Mountain Biodiversity – A Global Heritage

Eva M Spehn and Christian Körner

High biodiversity in high ecosystems

The world's mountains support approximately one quarter of terrestrial biological diversity, with nearly half of the world's biodiversity hotspots concentrated in mountains. Isolated mountains (such as Mount Kinabalu in Malaysia) are often rich in endemic species: plants and animals that occur nowhere else. In the alpine belt (the treeless life zone of mountains, ca. three percent of the global land-area), around four percent of the global number of flowering plant species (about 10,000 alpine species) are estimated to occur, which means that the alpine life zone is richer in plant species than would be expected from its area (Körner 2004). A biological inventory of the world's mountains does not yet exist, but data mining of existing archives of biodiversity offer new avenues to assess mountain biodiversity. The Global Biodiversity Information Facility (GBIF) established a data portal *www.gbif.org* that connects more than 174 million single species occurrence records from various data providers such as natural history museum collections. In cooperation with GBIF, the Global Mountain Biodiversity Assessment (GMBA) of DIVERSITAS is currently developing a thematic mountain portal, which will allow specific searches for primary biodiversity data in mountains.

Mountain areas have been affected by loss of diversity caused by human action, largely due to changes in land use and climate. Uphill expansion of agriculture and settlements, logging for timber and fuel wood and replacement by highland pastures are threatening mountain forests, which are among the most biologically diverse biota. Evergreen tropical cloud forests are the most fragile and most diminished part of mountain forests, but are very rich in endemic species (e.g. in Peru 30 percent of the 272 species of endemic mammals, birds and frogs are found in cloud forests). These harbour the wild relatives and sources of genetic diversity of important staple crops such as beans, potatoes and coffee. Global warming largely affects mountain biodiversity by reducing available land area for organisms adapted to the cold. Plant invasions into higher mountain areas may be promoted by climate warming. The pace of plant species moving uphill is quite high (e.g. a mean of 13 metres for all species in the Swiss Alps since 2001), increasing the total number of species in the upper belts in the short term, but outcompeting rare species or those adapted to the cold in the long term. With higher temperatures predicted, longer summers with a greater incidence of drought are expected in many mountain regions worldwide. Plant invasions into higher mountain areas may be promoted by climate warming.

Important role of mountain biodiversity for ecosystem services and human well-being

In steep terrain, more than anywhere else, ecosystem integrity and functioning depends on a structurally diverse plant cover. This functional diversity of species is nature's insurance against complete system failure, i.e. the loss of substrate on slopes in the case of mountains. At the same time, it secures other 'services' such as provision of medical plants, food and fodder, fibre and other montane forest products. It also ensures clean runoff water and offers attractive landscapes. The costs of replacing the services provided by mountain biodiversity are huge – both in economic, political, social and other terms.

The majority of the world's most precious gene pools (for agriculture and medicine) and traditional management practices are preserved in mountains. Several crops (maize, potatoes, barley, sorghum, tomatoes and apples) and a large proportion of domestic animals (sheep, goats, yaks, llama and alpaca) originated in mountains, whereas other crops found new homes in the mountains and evolved into many different varieties. However, mountain crops and breeds deserve greater attention as a genetic storehouse and buffer against increasing environmental pressure and to secure food of mountain people. Medicinal plants are one of the most valuable resources at high altitudes. For example, 1,748 species from the Indian Himalaya are used for local medicinal treatment or for trade involving the pharmaceutical industry. Roughly a third of them grow in the subalpine or alpine zone.

Managing mountain biodiversity

Managing mountain biodiversity has been recognised as a global responsibility in recent decades. Globally, protected areas have increased six to eight fold in the last 40 years, largely in

Cuenca Rio Blanco Chingaza, Colombia. Photo: Klaus Schutze.

Introduction

Sangla-kanda pasture, Sangla Valley, Kinnaur, Himacha Pradesh, India. Photo: Uttam Lal.

mountain areas, and covered nine percent of all mountain areas in 1997 and 16 percent in 2003. On a global and regional scale, mountains are hot spots of biological richness because of the rapid altitudinal change of climatic conditions over a very short distance. This compression of life zones, each with its characteristic biological inventory, makes mountains so unique for conservation projects, and in fact, nearly a third of all conservation areas are in mountains (264 million ha. out of 785 million ha. in 2004, UNEP-WCMC).

While protected areas are essential, they alone cannot achieve biodiversity or cultural heritage conservation. Mountain places where people live and work require innovative approaches to conservation, engaging local people in the stewardship of the natural and cultural heritage. The Concept of UNESCO's Man and Biosphere reserves or conservation landscapes are tools to maintain high levels of biodiversity in combination with intensive, but diversified small-scale agriculture in densely populated mountain areas, where the establishment or extension of protected areas is not feasible. Participation of mountain populations at all stages is crucial in the sustainable management and use of biodiversity. Payment for environmental services (PES) is an innovative tool to compensate upland land users for the lack of on-site benefits, therefore enacting a much needed resource transfer to upland communities which are often socially and economically disadvantaged, compared to surrounding lowland areas (see IMD 2006).

Transboundary connectivity for mountain biota

Mountains can also have a corridor function for mountain biota, for instance connecting mesic temperate lowland regions, otherwise separated by hot or dry lowland climates, as is the case with the southern slopes of the Himalayas. Connectivity conservation corridors (and their associated transboundary protected areas) help conserve habitats and the opportunities for species to evolve, adapt and to move. Especially on a large scale, connectivity corridors provide additional opportunities for some species to survive in a world affected by climate change. Some of these large scale conservation corridors in mountains are underway in the Himalayas, Altai-Sayan, Australian Alps and Albertine Rift Valley in Africa (Worboys 2009).

Set of actions for mountain biodiversity

Managing mountain biodiversity with the aim of maintaining ecosystem integrity as a basis for the provision of crucial ecosystem services is a major challenge, requiring a global alliance of international organisations, national governments, civil society, the private sector, and most importantly, mountain populations as stewards and beneficiaries of biodiversity in mountains.

Research has several important roles to play. Inventorying and ensuring open access to existing biodiversity data are key tasks, as in some regions only a small fraction of mountain species are known to the global community. Ecosystem services linked to mountain biodiversity, such as the productivity of upland pastures, water supply, or erosion control, need to be demonstrated and quantified. Projections of how future climate change will impact mountain ecosystems and management scenarios need to be explored, in ways which serve both biodiversity conservation and human needs.

The Convention on Biological Diversity, signed by 150 governments worldwide, with its specific Programme of Work on Mountain Biodiversity, provides a set of actions addressing characteristics and problems that are specific to mountain ecosystems. The review of the Work Programme in 2010 and the International Year of Biodiversity in 2010 will provide opportunities to promote action for the sustainable management of mountain biodiversity at international, regional, national and community levels.

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Global Mountain Biodiversity Assessment (GMBA) of DIVERSITAS
gmba@unibas.ch, Institute of Botany, University of Basel, Switzerland.