

Climate Change in the Himalayas: the Vulnerability of Biodiversity

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The Hindu Kush-Himalayan (HKH) range of mountain chains is astounding, not only from an aesthetic point of view but also in terms of the abundance of natural resources sheltered within the huge folds of rugged mountain valleys.

It is here that rare and endangered flora and fauna exist: global biodiversity hotspots. The HKH includes all or part of four Global Biodiversity Hotspots, 330 Important Bird Areas, two Mega-Diversity Countries (India and China), and 60 eco-regions of which 12 are Global 200 Eco-regions. A total of 488 protected areas cover 39% of the total area. The region directly provides essential ecosystem services to more than 200 million mountain people, and indirectly provides services to 1.3 billion people living downstream. The river basins are an important source of food and energy.

Anxiety about global climate change, the impacts it could have in mountain regions, the implications in terms of the vulnerability of mountain biodiversity, and the paucity of human adaptation mechanisms to cope with the prospective changes have brought mountain regions into the spotlight. This article discusses these issues as well as people's perceptions of climate change, its variability, and the vulnerability of mountain biodiversity to the change.

Mountain biodiversity in a global context

About 25% of the Global Biodiversity Hotspots and 40% of the Global 200 Eco-regions in the HKH region are part of protected area networks. The Indo-Burma Hotspot alone has 7,000 endemic plants and possesses 1.9% of the global endemic vertebrates. More than 7,000 species of plants, 175 species of mammals, and over 500 species of birds have been recorded in the Eastern Himalayas (Chettri et al. 2008). These statistics highlight

the fact that the services provided by biodiversity in the HKH must be substantial; they are now threatened by the changing trends in climate, with similar implications for mountain ecosystems everywhere.

Climate change variability

The Fourth Assessment Report of the Inter-Governmental Panel on Climate Change (IPCC) concluded that changes in the atmosphere, oceans, glaciers and ice caps demonstrate that the planet is warming. The data available for the Eastern Himalayas show that there is a definite warming trend at higher altitudes and that areas at altitudes above 4,000m seem to be experiencing the greatest warming trend. The warming trend observed ranges from 0.01 to 0.06°C/yr and the annual mean temperature is expected to increase by 2.9°C by the middle of the century. The Eastern Himalayas are predicted to experience milder winters with increases in precipitation. While some observational data are available for the Eastern Himalayas (Figure 1), knowledge about climatic characteristics for the HKH region is limited by both paucity of observation and insufficient theoretical attention. In order to determine the degree and rate of climatic trends, long-term data sets are needed. ICIMOD is proposing to rectify this paucity of data by developing and implementing 'transects and landscapes' for long-term monitoring.

Local perceptions of climate change

People in the Eastern Himalayas perceive climate change as a threat. They believe it to be caused by excessive human extraction of and impacts on natural resources and, to a lesser extent, part of natural climatic variability. Most people from the region who responded to our research associated climate change with an increased risk of floods and landslides and an

increase in temperature, land degradation, drying up of water sources, outbreaks of pests, and food shortages. Respondents recollected personal experiences of changing climate conditions and were of the opinion that farmers would be the hardest hit. Many others reported phenological changes in trees (times of budding, flowering, leaf fall, and so forth) which they thought to be good indicators of climate change in the region (Table 1). Local communities are reported to be changing their cropping patterns.

The vulnerability of biodiversity

Biodiversity hotspots in the HKH are vulnerable to climate change because they are rich in endemic species with restricted distribution. Threats to biodiversity include the possible loss of genetic resources and species, possible loss of habitats, and, concomitantly, a decrease in ecosystem services.

Not all of the possible threats are to the natural environment. Human systems also could suffer. A recent study in the Eastern Himalayas found that its subsistence economy, dependent as it is on ecosystem services, would be challenged to adapt in the event of significant changes in climate. Agricultural practices would have to change and, although rangelands in high-altitude areas might benefit in some ways, alpine shrubs and meadows as well as the habitats of endangered, restricted range species and Trans-Himalayan migratory

birds might come under threat. There would also be impacts on water and wetland resources (Table 1). Community vulnerabilities to stresses caused by water scarcity, food insecurity, water-borne diseases, glacial lake outburst floods, and flash floods would all be exacerbated by climate change. Fragmentation and loss of habitats threaten species' survival – high-altitude species found in the transition zone between sub-alpine and alpine and high-altitude wetland species will be vulnerable to climate change.

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People living in the Eastern Himalayas are likely to be less resilient to climate change because they are extremely poor. Population growth rates are high and infrastructure is weak. The main occupation is subsistence farming. Although there is hydropower potential, this potential could also be severely impacted by climate change. Empirical research is essential, but at the moment it is almost non-existent. Plans are being formulated to rectify the research situation, however.

Table 1: Overview of climate change trends, peoples' perception, impacts, and vulnerable entities in the Eastern Himalayas

Preliminary Results

Climatic Trends/Projections	Potential Impacts	Vulnerable Entities	Peoples' Perception
<ul style="list-style-type: none"> There is increased magnitude of warming with elevation, with areas >4000m experiencing the highest warming Observed warming is 0.01 to 0.06°C/yr Annual mean temperature is expected to increase by 2.9°C by the middle of the century The Hadley Centre regional climate model- HadRM2 gives projection of milder winter with enhanced precipitation 	<ul style="list-style-type: none"> Climate change impact in the Eastern Himalayas to be more pronounced than global average Hydrological changes to impact functions and services of wetlands Successional shift from wetlands to terrestrial ecosystem Increased degradation of peat land, bog, swamp and marshland Change in ecotone and microenvironmental endemism Vertical species migration and extinction Dominance of invasive and xeric species Reduced productivity of alpine and cryospheric ecosystems Reduced agrobiodiversity and their production, decline of genetic diversity 	<ul style="list-style-type: none"> Region's economy less resilient to current climatic variability Stresses due to water scarcity, food security, water-borne diseases, GLOFs, and flash floods to increase communities vulnerability Isolated protected areas with little or no habitat connectivity Brahmaputra and Ganges river basin Riverine islands, ephemeral and cloud forest ecosystems, Alpine shrubs and meadows Agroecosystems in high altitudes of eastern Nepal, Sikkim, Bhutan, Arunachal Pradesh and TAR High altitude rangelands Endangered, restricted range species(endemic) and trans-Himalayan migratory birds 	<ul style="list-style-type: none"> Perceived as a consequence of diverse human activities causing pressure on resources Associated in context to warming weather condition, hazards, outbreak of pests, food and water shortage Adaptation towards change in cropping pattern Better farmland productivity at high altitude, less at lowlands Changes in phenology



Rhododendron dominated forest in the subalpine and alpine ecotone showing rhododendron (inset) as keystone species; Shangrila, PR China

Adaptation strategies

In the past, natural ecosystems adapted autonomously without much interference on the part of those who stood to benefit from their services. Traditionally, communities depending on these ecosystems and their resources have had informal institutions and customary regulations in place to ensure that external perturbations did not exceed natural resilience. In recent times climate and other global changes have accelerated to such an extent that the need for planned adaptation is now acute. At present the rate at which demographic and sociopolitical changes are taking place in response to global changes is outstripping the ability of traditional approaches and coping mechanisms to respond. Formal adaptation measures will have to supplement traditional approaches in order to address these new threats to biodiversity.

Recently, there has been a shift from contemporary conservation approaches to a new paradigm of

landscape-level interconnectivity between protected area systems. This concept advocates a shift from the species-habitat focus to an inclusive focus – expanding the biogeographic range so that natural adjustments to climate change can proceed without being restrictive. The benefit of translating the concept into action, however, has yet to be realised.

References

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