae*, *Caricetum rostratae* and moss rich spring fens. In the study area 102 species of lichens were found, also 134 Taxa of bryophytes.

The results of all investigations of the vegetation, bryophytes and lichens display the mire as a biotope worth to be protected. As a further result of this study necessary measures for the conservation of the Gradenmoos are derived. The grazing damages the Gradenmoos severely, it should be ceased as soon as possible. The repeat of the studies is recommendable, because there are only few studies in monitoring areas in the Hohe Tauern.

Research area

The „Gradenmoos" is a typical mountain mire with a length of 250 meters and a width of 100 meters. It is situated in an altitude between 1910 and 1940 m in the Graden valley, a typical glacial U-shaped valley with some terraces in the terrain. The Gradenmoos belongs to the type of a retention meander-mire. Its appearance is characterized by a relative even terrain and a stream in form of a meander. From the south side large alluvial fans extend into the mire, the north side is bounded by outcrops. The surrounding mountains consist of mica slate and transitions to schistous gneiss (VETTERS 1993). The occurring plants prefer siliceous soil.

The climatic conditions at the north-western part of the province of Carinthia are alpine. Only on 90 days in the year the average temperature is + 5 °C. The annual precipitation rates reach 1200 to 2000 mm (HARTL et al. 1992).

The mire is located at the timber line. The slope below the mire is covered with a sparse spruce-larch-forest. Also the alluvial fan on the south side is overgrown with spruce, larch and mountain pine. Apart from some dwarf shrubs there are no woody plants in the mire. Since 1983 the mire is situated in the core zone of the National Park Hohe Tauern.

History of vegetation and actual vegetation

The Gradenmoos exhibits only on relative small areas in the south east and in the north east a considerable formation of peat. On the other areas the vegetation is developed on mineral soils. Probes with the Dachnowski-sampler were possible till to a depth of 220 cm. The history of the mire went changeable. Phases with relative sedate plant growth are followed by disturbed phases caused by covering with sediments, which interrupted the development of the vegetation. From the cores which were extracted with the Dachnowski-sampler probes were gained in a distance of 10 cm and solubilized with the usual practices of pollen analyses. Two samples were dated by C^{14}-method. The deepest sample has an age of 2.800 years. This corresponds to the end of the Subboreal or the beginning Subatlanticum. The timber line was in the Subboreal in the Alps on the highest level (KRAL 1979; LANG 1994). The content of pollens support these datings, because in the deepest samples the pollens of elm, lime tree and hazel are present, which later disappear. Between 400 BC and 400 AD the formation of an undisturbed layer of peat can be observed. Five hundred year ago a deforestation started in the surroundings of the mire, because the curve of the pollens of the trees decreases clearly. The deforestation can be connected with clearances caused by prospering mining in the Hohe Tauern. The appearance of maize pollen in the top layers points out that the mire in spite of intensive grazing did not cease the growth, although the rate of increase is very low.

Contribution received at: 04.08.2005

In total 30 relevés were taken in the mire according to the method of Braun-Blanquet. The flora of the Gradenmoos corresponds to the vegetation in the higher levels of the Hohe Tauern. The dominant plant communities are *Caricetum nigrae*, *Caricetum rostratae* and moss rich spring fens. *Carex paupercula* is the one species belonging to the red list of threatened plants (NIKLFELD & SCHRATT-EHRENDORFER 1999).

Lichens

In the Gradenmoos and its proximate surroundings 102 lichen species were found. The diversity of lichen in the mire is relatively low. Between the phanerogams grow *Cladonia arbuscula* ssp. *mitis* and *C. rangiferina*, mainly. The most important substrate in the mire are the boulders. As an aquatic lichen Verrucaria funckii occurs on stones in the alluvial fan south of the mire. Aquatic lichens are rare in many regions because they prefer undisturbed substrata in a very clear water. An important substrate for lignicolous lichens is a bridge in the east of the mire, where 12 lichen species occur. In the study area and the surroundings 13 species of the red list of threatened lichens of Austria (TÜRK & HAFELLNER 1999) could be found.

Bryophytes

The bryophyte flora includes 134 taxa, from which 42 species are listed up in the red list of threatened bryophytes (GRIMS & KÖCKINGER 1999; SAUKEL & KÖCKINGER 1999). Within the northern part of the mire the following *Sphagnum* species occur: *Sphagnum capillifolium*, *S. compactum*, *S. teres*, *S. warnstorfii*, *S. russowii* and *S. girgensohnii*; the latter two can be considered as remnants of forest from the time, when the timberline was higher up. In the watercourses patches of *Scapania undulata*, *Hygrohypnum alpinum* and *Hygrohypnum* duriusculum can be observed. On the wet stones besides the water *Anombryum julaceum* and *Brachythecium rivulare* occur. On cow faeces the typical mosses *Splachnum sphaericum* and *Tetraplodon mnioides* can be seen. The rocks in and outside the mire support mosses adapted to slightly drier conditions: *Andreaea rupestris*, *Mielichhoferia mielichhoferiana* and others. On the other side in the spring fens *Philonotis fontana* und *P. seriata*, *Bryum pseudotriquetrum*, *Palustriella decipiens*, *Blasia pusilla* and others can be observed.

Measures for the conservation of the Gradenmoos

As a further result of this study necessary measures for the conservation of the Gradenmoos are derived. A serious problem for the mire is the intensive grazing. This grazing should be ceased or at least reduced. The disappearance of some rare species which were found by Mussnig et al. (1998) is to attribute to the heavy grazing. Also the results of the investigation of the bryophytes display the mire as a biotope worth to be protected. Especially in the spring fens damages caused by steps of the cattle occur, which cannot be repaired during the vegetation period.

Concerning the further development of the mire the establishment of monitoring areas would have a high significance. From the results of these investigations the future measures of management could be derived. Also the repeat of the lichenological studies is recommendable because just the lichens are bioindicators for the air quality and for the hemeroby in different terrestrial ecosystems (PFEFFERKORN & TÜRK 1996).

References

GRIMS, F. & KÖCKINGER, H. 1999: Rote Liste gefährdeter Laubmoose (Musci) Österreichs. 2. Fassung. - In: Rote Listen gefährdeter Pflanzen Österreichs. - Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie 10: 157-171.

HARTL, H., KNIELY, G., LEUTE, G. H., NIKLFELD, H., & PERKO, M. 1992: Verbreitungsatlas der Farn- und Blütenpflanzen Kärntens. – Naturwissenschaftlicher Verein für Kärnten, Klagenfurt. 451 pp.

KRAL, F. 1979: Spät- und postglaziale Waldgeschichte der Alpen auf Grund der bisherigen Pollenanalysen. - Veröff. Inst. f. Waldbau Univ. Bodenkultur Wien. 175 pp.

LANG, G. 1994: Quartäre Vegetationsgeschichte Europas. – Stuttgart, 462 pp.

NIKLFELD H. & SCHRATT-EHRENDORFER L. 1999: Rote Liste gefährdeter Farn- und Blütenpflanzen Österreichs. 2. Fassung. – In: Rote Listen gefährdeter Pflanzen Österreichs. - Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie 10: 33-153.

MUSSNIG, G. (Hrsg.) 1998: Naturführer Gradental. – Innsbruck. 89 pp.

PFEFFERKORN, V. & TÜRK, R. 1996: Flechten als Zeiger des Hemerobiegrades in terrestrischen Biotopen. - Sauteria 8: 181-192.

SAUKEL, H. & KÖCKINGER H. 1999: Rote Liste gefährdeter Lebermoose (Hepaticae) und Hornmoose (Anthoceratae) Österreichs. 2. Fassung. – In: Rote Listen gefährdeter Pflanzen Österreichs. – Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie 10: 172-179.

TÜRK, R. &. HAFELLNER, J. 1999: Rote Liste gefährdeter Flechten (Lichenes) Österreichs. 2. Fassung. – In: Rote Listen gefährdeter Pflanzen Österreichs. – Grüne Reihe des Bundesministeriums für Umwelt, Jugend und Familie 10: 187-228.

VETTERS, H. 1933: Geologische Karte der Republik Österreich 1 500.000.

Contact

Univ.-Prof. Dr. Robert Krisai
robert.krisai@sbg.ac.at

MMag. Wolfgang Mayer
wolfgang.mayer@sbg.ac.at

Mag. Christian Schröck
christian.schroeck@aon.at

Univ.-Prof. Dr. Roman Türk
roman.tuerk@sbg.ac.at

University of Salzburg
Department of Organismic Biology
Hellbrunnerstraße 34
A 5020 Salzburg
Austria