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Detecting Signals of Global Change

International scientific cooperation using mountain biosphere reserves

Contemporary global environmental change, which is much more than climate change, affects all ecosystems. Mountain areas as fragile ecosystems are particularly susceptible as they are subject to both natural and anthropogenic drivers of change. Thus they play an important role for studying and monitoring global environmental change.

Past studies have shown that global warming is affecting mountains by: Accelerated glacial melt; increased erosion and land-slides; migration of warmer temperature tolerant species to higher

elevations and thus replacing other, often rare and endangered species; increases of wild fire frequencies; reduced snow cover periods affecting tourist resorts; and modified growing periods in the agri-

cultural calendar. It is obvious that global change will seriously impact on mountain environments and their economies, and the livelihoods of people.

A global network for global data

In this context, mountain biosphere reserves play an important role as monitoring and study sites. They have been designated the world over, and can be used to assess the impact of global change on mountains and their related economies. As biosphere reserves include protected areas in their core zones, the effects of global warming can be studied in natural or near-natural environments, such as the change of composition of plant and animal species over time.

Most biosphere reserves dispose of long term series of climate data (temperature, precipitation) and species lists which can be monitored over time and correlated with global warming. Moreover, biosphere reserves also include areas where people live and make a living in the transition zones, hence the repercussions of global warming can be assessed on local mountain economies and people's livelihoods.

The GLOCHAMORE project

This was the starting point for the international project on "Global Change and Mountain Regions (GLOCHAMORE)" which uses biosphere reserves as testing sites for global change studies in mountains throughout the world



Mount Denali in the Denali Biosphere Reserve (USA)

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(including the German Berchtesgaden Biosphere Reserve). Scientists from various disciplines, including ecologists, hydrologists, glaciologists and socio-economists worked with 25 biosphere reserve representatives to prepare a Research Strategy to detect signals of global environmental change. The project also aimed at evaluating the consequences of global change for mountain regions as well as for lowland systems that depend on mountain resources (highland-lowland interactions). In this vein, the development of sustainable land, water, and resource management strategies for mountain regions can be explored.

For the project, biosphere reserves were selected as representative sites of major mountain ranges in all continents (see box on page 32). Site managers of the mountain biosphere reserves met with global change researchers at five international workshops:

- “Global Change in Mountain Biosphere Reserves” (Sörenberg, Entlebuch Biosphere Reserve, Switzerland, November 2003);
- “Global Environmental and Social Monitoring” (Vienna, Austria, May 2004);
- “Projecting Global Change Impacts in Mountain Biosphere Reserves” (Gran Sasso National Park, Italy, November/December 2004);
- “Sustainable Land Use and Natural Resource Management in Mountain Biosphere Reserves” (Granada, Spain, March 2005);
- “Process Studies along Altitudinal Gradients” (Samedan, Switzerland, July 2005).

Each of these thematic workshops contributed to the development of the

GLOCHAMORE research strategy. Presented at the Open Science Conference on “Global Change in Mountain Regions” in October 2005, which was organized by the Centre for Mountain Studies at Perth College (United Kingdom), the draft strategy was reviewed and discussed in the concurrent sessions. The research strategy is available in hard-copy as well as at the UNESCO-MAB website.

The research strategy

The research strategy is built on the assumption that sustainable management can only be achieved with stakeholder involvement. Stakeholder involvement will not only increase the clarity of the research, but also enhance its relevance and acceptability, and thus the efficiency and impact of the research project. Consulting local people and the managers of mountain biosphere reserves is

UNESCO Biosphere Reserve Berchtesgaden

Berchtesgaden is unique among the German biosphere reserves in that it is the only alpine landscape. The mountain landscape of the north limestone Alps with differences in height of more than 2,000 metres offers a rich diversity of habitats such as alpine mixed forests, alpine meadows and pastures. There are many endangered species to be found here such as the marmot, snow grouse, edelweiss and gentian. This area, in the farthest south-eastern part of Germany, was designated by UNESCO in 1990 and spans 467 km². The national park of the same name makes up the core area and buffer zone of the biosphere reserve.

The topography and climate make agriculture and landcare difficult. The landscape is structured by the small farmsteads, which are in need of further development to be sustainable. The pristine nature and fascinating mountain scenery make this biosphere reserve a magnet for tourism, which accounts for 70 percent of local revenue. The healthy mountain climate is an important factor for marketing the region, especially for people suffering from allergies. The development of sustainable concepts for winter tourism against

the backdrop of climate change counts as one of the greatest challenges in the coming years.

Further information:
<http://www.regierung-oberbayern.de/Bereich5/5wirueberuns/5sgvorstell/5Biosphaerenreservat/biosbgl.htm>



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therefore central to the implementation of future GLOCHAMORE projects.

This research strategy is organized according to our current understanding of the main axes of causality. It focuses first on drivers of global change, then on the impacts of global change on ecosystems, then on the subsequent impacts on ecosystem goods and services, regional economies, and health, and finally on institutional arrangements. Placing the human dimension in the second half of the list emphasizes mountain and lowland people's dependence on mountain goods and services that are affected by both indirect and direct impacts of global environmental change.

The GLOCHAMORE project, a consortium of 14 research institutions, was funded by the European Commission's Sixth Framework Programme and UNESCO's MAB programme from 2003 to 2005. Several regional workshops (Mendoza, Argentina, March 2006; Almaty, Kazakhstan, November 2006; Kampala, Uganda, 2007) now aim at the implementation of the Research Strategy, especially to work out adaptation schemes to cope with climate change. Indeed, mountain sites of the World Network of Biosphere Reserves prove to be important in promoting international scientific collaboration.

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*The GLOCHAMORE research strategy online:
<http://unesdoc.unesco.org/images/0014/001471/147170E.pdf>.*



Mountain meadows in the Berchtesgaden Biosphere Reserve

Photo © Biosphärenreservat Berchtesgaden, Regierung von Oberbayern

Mountain biosphere reserves in the GLOCHAMORE project:

- Australia:
Kosciuszko Biosphere Reserve;
- Austria:
Gossenköllesee Biosphere Reserve and Gurgler Kamm Biosphere Reserve;
- Canada:
Mount Arrowsmith Biosphere Reserve;
- Chile:
Araucarias Biosphere Reserve;
- China:
Changbaishan Biosphere Reserve;
- Colombia:
Cinturón Andino Biosphere Reserve;
- Germany:
Berchtesgaden Biosphere Reserve;
- India:
Nanda Devi Biosphere Reserve;
- Kenya:
Mount Kenya Biosphere Reserve;
- Kyrgyzstan:
Issyk Kul Biosphere Reserve;
- Mongolia:
Uvs Nuur Basin Biosphere Reserve;
- Morocco:
Oasis du Sud Marocain Biosphere Reserve;
- Peru:
Huascaran Biosphere Reserve;
- Russian Federation:
Katunskiy Biosphere Reserve; Sikhote Alinskiy Biosphere Reserve and Teberda Biosphere Reserve;
- South Africa:
Kruger to Canyons Biosphere Reserve;
- Spain:
Sierra Nevada Biosphere Reserve;
- Sweden:
Lake Torne Biosphere Reserve;
- Switzerland:
Entlebuch Biosphere Reserve and Swiss National Park/Biosphere Reserve;
- United States of America:
Denali Biosphere Reserve; Glacier Biosphere Reserve and Niwot Ridge Biosphere Reserve.