

Mountain Biodiversity, Genetic Resources and Cultures

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Mountains cover 24 percent of the global land area and affect half the human population (Körner, 2002). They are home to rich biological diversity and genetic resources. However, our planet's ecological services are under threat. Urgent steps for the conservation and sustainable utilisation of mountain biodiversity are needed. It is of paramount importance to link human endeavour, cultures, traditional knowledge, not just for ecological concerns but to ensure the survival of humanity through sustainable use.

The mountain biota includes unique species that are adapted to extremes of temperature, soil water, disturbance to slopes and vulnerable environments. A vast number of plant species - Life Support Species (LSS: Kapoor, 1992; Kapoor, 2007) - are of socioeconomic and ecological value, as they ensure human survival in emergencies and in extreme environments. They are an integral part of native mountain cultures and communities and provide food, nutrition, primary health care, medicine and shelter. Central to maintaining the ecological integrity of the prevailing ecosystems, they provide ecological services which act as insurance against emergencies and hold the key to maintaining and preserving the ancient heritage of local traditions and cultures. Biological richness has an insurance value in times of crisis and serves as a buffer against system failure (Körner and Spehn, 2002). Traits in biodiversity in mountains adapted to extreme environments and which contribute to their ecological and biological uniqueness have been studied by scientists (Körner, 2003, 2009). More collaborative studies (e.g., Abbott 2008) are needed to build an inventory of the unique characteristics which enable LSS to survive and thrive in extreme mountain environments. More such efforts at local, regional and international levels would stimulate research to understand adaptations and the complex biology of species with high socio-economic and ecological values in the Himalayas, Andes and other mountain regions.

The current economic and financial 'world view' demands that monetary value be ascribed to biodiversity. This clear signal to estimate the value of the green matter of the mountains is still not fully recognised and the unique value of their cultures is not acknowledged. The erosion of cultures and languages in mountains is a warning that efforts to protect traditional knowledge should be encouraged and intensified. Mountain ecosystems are Nature's Bank for life (Kapoor, 2007) and underpin the ecosystems in which humanity, as we know it today, has evolved and flourished.

Mountain ecosystems represent dynamic living laboratories with rich traditional knowledge, often acting as a driver of biological diversity. While this knowledge needs to be protected and preserved, its sustainable use and conservation must also continue.

Mountain biodiversity and cultures are unique and invaluable as:

- They arise from millions of years of evolution that created the structure of mountains and isolated their indigenous communities;
- Mountain communities have attitudes and approaches to life that have evolved slowly by the assimilation of knowledge from people who moved to the mountains to escape the insecurities, persecution and turmoil of their native lands;

- Slow migration in the past due to very difficult physical access and the harsh environment led to the preservation of cultures in an undiluted form;
- Many areas have their cultures intact. They include ancient religious practices like the Mahayana Buddhism in Bhutan and the Vedic tradition of Hinduism in Uttarakhand. The land was fragile yet the microclimate was not disturbed, leading to the evolution and sustainability of biodiversity that included a wide variety of plants of very high medicinal, aromatic and nutritional value.

To ensure the continuity of biodiversity, cultures and traditions of mountains while providing food, nutrition, health and ecological security to mountain people in times of global climate change, the following recommendations are made with respect to traditional knowledge (TK) and conservation biology associated with biodiversity and genetic resources for action by the Convention on Biological Diversity (CBD) in 2010:

- 1 Definitions and terminology of TK need to carry within them embedded knowledge of the communities of people who live and create TK as a way of life. These definitions should draw on the ecological, social, philosophical, spiritual, cultural, scientific information and details attached to TK.
- 2 Equitable protection of TK should be based on its specific characteristics, i.e. that its evolution in space and time is influenced by the social, spiritual and beliefs, and that it imparts a unique identity and integrity to the TK holders in a given community, culture, habitat and ecosystem.
- 3 Specific strategies should be developed and associated frameworks should be designed for equitable sharing of benefits of TK, including ecosystem services which enable local people and communities to thrive in their unique mountain environments.
- 4 Sustainable development and TK protection policy should allow valuation of TK in both measurable and non-measurable terms. For example, a gene identified from a plant species can bring economic benefit to the TK community from which it originates, when prior informed consent (PIC) has been obtained and a benefit-sharing agreement has been legally agreed. The non-measurable value of the species and its associated TK will be the conserved habitat, other associated plant, animal, microbial species, the nature of soil, water, location, people, their culture, spiritual and social traditions etc. which have maintained the ecosystem services.
- 5 Any TK protection policy should:
 - Empower all people, especially women and the elderly who are often the TK holders;
 - Promote equitable benefit sharing;
 - Promote community development and legitimate trading activities. The CBD should develop such details in strategies which build and enhance trust and understanding, transparency among people who are the beneficiaries i.e. TK holders and with others, such as academics, scientists and commercial users of TK;
 - Accommodate all approaches and build a harmonised system based on international principles and agreement;
 - Create a structure of institutions and lay out processes for creation and flow of data, information and knowledge on TK and genetic resources;
 - Encourage capacity building, awareness creation and advocacy for Conservation Biology programmes linked to

traditional knowledge while targeting mountain biodiversity genetic resources research. Geo-coded information is essential in the inventory and assessment of biodiversity through biological and ethnobotanical studies on LSS in the Himalayas, Central Asia, Andes, Alps and other mountain regions.

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Spread of Non-Native Plant Species into Mountains: Now is the Time to Act

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Mountains are hotspots for biodiversity and of great importance to human societies. The worldwide placement of mountain areas in conservation reserves is recognition of their value. Managers have to remain vigilant to protect mountain ecosystems from future threats. One such threat is invasive, non-native plants. Invasive plants alter plant communities, affect grazing lands and homogenise the world's flora. Mountain areas have not been as intensely affected by plant invasions as low elevations because of harsh climatic conditions, isolation and limited human pressure. The relative resistance of mountain ecosystems to plant invasions may be transient, however, in light of ongoing global change (e.g. climate change, expansion of human pressures). Unique

mountain flora, fauna and habitats may become increasingly susceptible to invasions.

Building a knowledge base for managing plant invasions in mountains

In 2005, the Mountain Invasion Research Network (*MIREN*, www.miren.ethz.ch) was launched to investigate the degree of plant invasion in mountain ecosystems, to understand the invasion process using elevational gradients as a model system, and to evaluate and communicate the future threat from plant invasions associated with global warming and changing land use patterns (Dietz et al. 2006). MIREN is associated with the Consortium for Integrated Climate Research in Western Mountains (CIRMOUNT), the Global Mountain Biodiversity Assessment (GMBA) and the Mountain Research Initiative (MRI). The MIREN core program comprises comparative research in six mountain regions (Pacific Northwest USA, Swiss Alps, Chilean Andes, Australian Alps, Hawaii, and the Canary Islands Spain), covering major climatic zones including island and continental systems (Figure 1). Beyond the core program, MIREN networks with researchers and managers in mountain regions worldwide. In an issue of 'Perspectives in Plant Ecology, Evolution and Systematics' on plant invasions into mountains (Vol 7, No 3), MIREN showed that non-native plants are present in mountain ecosystems around the world, but that the distribution patterns and impacts along elevation gradients differ between regions. In an upcoming article of 'Frontiers in Ecology and the Environment' (Pauchard et al. in press), we present a



Figure 1: *Lupinus polyphyllus*, a native of the Pacific Northwest of North America is a garden escapee a) in the mountains of Switzerland and b) in the abandoned gold mining village of Kiandra in the Australian Alps. *Lupinus* illustrates the future threat of invasions by amenity species to mountain areas. Photos: T. Seipel, S. Haider.