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Mountain Biodiversity



Biodiversity in Mountains: A Natural Heritage Threatened by Climate Change

Eva Spehn
Christian Koerner
Global Mountain Biodiversity Assessment
Basel, Switzerland

The world's mountains are focal points of global biodiversity, hosting about half of the world's biodiversity hotspots. This is due to the great diversity of habitats within short distances, which is a result of altitudinal gradients, changes in exposition, and varying geology and soils.

In the forests of Mount Kilimanjaro (Ch. Koerner)

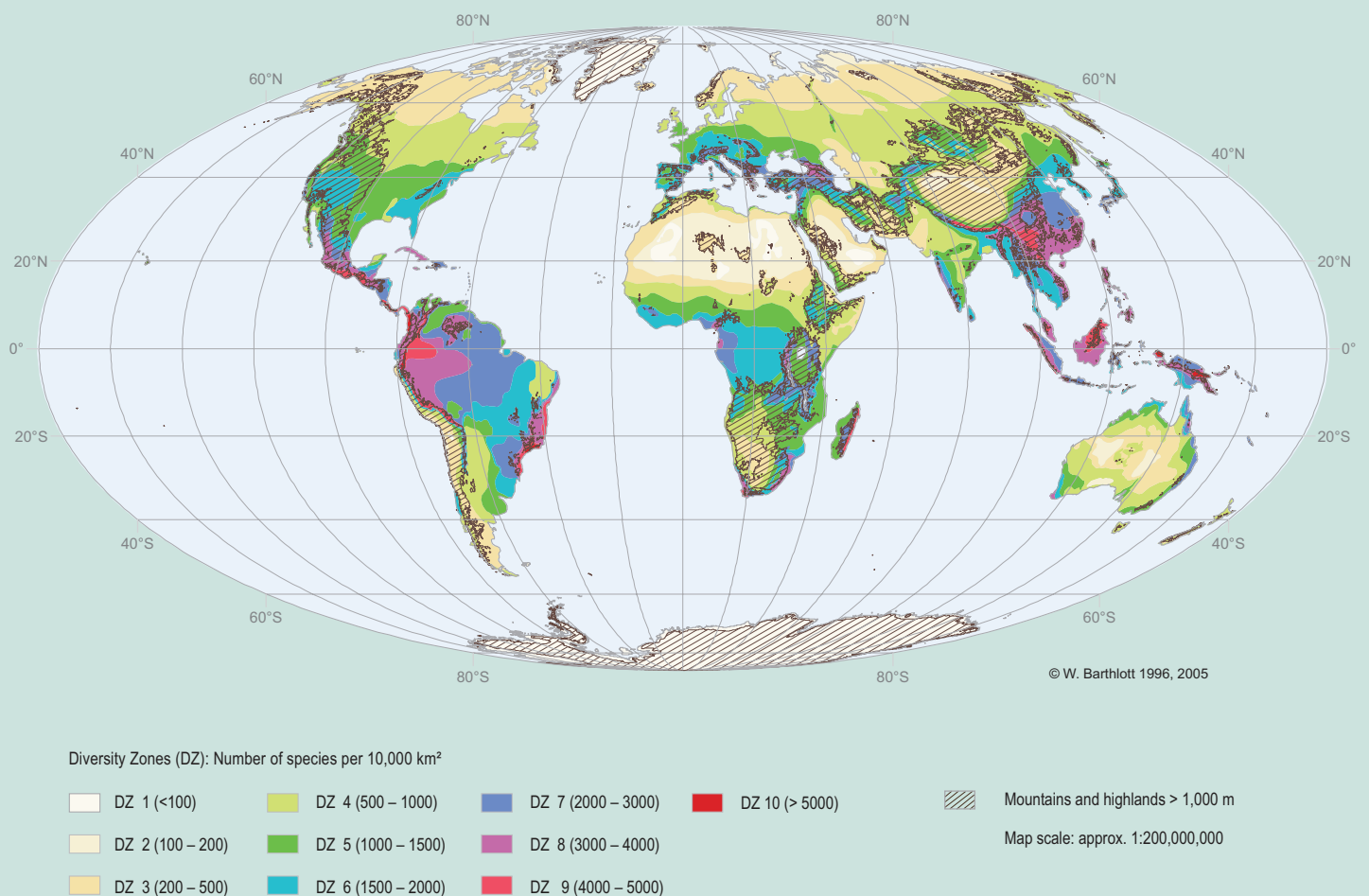
Mountains are also characterized by a high level of endemism, i.e. of plants and animals that occur nowhere else. Major centres of plant species diversity are in, or include, tropical and subtropical mountains: Costa Rica and Panama, the tropical eastern Andes, the subtropical Andes, the Atlantic forests in Brazil, the eastern Himalaya-Yunnan region, northern Borneo, New Guinea, and East Africa. For example, the mountains of tropical and subtropical America harbour over 90,000 species of flowering plants (Figure 5.1). Epiphytes such as mosses and ferns are an important component of this richness: Total moss diversity in the five tropical Andean mountain countries is estimated to be more than 7 times higher than diversity in the entire Amazon basin. Secondary centres of biodiversity are found in the Mediterranean mountains, the Rocky Mountains, the Alps, the Caucasus, and Central Asia. Mountains are also important centres of agro-biodiversity, with a great variety of locally adapted crops and livestock – an important genetic resource and an asset for assuring food security for a growing global population. Mountain biodiversity also supports the livelihoods of mountain and lowland populations by providing basic environmental services such as freshwater, timber, medicinal plants, and recreation for an increasingly urbanized world.

Mount Kinabalu (4101 m) in Sabah, Malaysia, is estimated to harbour over 4000 plant species, more than one-quarter of all the plant species in the United States of America.

Climate change: a threat to mountain biodiversity

Mountain areas have been increasingly affected by loss of biodiversity due to expansion and intensification of land use. In recent decades, climate change has emerged as another threat to diversity. With higher temperatures predicted, habitats for organisms adapted to the cold will be curtailed. Species already inhabiting summit regions will be in a very difficult situation, because they can go nowhere else. Longer summers with a greater incidence of drought are expected in many mountain regions worldwide. The main issue is the speed of change: ongoing and expected climatic changes are much faster than what evolution and migration are commonly able to cope with, even though the pace of plant species moving uphill is quite rapid; in the Alps, for example, it has been about 10 m on average per decade during the past century. An acceleration has been reported recently. Uphill movement increases the total number of species in the upper belts. Rare species or those adapted to the cold may be outcompeted in the long term. Mountain ecosystems are also likely to be exposed to more extreme events such as intensive rainstorms, severe insect and disease outbreaks, longer fire seasons and more severe fires.

Figure 5.1: Global biodiversity and mountain regions: Number of species of vascular plants in a regional perspective (100x100 km).





Mount Sajama, Bolivia (Ch. Koerner)

The need to reconcile conservation and development

Managing mountain biodiversity has increasingly been recognised as a global responsibility in recent decades. Globally, protected areas have increased sixfold to eightfold in the last 40 years, largely in mountain areas. Many of these are inhabited by local people. Climate change may further increase the pressure for more conservation as well as for more intensive resource use in mountains. Innovative concepts and approaches are thus required to reconcile biodiversity conservation with development. Not much time is left to reach the UN Millennium Development goal of reducing poverty and hunger by half by 2015, and even less time is left to reach the 2010 target to reduce the loss of biodiversity. Both are global commitments, but they are often conflicting goals in a concrete local and regional setting. One way of reconciling them is by engaging local people in the stewardship of their natural heritage, for example within the framework of conservation landscapes which include biodiversity sanctuaries within a pattern of agricultural land use. Conservation landscapes are increasingly recognized for their potential to maintain high levels of biodiversity in combination with intensive but diversified small-scale farming, where high population density inhibits the establishment or extension of protected areas. The Kigezi Highlands in Southwestern Uganda is such a conservation landscape. Despite intensive use and a population density of over 250 people per km², the agricultural production system supports biodiversity management based on a wide variety of crops and trees deliberately planted on farms. Many small-scale farming areas in Africa and in other parts of the world have the potential to become conservation landscapes owing to their diversified land use. Highly developed regions such as the Alps and, by contrast, mountain regions which are still in a natural or even pristine state – for example the Patagonian Andes – require different strategies such as creating protected areas or maintaining wilderness areas.

Mountain forests

Between 1990 and 2000, the area of natural forest decreased by 6.8% in the tropics, while in temperate areas it expanded by 1.2%, mainly due to an increase in forest cover in the mountainous countries of Europe (FAO 2001). Natural mountain forests are important reservoirs of species and they are essential for the provision of key environmental services such as freshwater. They can reduce peak runoff and local flooding, although this effect decreases as the size of the watershed and its distance from a headwater area increase. Many of the world's largest cities, including New York, Jakarta, Tokyo, Mumbai, Rio de Janeiro, Los Angeles, Barcelona, Nairobi, Melbourne, Bogota, La Paz, and Mexico City rely on protected forests in their watershed for much of their freshwater supply.

Evergreen tropical cloud forests are the most fragile and most diminished parts of mountain forests, but they are very rich in endemic species, i.e. species that occur nowhere else. In Peru, for example, 30% of the 272 species of endemic mammals, birds and frogs are found in cloud forests. In Ecuador, 17,000 km² of tropical cloud forest contain 3400 vascular plant species – 300 more than in 70,000 km² of lowland Amazon forest. Cloud forests also harbour the wild relatives and sources of genetic diversity of important staple crops such as beans, potatoes and coffee. Moreover, montane cloud forests capture moisture from fog or clouds and thus add substantial amounts of water to the hydrological system. This is especially important in dry areas with frequent fog or cloud formation.



Conservation Corridors in the Hindu Kush-Himalaya

Conservation biology has demonstrated the usefulness of large habitats for maintaining larger populations with high genetic diversity. Such habitats provide connectivity, which assures the flow and movement of organisms across larger landscapes. These movements may be altered by climate change.

Nakul Chettri
Bandana Shakya and
Eklabya Sharma
ICIMOD Kathmandu
Nepal



Kanchenjunga from Darjeeling, India (N. Chettri)

In mountains, connectivity across altitudinal gradients will be important for the movement of organisms. The International Centre for Integrated Mountain Development (ICIMOD) is therefore promoting the idea of establishing seven transboundary landscapes and four trans-Himalayan transects across the Hindu Kush-Himalaya region, which will extend from low- to high-altitude areas and from dry to wet areas, with the aim of improving connectivity within the landscapes and systematic environmental monitoring in the region. The transboundary landscapes are nested within the transects. One of these transboundary landscape projects is the Kanchenjunga Landscape, which is shared by India, Bhutan and Nepal. The regional cooperative framework for Kanchenjunga addresses the root causes of biodiversity loss in the landscape – habitat loss, fragmentation of the landscape, over-extraction of resources, uncontrolled tourism – in order to exploit complementarities between and coordination among the many actors engaged in biodiversity conservation. Community-based conservation projects are being implemented with a view to improving local livelihoods. The present framework enables the countries to develop an implementation plan in line with the national conservation agendas.



Mountains, Climate Change, and Fire Hazard

Kilimanjaro is an icon of climate change due to its melting ice cap: Over the last century, rainfall has decreased by 30%, while temperatures have been rising since the 1970s. Another issue is the incidence of fire.

Eva Spehn
Christian Koerner
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Basel, Switzerland



View of Mount Kilimanjaro, Tanzania (Ch. Koerner)

The incidence of fire has increased, especially on the upper slopes, as the combined effect of climate change and human activities such as honey gathering and illicit logging. This has led to the destruction of 50 km² of montane cloud forest during the last three decades and a lowering of the tree line by 800 m. With the loss of the forest went one of its major environmental services, trapping water from clouds. The forest destroyed was by far more important for water supply to the densely populated lower slopes than the melting ice cap (Hemp 2005). A special fund was set up for fire fighting, to which various donors including environmental institutions and the private sector made contributions. A comprehensive development approach is now needed which includes effective patrolling of the endangered zones and an effective early warning system, and which considers the needs of a growing population (OECD 2003).

In dryer areas of the world, mountain regions are sensitive to fire. Increased frequency and intensity of fire has already been observed around the globe. Cases in point include the Bale Mountains in Ethiopia, the Blue Mountains of New South Wales in Australia, the Western Rocky Mountains, and the mountains on the fringes of the Mediterranean, which are likely to become regions of sustained fire hazard in future. As natural fires are quite rare at higher elevations, most natural highland vegetation is not specifically resistant to this hazard and is easily transformed when fires become more frequent as a result of climate change and human action, including arson. Burned areas are then normally poorer in species, particularly in forested areas, and are usually characterised by more widespread and common species.

