

Mountains and Their Grand Challenges

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Mountains are characterized as biodiversity hotspots, providing ecosystem services for and protection against natural hazards in adjacent regions. People living in mountainous areas face major challenges because signs of climate change are particularly clear due to the mountains' verticality, and heterogeneous habitats are present in the mountains on a small scale. In recent years, mountain research has become of major importance, focusing on topics such as:

- Mountain resources: e.g., ecosystem services such as water supply and forest products;
- Climate change: e.g., the observation of glaciers and permafrost, climate impact on high mountain ecosystems, migration processes in alpine plant species;
- Ecological connectivity: e.g., the migration and adaptation potential of species;
- Land degradation and risk assessment: e.g., protection against natural hazards such as floods, avalanches, storms, fire, and geological mass movements;
- Sustainable regional development: e.g., the management of mountain ecosystems enabling the provision of goods and services for local livelihoods and lowland people;
- Conservation and protection strategies for cultures and the environment;
- Capacity building, governance, and conflict management.

Awareness of mountain regions has not been a recent development. Josias Simler (1530-1576), a Swiss author, wrote the first book dealing solely with the Alps. And as far back as 1612, the Pasterze Kees, Austria's largest glacier below Austria's highest peak, the Grossglockner (3798 m), was drawn in a map of Carinthia by Is-

rael Holtzwurm. In 1886 a meteorological observatory was established at an elevation of 3106 m near the Rauriser Sonnblick, Austria. Even today it is the highest observatory in the Alps and very important for investigating climate change at high elevations.

Initial international recognition that protection of resources and resource use must go hand in hand was achieved at the 1968 biosphere conference, where it was also noted that interdisciplinary approaches are needed to achieve that goal. The conference was organized jointly by UNESCO, the UNESCO International Biological Program (IBP from 1964-1974), and the World Conservation Union (IUCN). Twenty-four years later, the Rio de Janeiro 1992 Conference on Environment and Development resulted in Chapter 13 of the Agenda 21, entitled “Managing Fragile Ecosystems: Sustainable Mountain Development.”

In the early 1970s the Man and Biosphere Program (MAB) not only financed IBP projects but soon realized that model regions or biosphere reserves should be designated for:

- i) the protection of species diversity and natural resources;
- ii) education, research, and dissemination; and
- iii) the development of models to integrate economic development and environmental protection. In 1977 the first Austrian model regions or biosphere reserves were established to maintain habitats and facilitate research and long-term monitoring.

The MAB project “Obergurgl” – a municipality in Austria situated at altitudes from 1770 m to 2154 m – started in the 1980s, and dedicated itself to studying the mountain ecosystem and all its ecologic and socioeconomic components. Georg Patzelt, a scientist from the University of Innsbruck, mentioned in 1987 that “Obergurgl should stand for a limited miniature cosmos and reflect the basic limitation of the total biosphere.”

Since then several institutes and institutions throughout the Alps have committed themselves to the very diverse field of mountain research, which requires an interdisciplinary approach combining ecologic, social, and economic issues and applying a long-term perspective: for instance, the Institute for Interdisciplinary Mountain Research (IGF) at the Austrian Academy of Sciences or the Interacademic Commission for Alpine Studies (ICAS), a Swiss networking program for inter- and transdisciplinary cooperation, situated in Bern, Switzerland, at the Swiss Academies of Arts and Sciences. The insights gained from this work serve basic research and can be used to design development and adaptation strategies.

Additional scientific collaborations have been established to enhance mountain research:

- on a regional level: in Innsbruck, Austria, composed of the IGF, the research focuses on Alpine Research – Man and Environment at the University of Innsbruck and alpS – Center for Climate Change Technologies;
- on a bilateral level: in order to leverage synergies and strengthen research into sustainable development in European mountain regions, the Austrian Federal Minister for Science, Research, and Economy and the Swiss State Secretary for Education and Research of the Federal Department of Home Affairs signed a Memorandum of Understanding in 2011 to create a Swiss-Austrian alliance of mountain research;
- on an Alpine-wide level: international scientific cooperations driven by the International Scientific Committee on Research in the Alps (ISCAR), transferring scientific knowledge to policy makers and the general public;
- on a global level: links are forged via MRI (the Mountain Research Initiative), which promotes and coordinates global change research in mountain regions; GMBA (Global Mountain Biodiversity Assessment), a global network of about 400 mountain biodiversity researchers and policy; and GLORIA (Global observation research initiative in alpine environments), a global long-term monitoring network in alpine areas – capturing vegetation and temperature data to identify changes in species composition and temperature regime.

Several conferences and workshops each year help to foster the exchange among scientists and with stakeholders in different countries. In July 2014, the MRI will hold a workshop at the University of Nevada in Reno, Nevada, US, on long-term observation systems of mountain social-ecological systems. The workshop will bring together scientists from the US, Austria, Switzerland, Italy, Rwanda, India, Australia, and other countries. In September 2014, the 11th meeting of the Forum Alpinum is being held in Italy on Alpine resources, offering a platform for the dialogue between science and policy. And in Fall 2015, an international conference will be held in Perth, Scotland, dealing with global change and the world's mountains.

These initiatives, which provide only a small insight into mountain networks of scientists, stakeholders, and mountain people, demonstrate the need to bring forward the challenges faced by mountains – not only on local and regional levels, but also globally.

Links:

Alpine Research Centre Obergurgl: <http://www.uibk.ac.at/afo/index.html.en>

Alpine Space – Man and Environment: <http://www.uibk.ac.at/alpinerraum/index.html.en>

alpS: <http://www.alp-s.at/cms/>

CH-AT Alliance: <http://www.chat-mountainalliance.eu/de/>

Forum Alpinum: <http://www.forumalpinum.org/>

GLORIA: <http://www.gloria.ac.at/>

GMBA: <http://gmba.unibas.ch/index/index.htm>

ICAS: <http://icas.akademien-schweiz.ch/d/index.php>

IGF: <http://www.mountainresearch.at/index.php/en/>

ISCAR: <http://www.iscar-alpineresearch.org/>

IUCN: <http://www.iucn.org/>

MAB Austria: <http://www.unesco.at/wissenschaft/mab.htm>

Mountain Observatories – a global fair and workshop: <http://mri.scnatweb.ch/en/events/fair-and-workshop-on-mountain-observatories>

MRI: <http://mri.scnatweb.ch/en/>

UNESCO: <https://en.unesco.org/>