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Workshops

3/1 Monitoring Biodiversity

Presentation: Thomas Spiegelberger, Eva-Maria Koch
Input: Christian Körner, Patrick S. Bourgeron

Worldwide biodiversity is decreasing due to climate and land-use changes. Ecosystems at high altitudes such as subalpine and alpine habitats are particularly threatened.

Monitoring is a useful tool to observe biodiversity and its development in space and time. In many cases monitoring programmes are restricted to local scales, being well-adapted for a certain region and the results being interpreted thoroughly for that specific site. However, climate change is a global challenge and therefore should be observed at a range of scales from local to global. This suggests a need to consolidate different methods and data sets into comparable results, to improve current techniques and to develop future monitoring systems.

There are many observational and experimental (sub)-alpine sites around the world, which are often already organised in networks. Worldwide acting networks increase the efficiency and the comparability of each participating site as it is the case in the Global Observation Research Initiative in Alpine Environments (GLORIA), the Global Mountain Biodiversity Assessment (GMBA) or the Long-term Ecological Research Network (LTER). Several networks are restricted to European regions such as the Alpine Network of Protected Areas (ALPARC) or are focused on a special topic such as the Mountain Invasive Species Network (MIREN). Some of these networks use their own monitoring method, well appropriate for their aims and purposes. However, no common platform exists where different approaches may be compared and further developed for (sub)-alpine-nival monitoring sites in Europe.

Therefore, the main idea of the workshop is to

– discuss the possibility to create a platform of (sub)-alpine-nival sites in Europe,

– envisage its possible organisation,

– consider its integration and collaboration with existing networks such as GLORIA, GMBA, LTER-Europe, ALPARC and others.

The aims and benefits of such a network will be:

– to compare European data sets in order to predict future patterns in European mountain biodiversity,

– to exchange information on practical monitoring and observational methods,

– to enable rapid responses and collaborations on forthcoming research calls about mountain biodiversity.

The workshop will be stimulated by two keynote speakers:

Christian Körner, president of the Global Mountain Biodiversity Assessment (GMBA) will talk about the importance of mountain biodiversity and past, recent and future activities of the GMBA.

Patrick S. Bourgeron, vice-president of LTER-US, Chair of the ILTER Science Committee, a long time manager of the LTER-sites in Boulder, Colorado, will speak about coupled social-ecological systems in high elevation ecosystems. He will further give an overview about the potential benefits of a thematic network of LTER-Sites working in the (sub)-alpine-nival zone.

Mountain Biodiversity – an Experimental Field of Nature (Ch. Körner & E. M. Spehn)

Worldwide c. 12 % of the terrestrial land area are mountains, and c. 3 % of mountain terrain fall into the treeless alpine zone present at all latitudes. Despite considered hostile, these high elevation ecosystems are richer in species of plants and animals than one would expect from the available area (Körner 2004). Globally, the alpine plant species diversity is estimated to represent 4 % of all species, and in Switzerland alone, 20 % of all higher plant species are alpine. The Global Mountain Biodiversity Assessment (GMBA, Basel), a cross-cutting research network of DIVERSITAS, aims at quantifying high elevation organismic diversity, explain its causes (both natural and anthropogenic ones) and

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also evidence its significance (function) for ecosystem integrity and functioning in steep terrain. Over the past 10 years, GMBA has synthesized a great deal of knowledge in this field, helped in creating a corporate identity of the concerned research community, and induced new avenues of research (Körner & Spehn 2002, Spehn et al. 2006).

Good evidence had been provided from around the globe that habitat diversity and steep environmental gradients are important causes of the far above average biological richness of mountains. Because a single mountain may host bioclimatic zones otherwise only found over thousands of km of latitudinal distance at low elevation, one can protect more biodiversity per unit of land area in mountains than anywhere else. The steep climatic gradients over short distances are nature's test fields for adaptation, and thus offer ideal possibilities for ecological and evolutionary research (e.g. Zhu et al. 2010). Sustainable land use has been shown to contribute positively to biodiversity (Spehn et al. 2006), stabilizes slopes and thus contributes to erosion control and catchment value (hydroelectric yield; Körner 2004).

Electronic biological archives offer new possibilities to test ecological and evolutionary theory in mountains. They offer completely novel avenues to study mountain biota (Körner et al. 2007, Spehn & Körner 2010).

At the occasion of the 10th anniversary, GMBA will launch a "Mountain Portal" in May 2010, allowing to search data from GBIF (Global Biodiversity Information Facility, Copenhagen) in a mountain specific context, in order to facilitate creative scientific data mining and to advance our understanding of mountain biodiversity globally. Climate change research can greatly profit from such broad data base information. By encouraging and training data holders to become compliant with GBIF (open access, standard formats, metadata documentation), GMBA aims to increase the availability and quality of geo-referenced biodiversity data in mountains provided online, e.g. from the Himalaya and the Caucasus.

Coupled Social-ecological Systems in High-elevation Ecosystems of the Colorado Front Range: Thresholds, Stable States, and Trade-offs Across Ecosystems Services in Response to Climate and Human-induced Changes (P. Bourgeron, H. Humphries, M. Williams & T. Seastedt)

Mountain ecosystems are of particular interest because:

1. they provide important ecosystem services worldwide, including clean water, wood, minerals, livestock forage, and recreation, among others; and

2. they have been identified as particularly sensitive to, and impacted by, the array of human-induced environmental changes that currently challenge society. Forecasting change in high-elevation systems presents significant challenges, as they are likely to display non-linear responses, i.e., they are more easily pushed or "tipped" across critical thresholds.

To investigate the behavior of high-elevation ecosystems in response to change and associated changes in ecosystem services, we have developed observational, experimental, and synthesis initiatives that incorporate empirical and modeling approaches to integrate complex information at the scales of Colorado Front Range coupled natural-human systems.

First, we have developed a feedback loop model for the Colorado Front Range based on the US-Long Term Ecological Research network integrative and iterative conceptual framework for social-ecological research (Collins et al. 2007) that was formulated to explicitly integrate socio-economic and ecological disciplines via a series of broad questions.

Questions for the high elevation ecosystems of the Colorado Front Range are as follows:

1. How do the pulse disturbances of extreme droughts and other large/high intensity disturbances interact with long-term disturbances to influence threshold behaviors and associated state changes in ecosystem structure and function?

2. How are the feedbacks between landscape patterns and community structure and function affected by extreme and long-term changes in climate, fire regimes, and land-use?

3. How do ecological changes affect regional climate and fire regulation, regional water budgets, and the supply of economic and recreational resources to residents?

4. How will management of water systems and fire/insect outbreak, landscapes for products and amenities be adjusted to observed, perceived, and predicted changes?

5. How do perceptions and outcomes affect human behavior?

6. Which combinations of individual and institutional decisions and actions affect the interactions between pulse/press disturbances by influencing landscape configuration, landscape connectivity, fuel loading, and fire regimes?

Second, we investigated the circumstances under which crossing a single threshold between alternative regimes often leads to a "cascading effect" in which multiple thresholds across scales of space, time, and social organization, and across ecological, social, and economic domains may be breached.

Third, the impact of such changes on ecosystem structure and function – including the creation of

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new stable states and or novel ecosystems – extends to ecosystem services, their interactions, and trade-offs. We analyzed the interactions between ecosystem services as a result of management for each of several individual ecosystem services. For example, as climate regulation (C storage) has increased as a function of increasingly closed and dense forests, the capacity of landscapes to mitigate the size and intensity of disturbances (such as fires and insect outbreaks) has decreased. Trade-offs in ecosystem services, then, occur across space and time with different degrees of reversibility. But more than that, they often result in multiple ecosystem services being compromised for the benefit of a solitary ecosystem enhancement. We also analyzed the relative change in ecosystem services since European settlement. Recreation value, for example, has increased at the expense of both water availability and natural hazards.

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3/2 Ecological Networks Within and Beyond the Alps

Presentation: Leopold Füreder, Christian Walzer
Input: Anke Hahn, Sylvia Hysek

The Alps are one of the best-known mountain ranges as well as one of the richest in biodiversity; this mountain area, however, is also one of the most densely populated. Although as a mountain range, they are a geographical entity with manifold continua of diversified natural habitats, their ecological connectivity is diminished or fragmented. More and more human activities and constructions are interfering, especially in corridors. Habitat loss and fragmentation, climate change, changes of agricultural practices and pollution count among the most important reasons for biodiversity loss and landscape destruction of the Alps.

The traditional tool used to conserve biodiversity and the natural environment has always been the creation of protected areas; however, it has become increasingly obvious that a majorly important aspect in the conservation process is to connect protected areas to one another to allow the movement of species across the entire Alpine range. Genetic flow across the entire Alpine range is important particularly to support species in adapting to environmental transformations brought about by climate change. To successfully protect biodiversity across the whole Alpine range a coordinated and transnational approach was initiated in the EU Alpine Space project ECONNECT in accordance with the legal framework provided by the Alpine Convention.

ECONNECT strives towards an ecological continuum across the Alps. Therefore, besides securing protected areas as core zones, specific activities focus on linking these areas in order to achieve connectivity between Alpine ecosystems. As animals and plants need to migrate — even more in times of climate change — between habitats, it is essential to maintain, improve and create ecological networks across the entire Alpine region and to surrounding lowlands and mountain ranges. To achieve an ecological continuum across the Alps and beyond, the ECONNECT project considers not just the purely naturalistic aspects (such as, for example, sustainable land use) but also the economic and social dimensions which are just as important in promoting ecological networks.

The Wildlife Perspective (Christian Walzer)

Today wildlife populations are highly fragmented within and over the Alpine range. For many species an ecological and habitat continuum no longer exists. The reasons for these fragmentations are highly diverse. These disruptions in the ecological continuum occur at various scales and range for example from local interruptions of amphibian migrations to major segregations along the Alpine