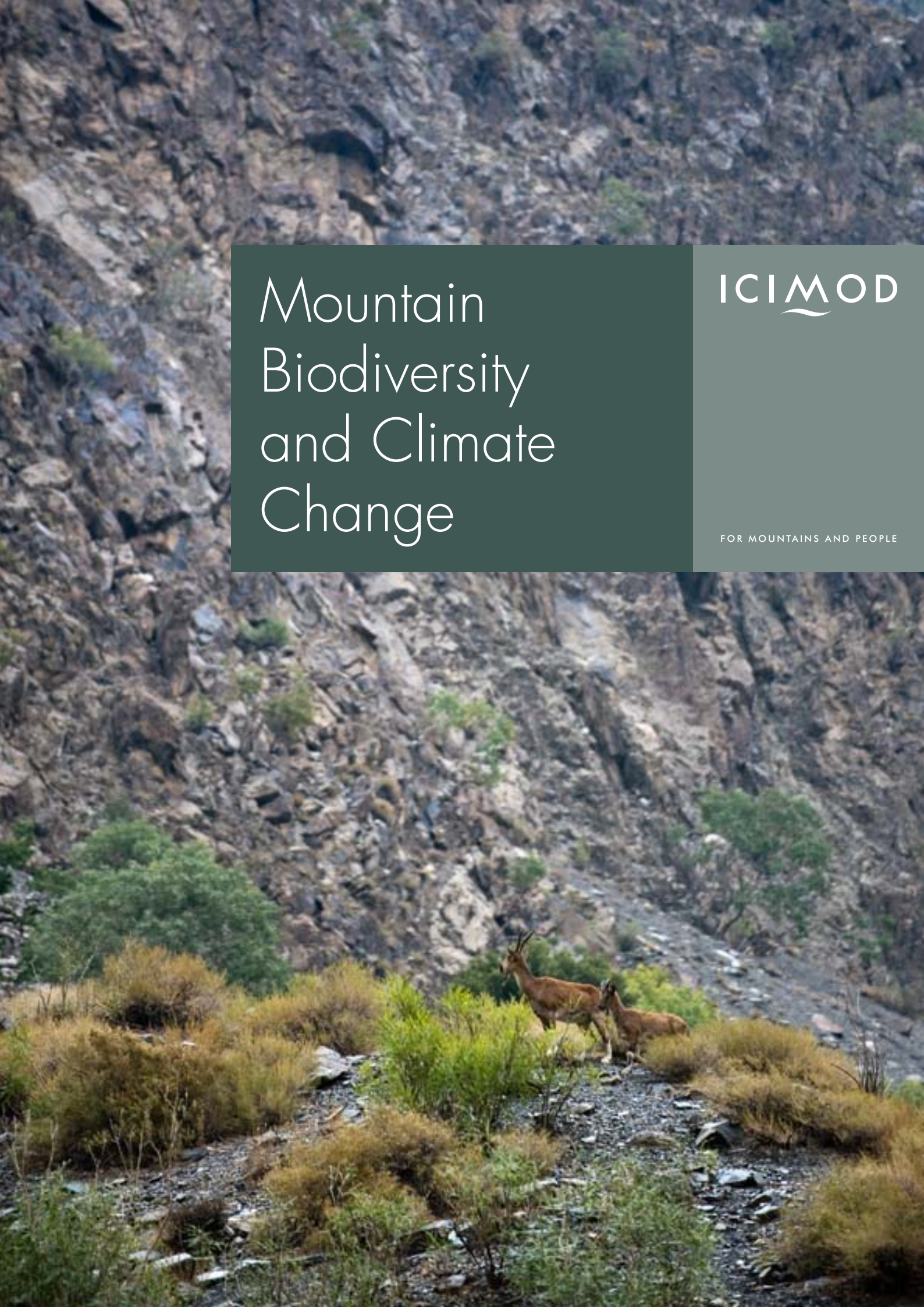
Mountain Biodiversity and Climate Change

ICIMOD

FOR MOUNTAINS AND PEOPLE



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Mountain Biodiversity and Climate Change

The need for long-term research and action in the Hindu Kush-Himalayas

Twenty-four per cent of the surface area of the Earth is covered by 'islands in the sky' – mountains. Some 12% of the global human population lives within this astounding series of rugged valleys and peaks. They do not live alone; however isolated these giant fortresses above us appear to be. Mountains are also home to a rich array of fauna and flora and are a source of water and other ecosystem services – more perhaps than we can imagine or that we know of at present. It is for this reason that mountains have ecological, aesthetic, and socioeconomic significance, not only for those living in mountain areas, but also for people living beyond. Amongst the most fragile environments in the world, the influence of the mountains extends far beyond their geographical limits to the surrounding lowlands that need their goods and services.

Mountains are places of legend and refuge, and many human mountain inhabitants have settled in them in the past to escape religious or political persecution or wars in the lowlands. In terms of biodiversity, our natural patrimony, they are its last refuge and well worth our attention. Today, the mountains are facing enormous pressure from global changes related to drivers such as climate change, industrialisation, increasing population, and changes in land use that place added demands on the ecosystem services the mountains offer. While mountain biodiversity and its people are the first to be affected by these changes, those in river basins downstream will also suffer and beyond them distant populations across the globe.

Mountains began to receive attention during the United Nations Conference on Environment and Development (UNCED) in Rio in 1992, with a specific chapter in Agenda 21. This was followed by the UN General Assembly's 2002 declaration of the 'International Year of Mountains', the World Summit on Sustainable Development in Johannesburg 2002, and the Global Mountain Summit in Bishkek 2002. However, despite growing awareness about the importance of mountain systems, they continue to be marginalised by the global international development agenda.

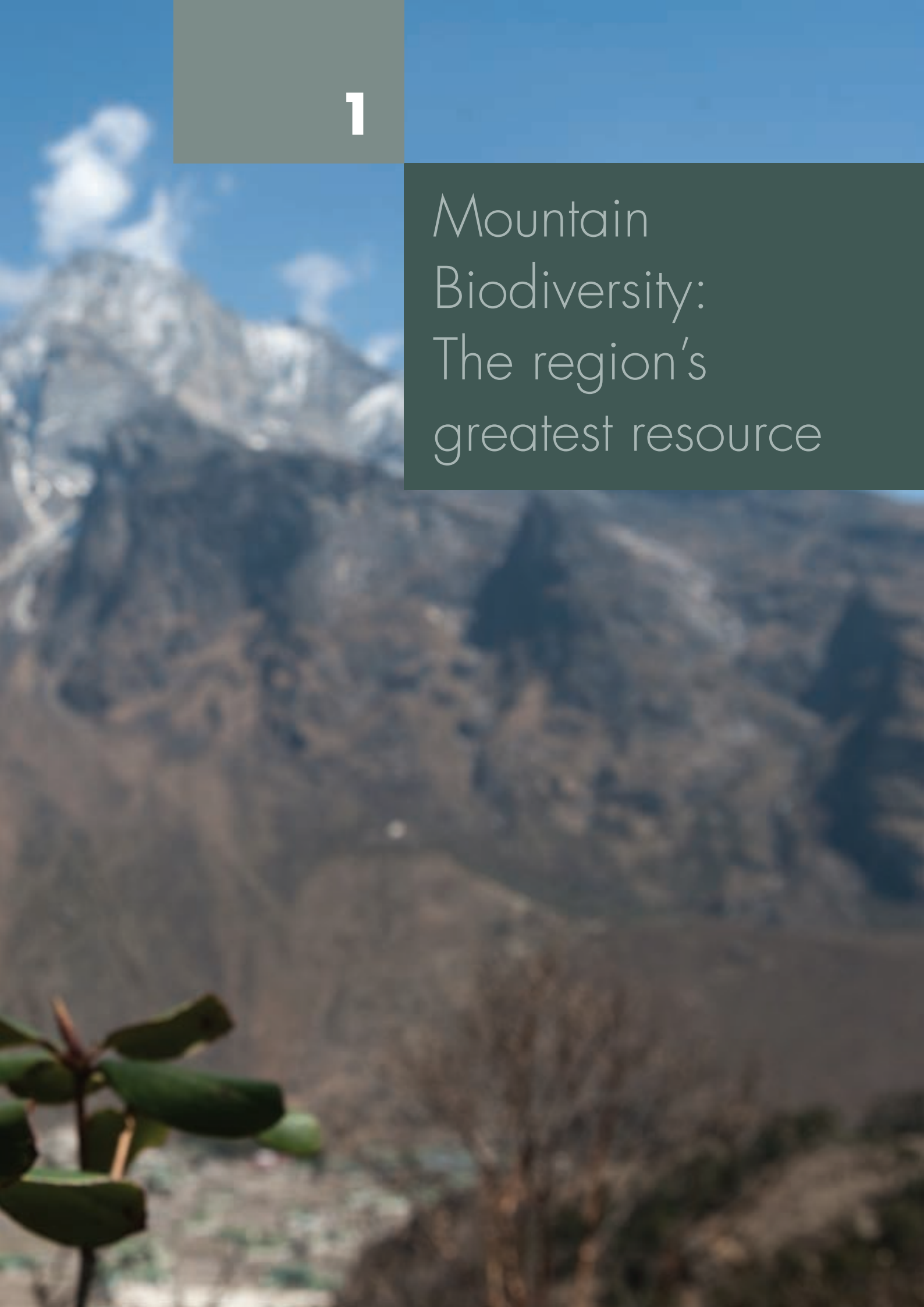
In 2007, the Inter-Governmental Panel for Climate Change (IPCC) provided concrete evidence of the global relevance of climate change in its 4th Assessment Report, which shows that the Earth's climate is definitely warming. Climate change is the most prominent force in global change; however, it is embedded in a matrix of drivers such as globalisation, population growth, and local land-use change. Reading the report, it seems that the Hindu Kush-Himalayan region is a virtual 'white spot' (or area of data gap) for which little consistent long-term information is available. The region has never received the attention of the global, regional, and national research mechanisms needed to fill this gap.

Most of the global biodiversity hotspots are located in mountain and coastal regions: they host the world's most threatened and endemic species. A large number of the people in these areas live in poverty and need the biological resources for their subsistence. The mountainous countries have set aside 11.4% of their areas as protected area networks, however, and the Hindu Kush-Himalayan region has all or part of four global biodiversity hotspots that provide immense value in terms of ecosystem services.

We have reached a stage at which the increasing awareness of the impact of climate change on mountain ecosystems, and the consequences for the rest of the world, has brought mountains to the centre of international debate. ICIMOD, along with its global and regional partners is determined to help mitigate the effects of climate change and contribute to the ability of the people of the Hindu Kush-Himalayan mountain system to adapt to them.

In November 2008 ICIMOD hosted the International Mountain Biodiversity Conference. The conference brought together some 75 renowned biodiversity, climate change, and conservation experts, representatives of global programmes, and representatives of institutions in the eight countries that share the Himalayan region. In addition to the main conference, two pre-conference

workshops on 'Mountain Transboundary Protected Areas' and 'Linking Geodata with Biodiversity Information', and a post-conference workshop on 'A Research Strategy on Global Change in Mountain Biosphere Reserves' were also held. These experts discussed ways of systematically gathering and sharing the information needed to develop a reliable picture of the present situation, and to formulate approaches towards a common future strategy for mountain biodiversity conservation. The text of this booklet is based largely on the papers contributed to the main conference, prepared in form of answers to the questions we hear people asking. The Conference Proceedings, which include all of the invited papers as well as the conference and workshop reports, are included in the CD found in the jacket of this booklet. All references can be found in the proceedings. Details of the participants and programme can be found the conference website <www.icimod.org/imbc> ICIMOD gratefully acknowledges the contribution of all authors.



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Mountain Biodiversity: The region's greatest resource

What are global biodiversity hotspots?

The term biodiversity refers to combinations of life forms and their interactions. These interactions occur at different levels (genetic, species, and ecosystem) and depend upon the physical environment. A biodiversity 'hotspot' refers to a region that contains a high proportion of threatened and endemic species, a high degradation of original habitats and high human pressure. Most of the 34 global hotspots are in mountain and coastal areas (see below).

The map on the next double page shows areas of the earth rich in vascular plants. Vascular plants are good indicators of biodiversity because they are found in a wide range of climates from humid to arid regions. The areas shown in red on the map have the greatest biodiversity. The diversity of mountain ecosystems is remarkable. Rich in endemic plant and animal species, they harbour one third of global terrestrial biodiversity.

Why is biodiversity high in mountain regions?

Biodiversity is high in mountain regions because of their wide range of habitats, varied micro-climates, and ecological conditions. These factors have resulted in a high degree of genetic diversity in terms of crop and livestock species and their wild relatives. Altitudinal gradients and ecological zones provide plants with different exposures over short distances. The topography itself is a varied and a fragmented mosaic of habitats or genetic 'islands in the sky'.

Global biodiversity hotspots

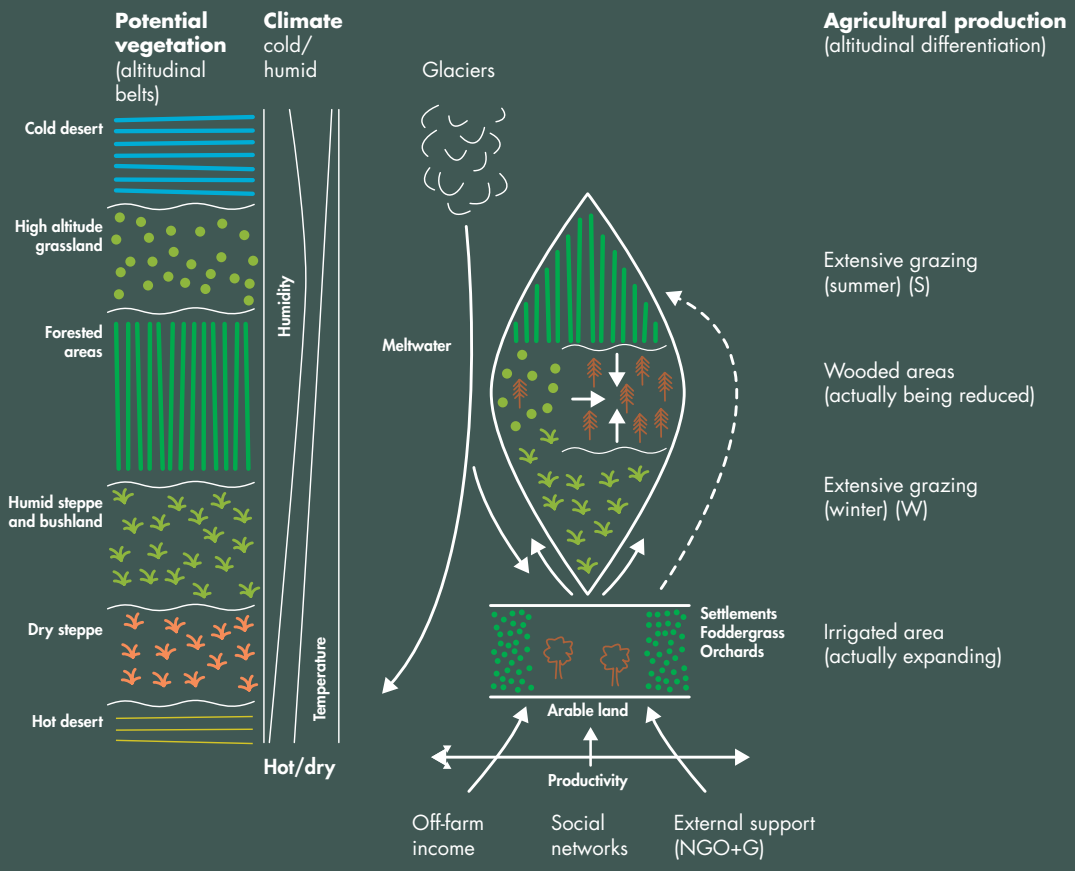
(redrawn from Conservation International, www.biodiversityhotspots.org)

What particular physiographic elements determine biodiversity in the Hindu Kush-Himalayas?

These mountain ranges rise from sea level to more than 8,000 metres within a distance of only a few hundred kilometres, extending from tropical (<500 m) to alpine ice-snow (>5000 m); with a principal vertical vegetation regime comprised of tropical and subtropical rain forest, temperate broadleaf deciduous or mixed forest, and temperate coniferous forest; and including high-altitude cold shrub or steppe and cold desert. From east to west for over 3,500 km, 10 big river systems drain this region which forms an ecological buffer between the Tibetan Plateau and South Asia. The western mountains are dry as they receive an average of less than 500 mm (or 0.5 m) of rain a year. In the east some areas have more than 4 m of rain per year (and up to an extreme of 12 m of rain a year in Cherapunjee in the Meghalaya Hills). Travelling from south to north the summer monsoon of the south gives way to the boreal winter circulation over the Tibetan Plateau. Such disparate physiographic conditions have produced varied natural and cultural landscapes and a diversity of species and mountain ecosystems.

Vertical arrangement of natural vegetation and agricultural productivity

(Redrawn from Winiger and Börst, 2003, in Jeanneret et al. Welt der Alpen - Gebirge der Welt 54, Berne: Haupt Verlag)



Global biodiversity: Species numbers of vascular plants

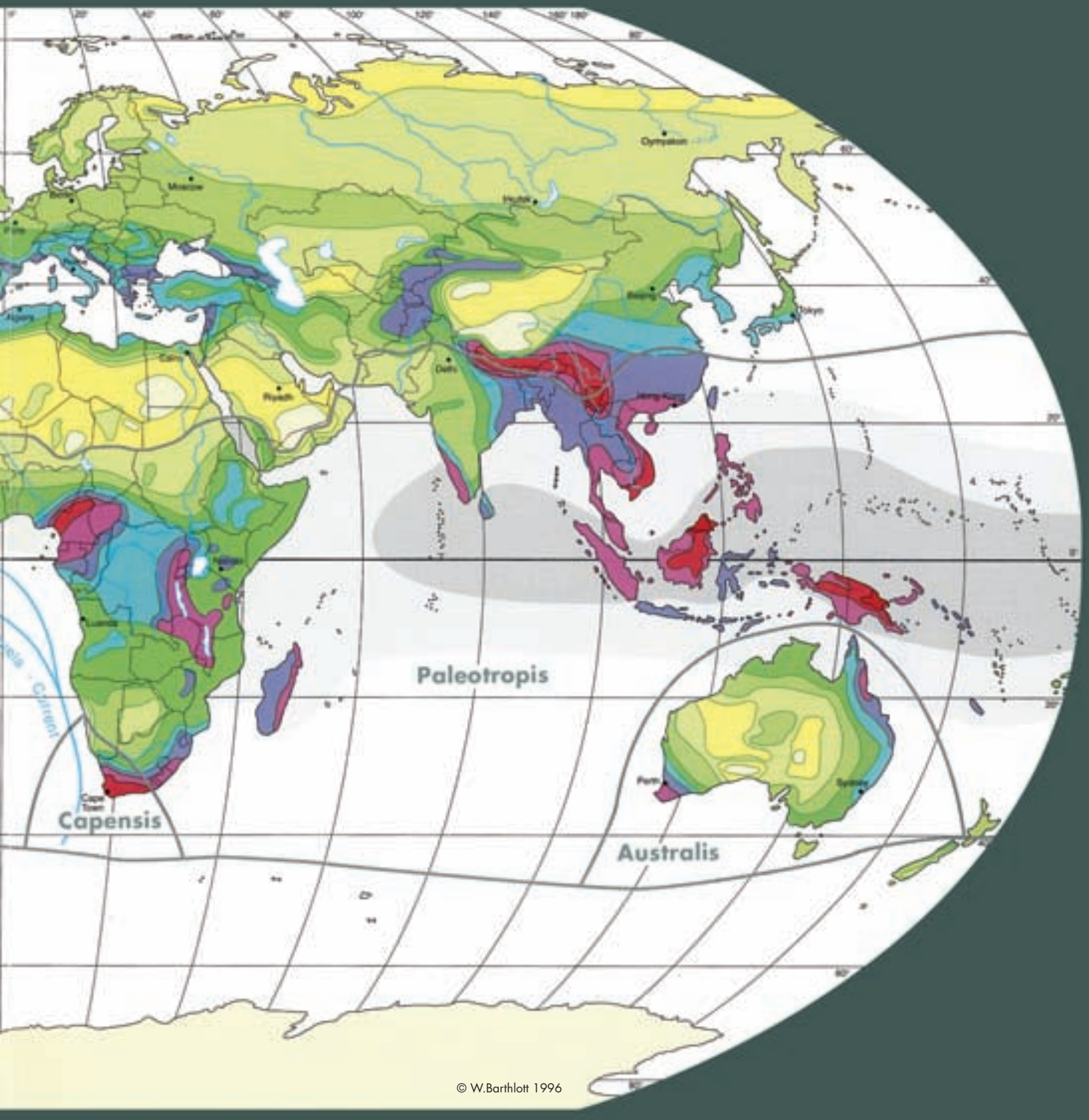
Diversity Zones (DZ): Number of species per 10,000 km²

- DZ 1 (<100)
- DZ 2 (100 - 200)
- DZ 3 (200 - 500)
- DZ 4 (500 - 1000)
- DZ 5 (1000 - 1500)
- DZ 6 (1500 - 2000)
- DZ 7 (2000 - 3000)
- DZ 8 (3000 - 4000)
- DZ 9 (4000 - 5000)
- DZ 10 (>5000)

Sea surface temperature

- >29°C
- >27°C
- cold current

Capensis floristic region



Robinson projection

Standard parallels 38°N und 38°S

Scale 1:100 000 000

W.Barthlott, W.Lauer, A.Placke

Departments of Botany and Geography

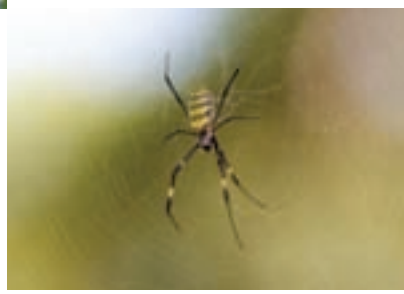
University of Bonn

Cartography: M.Gref

Department of Geography

University of Bonn

What biodiversity is present in the Hindu Kush-Himalayas?



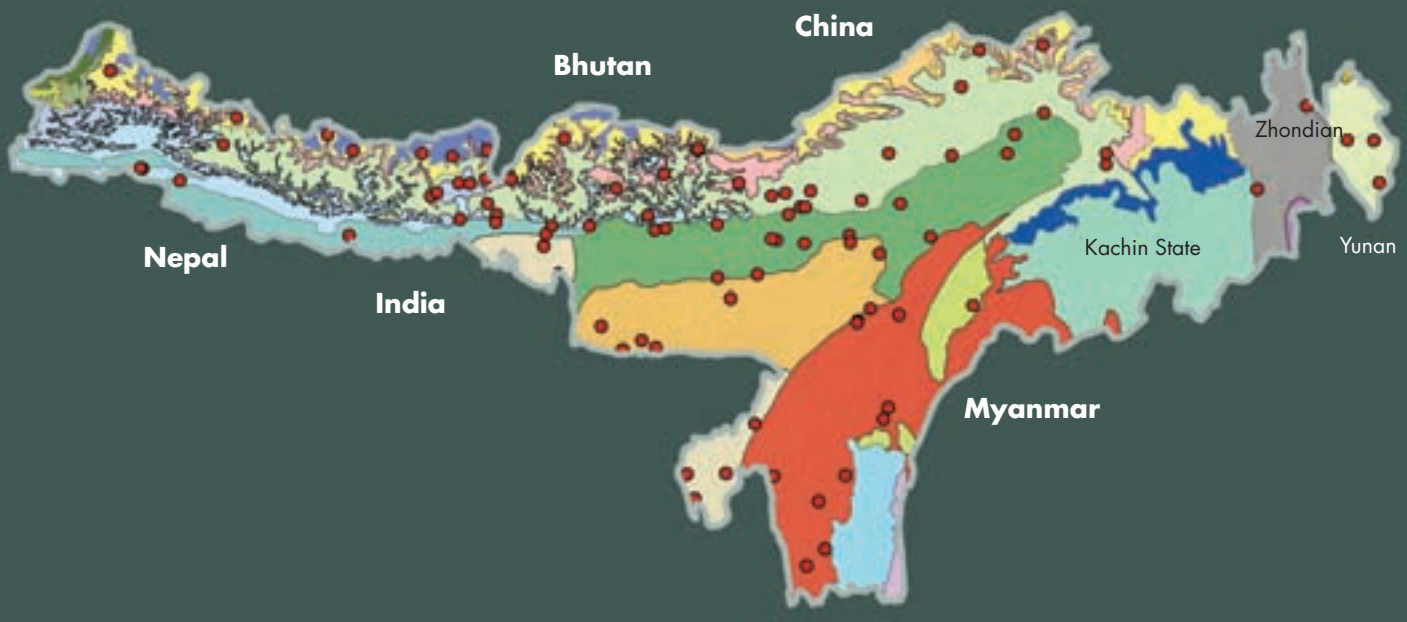
The high degree of endemism means there are numerous critical eco-regions of global importance. The Hindu Kush-Himalayan region as covered by ICIMOD includes parts of 4 global biodiversity hotspots as well as 6 UNESCO Natural World Heritage Sites, 60 eco-region types (including 30 critical eco-regions and 12 Global 200 eco-regions), 30 Ramsar sites, 488 protected areas, 330 Important Bird Areas (IBAs), and 53 Important Plant Areas (IPAs) for medicinal plants.

This awesome range of landscapes contain 25,000 species of angiosperms (10% of the global total), 75,000 species of insects (10% of the global total), 1,200 bird species (13% of the global total), and the wild relatives of many modern-day crops. However, little is known about the biological wealth in the region in detail or about the distribution and composition of communities and ecosystems.

"These awesome landscapes contain 10% of the global total of angiosperms and insects, and 13% of the global total of birds."

Biodiversity in the Eastern Himalayas (EH)

The Eastern Himalayan (EH) region showing the 25 eco-regions and the distribution of protected areas. The climate of the EH region is diverse and its topography complex. Forests and vegetation types are broadly tropical,sub-tropical, warm temperate, cool temperate, sub-alpine, and alpine, and these are further classified into layers based on other bioclimatic attributes. There are several globally significant mammals (45 species); birds (50 species); reptiles (16 species); amphibians (12 species); invertebrates (2 species); and plants (36 species); most of which (about 144 species) are found in the northeastern states of India. About one-third of the total flora are endemic to the region.The people belong to many different ethnic groups and speak a rich array of languages. It is their traditional knowledge that has kept this location and its ecosystem services as the heritage of future generations.



- Protected area
- ICIMOD Eastern Himalayan boundary
- Meghalaya subtropical forests
- Mizoram-Manipur-Kachin rain forest
- Northeast India-Myanmar pine forest
- Northeastern Himalayan subalpine conifer forest
- Northern Indochina subtropical forest
- Northern Triangle subtropical forest
- Northern Triangle temperate forest
- Nujang Langcang Gorge alpine conifer and mixed forest
- Rock and ice
- Southeast Tibet shrubland and meadow
- Terai-Duar savanna and grassland
- Western Himalayan alpine shrub and meadow
- Western Himalayan broadleaf forest
- Western Himalayan subalpine conifer forest
- Yarlung Tsangpo arid steppe
- Brahmaputra Valley semi-evergreen forest
- Chin Hills-Araken-Yoma montane forest
- Eastern Himalayan alpine shrub and meadow
- Eastern Himalayan broadleaf forest
- Eastern Himalayan subalpine conifer forest
- Hengduan Mountains subalpine conifer forest
- Himalayan subtropical broadleaf forest
- Himalayan subtropical pine forest
- Irrawaddy moist deciduous forest
- Lower Gangetic Plains moist deciduous forest

What special challenges does biodiversity face in the Hindu Kush-Himalayas?

Challenges to biodiversity come on a number of fronts and are both global and local. Human activities threaten mountain species. Modern methods can be used in conjunction with traditional knowledge to keep pace and adapt to use resources sustainably. Genetic resources offer opportunities for livelihoods but only if used wisely. Tourism can benefit people and the environment if sufficient revenue is retained locally. Rangeland conditions present special challenges, and conflicts between people and wildlife are problems concentrated in protected areas where people live.

The region's organisational challenges include inadequate policies and strategies; weak institutional, administrative, planning, and management capacities; inadequate data and information management; and poverty. These challenges cannot be met without regional coordination to achieve transboundary conservation and promote the sustainable use of resources. Biodiversity conservation is especially challenging in ecosystems that cross national borders such as transboundary landscapes.

Namche in the Khumbu region of Nepal

"The loss of biological diversity in these ecologically sensitive areas poses a threat to the security of the Himalayan region and endangers the world's global genetic heritage. Himalayan biodiversity is disappearing at an alarming rate and the time to act is now."

Andreas Schild, ICIMOD Director General

Why is it important to study mountain biodiversity?

Difficult as mountain environments are, they are also rich repositories of biodiversity and ecosystem services. Their impact extends far beyond the immediate mountain hinterland and, in some instances in the past 15 years, this fact has been recognised, especially on two important occasions: at the Earth Summit in Rio de Janeiro in 1992 and since then during the International Year of Mountains (2002).

How do global changes adversely affect the conservation of mountain biodiversity?

Despite international recognition, mountain areas continue to face enormous pressures as a result of changes taking place globally. Direct drivers of environmental changes include climate change, changes in land use and land cover, and introduction or removal of species; indirect drivers include demographic, economic, and sociopolitical changes. Such changes have negative impacts on biodiversity conservation, ecosystem services, and the well-being of people living in the mountains. Land-use, land cover, and climate change have already led to a contraction in species' range as well as extinctions. Human-induced climate change is expected to threaten the existence of some species. People's ability to cope with the changes in mountain areas will also be threatened, with ramifications downstream and beyond.

"Direct drivers of environmental changes include climate change, changes in land use and land cover, and introduction or removal of species"

What steps are being taken to protect biodiversity in the region?

"The Convention on Biological Diversity (CBD) has produced global objectives for the conservation of biological diversity"

In 1992, the Convention on Biological Diversity (CBD) produced global objectives for the conservation of biological diversity, for the sustainable use of its components, and for fair and equitable sharing of the benefits arising from genetic resources. All eight Hindu Kush-Himalayan countries are signatories to the CBD and are committed to conservation as a measure towards the immediate protection of globally significant landscapes.

In 2004, the Conference of Parties adopted an 'ecosystem approach' to biodiversity conservation and management which included a programme of work on 'Mountain Biodiversity' to reduce the loss of mountain biological diversity significantly at global, regional, and national levels by 2010. These programmes try to strike a balance between protection of biodiversity and local development.

Snow leopard in the Himalayas

The Convention on Biological Diversity - A treaty to sustain the diversity of life on Earth

The Convention on Biological Diversity (CBD) was conceived as a practical tool for translating the principles of Agenda 21 into reality. The Convention recognises that biological diversity is about more than plants, animals, and micro organisms and their ecosystems – it is about people and the need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. The three objectives of the CBD: are conservation, sustainable use, and equitable sharing of the benefits arising from the use of genetic resources. These objectives closely link socioeconomic and cultural elements with conservation and are an expression of the most fundamental values that any government would wish for its people. The Convention on Biological Diversity was signed by 150 government leaders at the 1992 Rio Earth Summit and this had grown to 191 parties by 2008. (See http://www.cbd.int)

In 2004 the Conference of Parties of the CBD adopted a Programme of Work (PoW) on Mountain Biodiversity. The objectives of this PoW are to contribute to poverty alleviation in mountain ecosystems and in lowland areas dependent on mountain ecosystem services. Its overall purpose is to reduce the loss of mountain biological diversity significantly at global, regional, and national levels by

- reducing the rate of loss of the components of biodiversity;
- promoting sustainable use of biodiversity;
- addressing the major threats to biodiversity;
- maintaining ecosystem integrity;
- protecting traditional knowledge, innovations, and practices;
- ensuring the fair and equitable sharing of benefits arising out of the use of genetic resources; and
- mobilising financial and technical resources.

The countries of the Himalayan region have already started to fulfil their role as signatories to the CBD by setting aside considerable biodiversity rich areas for different forms of protection. A notable second step would be to participate in data collection at transect sites and to collaborate on transboundary landscapes and corridors.

What is the role of protected areas?

Protected areas in the mountains house some of the world's most threatened species; they are also home to some of the world's poorest people who are dependent upon the biological resources that the mountain ecosystems offer. Over the past few years the rationale for establishing these protected areas has evolved as the understanding of the role they play has deepened.

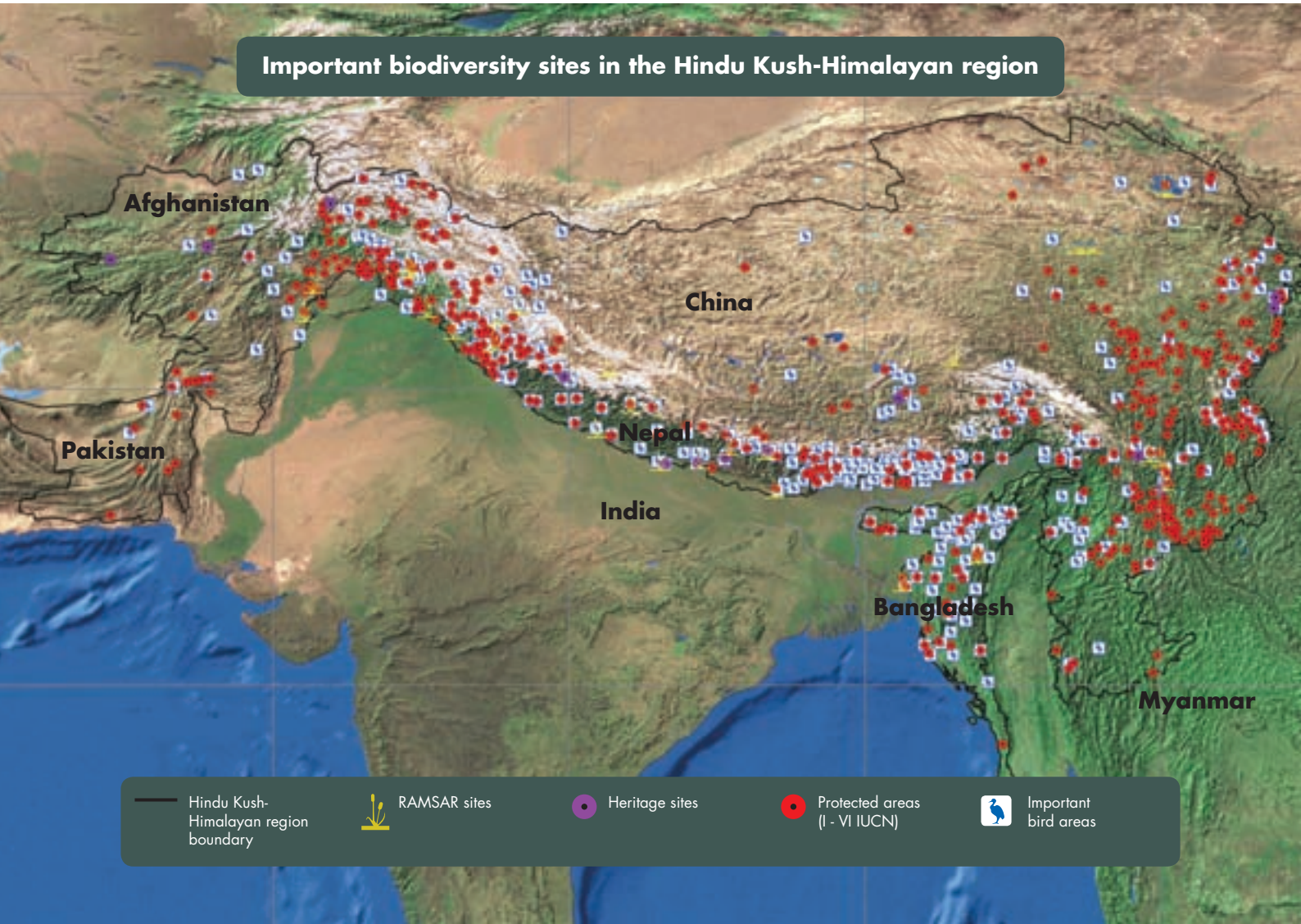
Initially the focus was on conserving wilderness and uniqueness, but now the focus has shifted to their ability to preserve biodiversity, maintain cultural landscapes, and deliver ecological services. As of 2007, the Hindu Kush-Himalayan region had 488 protected areas, covering more than 1.6 million sq km, representing 39% of the region's terrestrial area.

"We have the moral responsibility to bequeath to our children a world which is safe, clean and productive, a world which should continue to inspire the human imagination with the immensity of the blue ocean, the loftiness of snow-covered mountains, the green expanse of extensive forests and the silver streams of ancient rivers. This is a world which we hold in trust, a world which has created and nurtured life for countless generations. Today, climate change ..... threatens our planet. There is a real possibility of catastrophic disruption of the fragile life-sustaining ecological system that holds this world together. Science is now unequivocal on this assessment."

Man Mohan Singh, Prime Minister of India, June 2008, on announcing India's National Action Plan on Climate Change

"We have now moved from protection of charismatic species to habitat conservation and finally to people-managed conservation areas."

Eklabya Sharma, ICIMOD, at the IMBC conference



Understanding the Effects of Climate Change in Mountain Areas: Lack of basic data is the biggest challenge

2

What are the risks associated with climate change?

Climate change could lead to changing weather patterns and more frequent weather extremes such as storms and flood disasters and a general warming of global temperatures. Fresh water supplies and food production will be jeopardised, leading to environmentally-induced migration.

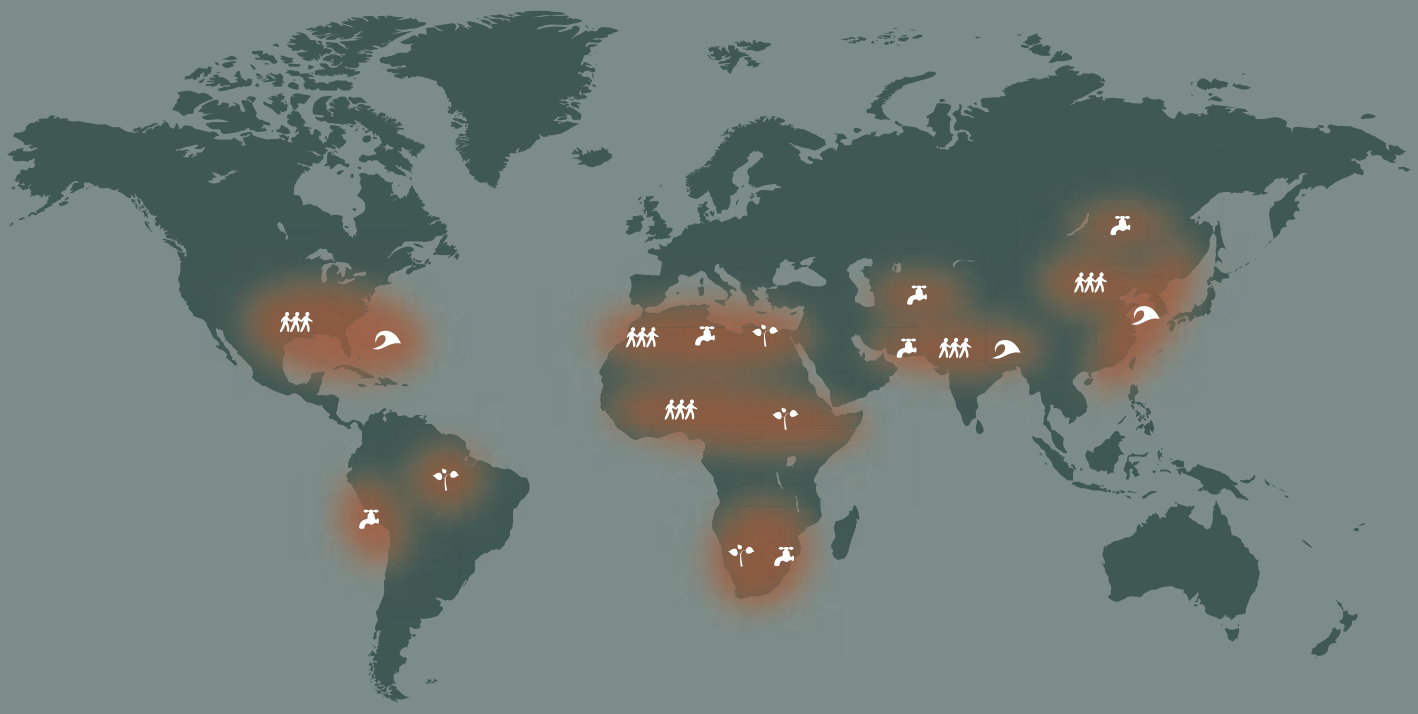
Substantial impacts in the form of contractions in species' range and extinctions could be experienced. The consequences will be greatest for the poor and marginalised people who depend almost exclusively on natural resources.

"...we shall have to know more about the origins of conflicts. ... As I see it, next to reasonable politics, learning is in our world the true credible alternative to force."

Willy Brandt in his acceptance speech for the Nobel Peace Prize in 1971

Conflict constellations in selected hotspots

Redrawn from WBGU 2007, Global change as a security risk (R. Schubert et al.) www.wbgu.de/wbgu_jg2007_engl.pdf



Why are mountains particularly sensitive to changes in climactic conditions?

Mountain environments respond strongly even to small changes in temperature because their vertical (altitudinal) dimensions create gradients of temperature, precipitation, and solar radiation. One can pass through several climatic systems in ascending one mountain slope and each system is a microcosm, a habitat in itself. Ecological zones also vary with altitude. Increasing global temperatures will result in an upward shift of these ecological zones, species' ranges, and marked ecotones such as the treeline. It is predicted that some areas of the Hindu Kush-Himalayan region will experience an altitudinal shift of approximately 80-200m per decade with the current rate of warming. Will species adapt or shift? We do not know how they will respond.

What is known about temperature trends in the Himalayas?

Currently knowledge about temperature trends is limited by both paucity of observations and insufficient theoretical attention. Despite the limitations, a growing number of studies support the IPCC reports which claim that there is a definite warming trend. Some predictions for the central Himalayas and Tibetan Plateau estimate a rise of 0.04°C-0.09°C/yr with greater shifts as altitudes increase because the rate of warming accelerates with altitude.

1950s

Imja Glacier

(Erwin Schneider, courtesy of the Association for Comparative Alpine Research, Munich. Archives of Alton Byers, The Mountain Institute)

2007

Imja Glacier

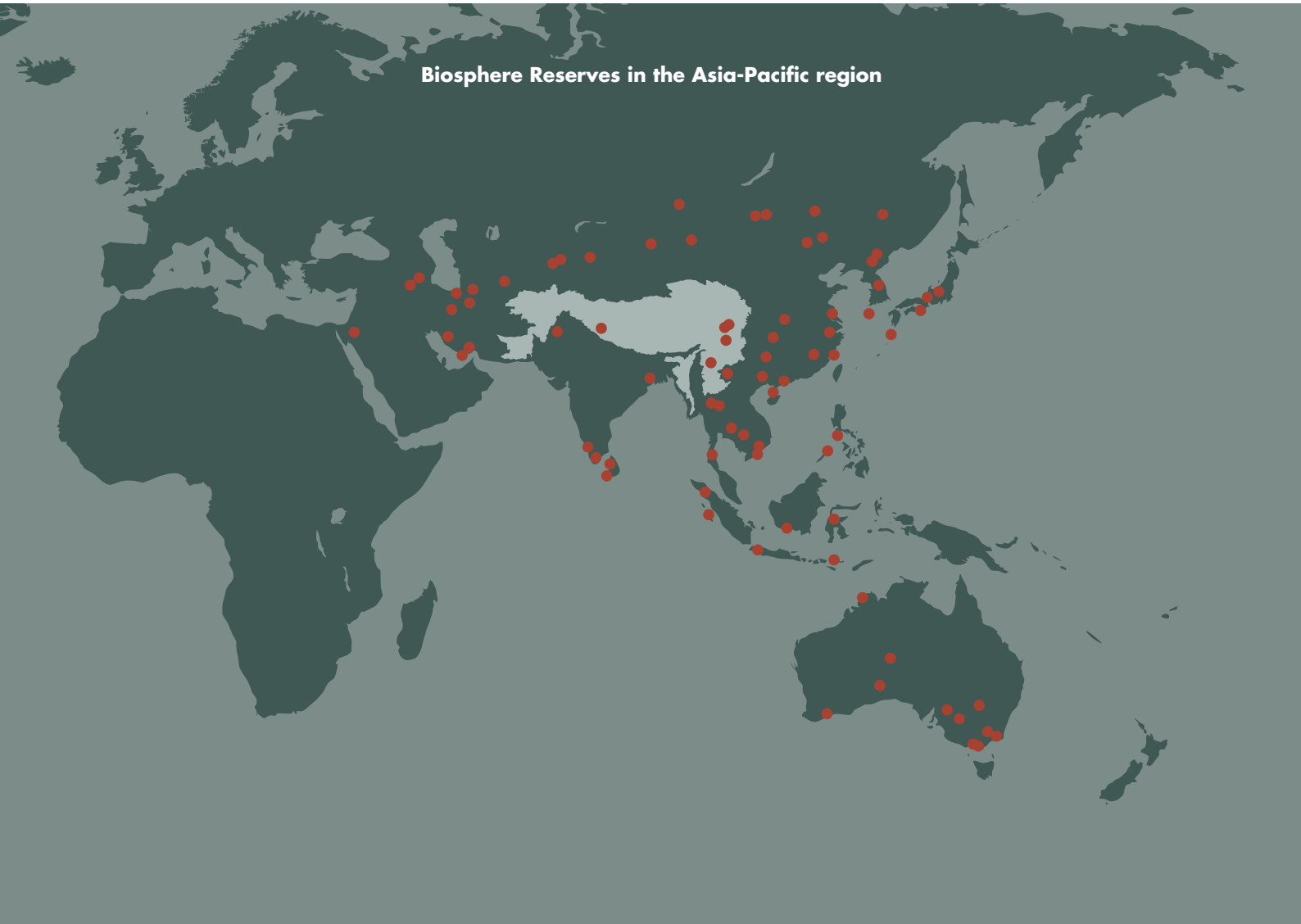
(Alton Byers, The Mountain Institute)

What climate change data are available for the Hindu Kush-Himalayan region?

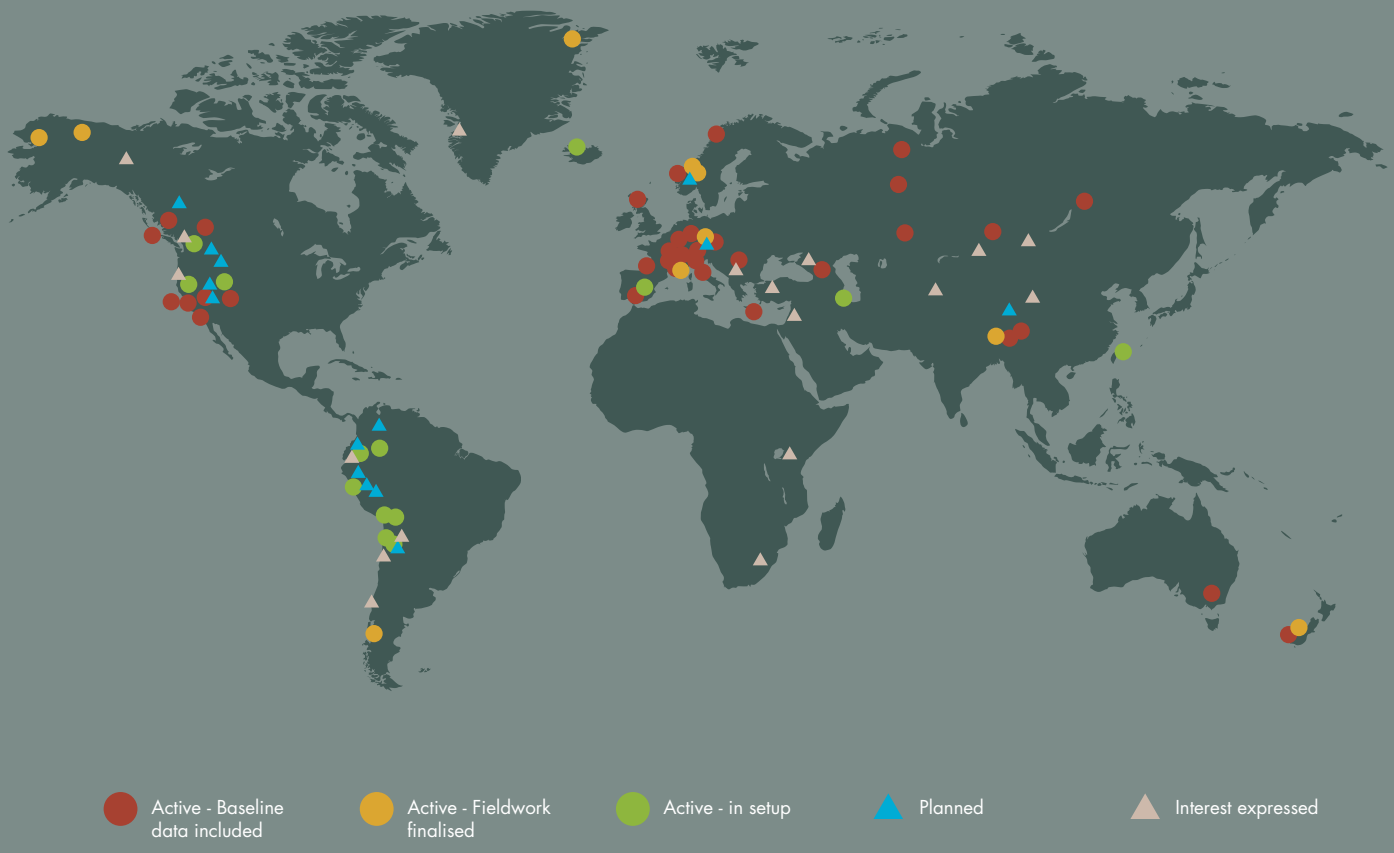
On the whole, data for the Hindu Kush-Himalayan region on climate change are fragmented and anecdotal. Anecdotes may be compelling – as seen in the time series' photos of the Imja glacier on the previous page taken 50 years apart – but they are not sufficient. Scientists consider the entire Himalayan region to be almost a 'white spot' in terms of climate data. For example, the map from the IPCC Assessment Report 2007 shows that whereas 28,115 significant, observed biological changes were reported for Europe: the number reported for the whole of Asia during the same period, was only 8!

Since UNESCO's Biosphere Reserve sites provide, among other things, logistical support for research and monitoring, the presence of these sites is a good indication that monitoring is taking place and that data are available for the area where they are located. UNESCO has 531 sites worldwide in 105 countries; the whole of the Hindu Kush-Himalayan region has five of these, four of them in the far eastern part in China, (although India has many national Biosphere Reserves that are not [yet] included in the UNESCO list). Similarly, the target regions for the Global Observation Research Initiative in Alpine Environments (GLORIA) shows that the Hindu Kush-Himalayan region is virtually devoid of test sites (next page).

The data that exist for the region are focused, as with the majority of conservation approaches in the past, on altitudinal gradients, critical ecological zones, and areas rich in biodiversity concentrated mainly in an east-west direction. It is now known that it is important to consider latitudinal changes too as there are special risks for high-altitude species in the transition zone where they are particularly vulnerable to climate change. Data on how climate change affects south-north aspects in the Hindu Kush-Himalayan region are almost completely lacking, however.



Gloria target regions



"There is a shortage of facts. Plausibility should not be taken as evidence."

Christian Körner, Univ of Basel, Switzerland

Why is there a lack of systematic environmental data on the Hindu Kush-Himalayan region?

The Hindu Kush-Himalayan region covers a massive geographical area (more than 3,500 km from east to west covering about 4.3 million sq.km in area) with inaccessible terrain and diverse ecological conditions. Hence there are practical limitations to comprehensive research initiatives. Also, until very recently, many of the regional countries were among the poorest in the world with great geo-political and socioeconomic differences and disparate research capacities among them. Environmental issues are regional, but most research efforts are local and national; which limits opportunities for comparing regional data. Projects are scattered and there is no central repository for data from the region as a whole.

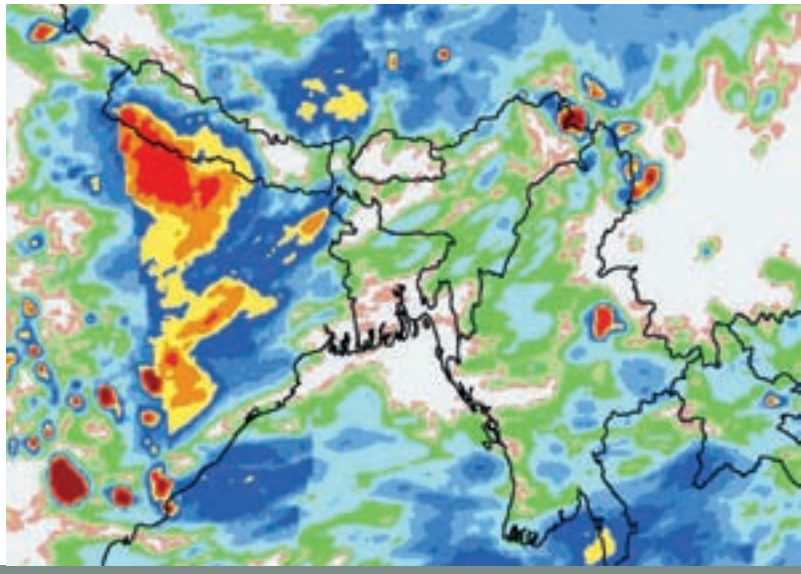
How can better data on climate change make a difference?

"Reduce talking, increase doing!… wherever you have influence …and, make your own hands dirty."

A comment by Christian Körner, applauded by the participants of the Conference

The link between climate change and biodiversity is poorly understood. Unless data are reliable, plans (such as access and benefit sharing and payment for ecosystem services) can neither be formulated nor implemented. The countries of the region are aware that collection of basic data is the first step and they have volunteered to collaborate with global data-sharing mechanisms and to be part of the international process.

Satellite precipitation estimate (NOAA/CPC)



Linking geodata with biodiversity information in the Himalayas*

The inventory and assessment of biodiversity resources and ecosystem dynamics have become essential for policy-making and management strategies as well as for developing and testing scientific hypotheses. Mountain biodiversity databases need to be compiled and made available to the wider community of climate change scientists in order to address climate change scientifically. The workshop brought together representatives of the Global Mountain Biodiversity Assessment of DIVERSITAS in cooperation with the Global Biodiversity Information Facility (GBIF) and national partners from the Hindu Kush-Himalayan region to explore the possibility of hosting a regional platform for mountain biodiversity data from the Hindu Kush-Himalayas.

The workshop highlighted the usefulness of geo-referenced data on biodiversity for the integrated analysis and spatial visualisation of information on biodiversity in relation to climate, land use, physiography, and other important parameters. Among the issues discussed were the following. How to design a GBMA/ICIMOD mountain biodiversity portal? How to promote geo-referenced data on biodiversity? How to improve biodiversity databases on the Hindu Kush-Himalayan region? The regional perspective and issues related to specific geo-referencing tools, mountain specific location, capacity building, and linkages with regional and global initiatives were considered also.

The participants unanimously recommended that ICIMOD take on the role of a regional knowledge hub for information about biodiversity in the Himalayas and that it become a regional node of GBIF. The platform, to be housed at ICIMOD's MENRIS facility, would provide easy and open access to data and metadata on Himalayan biodiversity and make it available for widespread dissemination both regionally as well as among the global change research community. Furthermore, the workshop recommended that ICIMOD facilitate or encourage key national partners in the regional member countries to become national nodes of the Global Biodiversity Information Facility.

*A workshop convened in partnership with Global Mountain Biodiversity Assessment of DIVERSITAS and the International Centre for Integrated Mountain Development (ICIMOD). The Workshop was held at ICIMOD Headquarters, Kathmandu, Nepal, on 15-16 November 2008.

How is ICIMOD addressing the scarcity of data related to climate change in the region?

ICIMOD's programmes on Integrated Water and Hazard Management, Environmental Change and Ecosystem Services, and Sustainable Livelihoods and Poverty Reduction focus on adaptation in the region and by its mountain population to the changes brought about by globalisation and climate change.

ICIMOD is also addressing the serious problem of data scarcity in the Hindu Kush-Himalayan region, since this lies at the root of many of the challenges to development that are commonly encountered. ICIMOD brought representatives from global programmes, respected conservationists, and countries sharing the Himalayan region together to participate in a series of workshops and a conference about various aspects of the problem. By convening the International Mountain Biodiversity Conference (Nov.16-18, 2008) ICIMOD provided a forum where world-renowned experts and professionals from global programmes could discuss issues with the countries of the Himalayan region with a view to developing a common strategy. A method of bridging the data gap was proposed in the concept of transects and transboundary landscapes for long-term monitoring in the Hindu Kush-Himalayas.

"There is a gap in our knowledge of biodiversity (in the region) particularly of the lower groups of plants and invertebrates."

Ram P. Chaudhary, Tribhuvan University, Nepal

What controls the edge? - Keystone species contribute to a diversity of life

Common to both the ecological and the economic motive for caring for biological diversity is the insurance principle. This states that there is a reduced risk of losing the integrity of a system when it depends upon many different players. The more diverse a system is, the more likely it is that there will be species that can cope with extreme events. In some cases, important 'keystone' species are obvious, but in others they may remain hidden and only emerge under extreme environmental conditions. Nevertheless their absence or presence is vital to ecosystem functioning.

The example shown in these photos is of a landslide area in the central Caucasus – here deep erosion gullies have cut into an ancient montane pasture rich in species. Close examination reveals that the eroded edge is inhabited by only a single grass species *(Festuca valesiaca)* that plays no spectacular role in intact grassland but becomes vital at erosion edges. The harsh life conditions at the edge eliminate most other species, and this little grass plant, owing to its dense root system and drought resistance, seems to single-handedly 'engineer' the edge and delay the erosion process. A small species may suddenly become a keystone species and its presence or absence can emerge as decisive for survival of the landscape.

Managing Biodiversity-based Goods and Services: How to increase benefits for mountain communities

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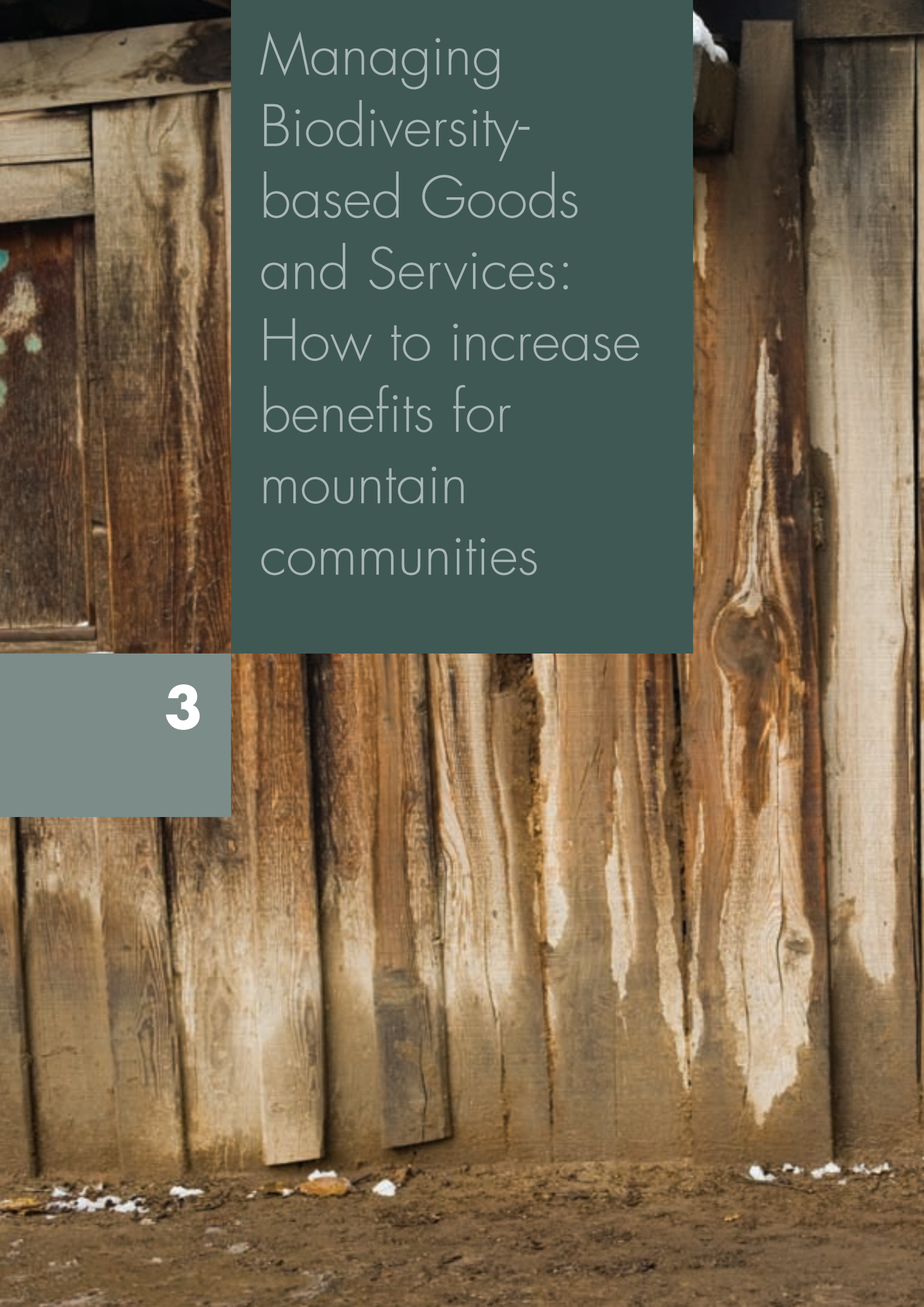


What is the value of economic benefits of ecosystem biodiversity in the Hindu Kush-Himalayas?

Traditional prayer wheel, Pangboche monastery, Nepal

The Millennium Ecosystem Assessment (MA 2005) describes ecosystem services as provisioning services (for genetic resources, food, fibre, fresh water, and so forth); regulating services (including the regulation of climate, water, and some human diseases); supporting services (includes productivity, soil fertility, and nutrient cycling); and cultural services (such as spiritual enrichment, recreation, aesthetic experience, and so forth).

People's livelihoods in the region are directly tied to the food, fibre, dyes, medicines, timber, fodder, and fuel provided by their ecosystem's biodiversity. The economic benefits of biodiversity are huge, but rigorous economic analysis is difficult. The services rendered by nature are not captured by conventional economic analyses, so evaluating them and assigning monetary values are not easy tasks. For example, one important provisioning service of the Hindu Kush-Himalayan region is providing water for 1.3 billion people – 20% of humanity. To date there has been no initiative to either quantify these benefits in economic terms or to share them with the custodians of the resources.

How have mountain societies traditionally managed biodiversity-based goods and services?

The knowledge base of mountain societies provides a holistic approach to 'nature and culture' in which both the tangible and intangible benefits of cultural diversity and biological diversity are mutually supportive of one another.

Traditional ecological knowledge has been used for harvesting resources and planting agricultural crops, as well as in the use of natural herbs and other materials for medicinal purposes, over hundreds of years.

Carrying fodder, Uttaranchal, India

"Peace can be defined as security and the secure access to resources that are essential for living. In this regard, climate change will have several implications as numerous adverse impacts are expected for some populations in terms of access to clean water, access to sufficient food, stable health conditions, ecosystem resources, and security of settlements."

Rajendra Pachauri, the Chair of the UN's Intergovernmental Panel on Climate Change, Nobel Lecture, Oslo, 10 December 2007.

How can traditional knowledge be used to address global change?

Hundreds of years ago, the present environmental threats did not exist. Today, traditional knowledge, as such, cannot overcome the challenges posed by these new threats. The ethnic-specific approach, with its time-tested values, should not be dismissed but it does need modification.

Linking traditional and formal approaches can help mountain communities to adapt to changing times. A hybrid system can contain either greater (incremental pathway) or lesser proportions (contour pathway) of traditional compared to formal knowledge as needed.

What environmental changes are degrading biodiversity-based goods and services?

Widespread poverty, poorly-managed subsistence activities, changes in land use and land cover, introduction or removal of species, population growth, roads, urbanisation, commercial exploitation, resource extraction, conflicts over resources, and unsustainable or poorly-managed tourism – all have adverse impacts on mountain biodiversity.

Species with narrow habitat ranges, especially those from higher elevations and/or with poor dispersal capacity, are particularly at risk. Globalisation, migration, global climate change, economic, and socio-political changes, all affect mountain biodiversity and the communities living in the mountains. When biodiversity resources are degraded, or access to them restricted, communities invariably suffer.

How can land-use and land-cover change affect biodiversity?

Changes in people's lifestyles such as that of nomads in highland rangelands; forest transition due to plantation and agroforestry; agricultural intensification; and tropical forest and lowland plantation economies lead to land-use and land-cover changes.

Hydrological processes are altered as a result and, as they contribute to carbon sequestration and nitrogen deposition, they are among the drivers of climate change. Biotic and species' diversity are adversely impacted by these changes and eventually affect the ability of biological systems to support human needs: the results could be economic or sociopolitical upheaval.

What factors are causing land-use/ land-cover changes in the Hindu Kush-Himalayan region?

Recent changes have taken place when traditional nomads, agropastoralists, and shifting cultivators have altered their lifestyles, but there is little information available on the overall trend of land-cover or land-use changes in the Himalayas. Scientists recognise that an overall forest transition is taking place in most Himalayan countries which includes plantation and forest recovery. Rangeland degradation is also widespread. Better data alone cannot predict future trends in land use. What is needed is a better understanding of change and interaction among different drivers, interlinkages between land-use systems along elevation gradients for ecosystem services, as well as feedback to coupled ecological-social systems.

Land use/cover in Himalayan highlands

(from the presentation by Xu Jianchu, based on various sources)

"What is needed is a better understanding of change and interaction among different drivers..."

India's new focus on Himalayan ecosystems - Towards addressing global climate change in India

In June 2008, the Prime Minister of India and the Prime Minister's Council on Climate Change announced India's National Action Plan on Climate Change outlining existing and future policies and programmes addressing climate mitigation and adaptation. This plan establishes an effective, cooperative, and equitable global approach based on the principle of common but differentiated responsibilities and respective capabilities enshrined in the United Nations Framework Convention on Climate Change. The plan identifies eight core 'national missions.'

These missions are: Solar, Enhanced Energy Efficiency, Sustainable Habitats, Water, Sustaining the Himalayan Ecosystem, Green India, Sustainable Agriculture, and Strategic Knowledge for Climate Change. The national mission on Sustaining the Himalayan Ecosystem aims to conserve biodiversity, forest cover, and other ecological values in the Himalayan region. This mission will simultaneously focus on multiple fronts by promoting an understanding of climate change, adaptation and mitigation, energy efficiency, and natural resource conservation and will achieve its key goals through multi-pronged, long-term and integrated strategies. It will evolve management measures for sustaining and safeguarding the Himalayan mountain ecosystems.

These measures will include enhanced monitoring of Himalayan ecosystems (especially glaciers and river systems); establishing an observational and monitoring network to assess freshwater resources and ecosystem health; promoting community-based management with incentives for protection and enhancement of forested lands; and overall strengthening of regional cooperation for the exchange of information with countries sharing the Himalayan ecosystem.

How are land-use and land-cover changes related to scale?

Assessing land-use change and its impact on biodiversity is scale dependent. On the largest scale there can be intense land-use and land-cover changes causing the smallest habitats and populations of organisms to suffer negative impacts.

On the intermediate and local scales, however, land-use and land-cover changes are site specific, dependent on history, national policies, and whether natural mountain biodiversity, agricultural biodiversity, or functional biodiversity are being measured. Positive and negative impacts can ensue.

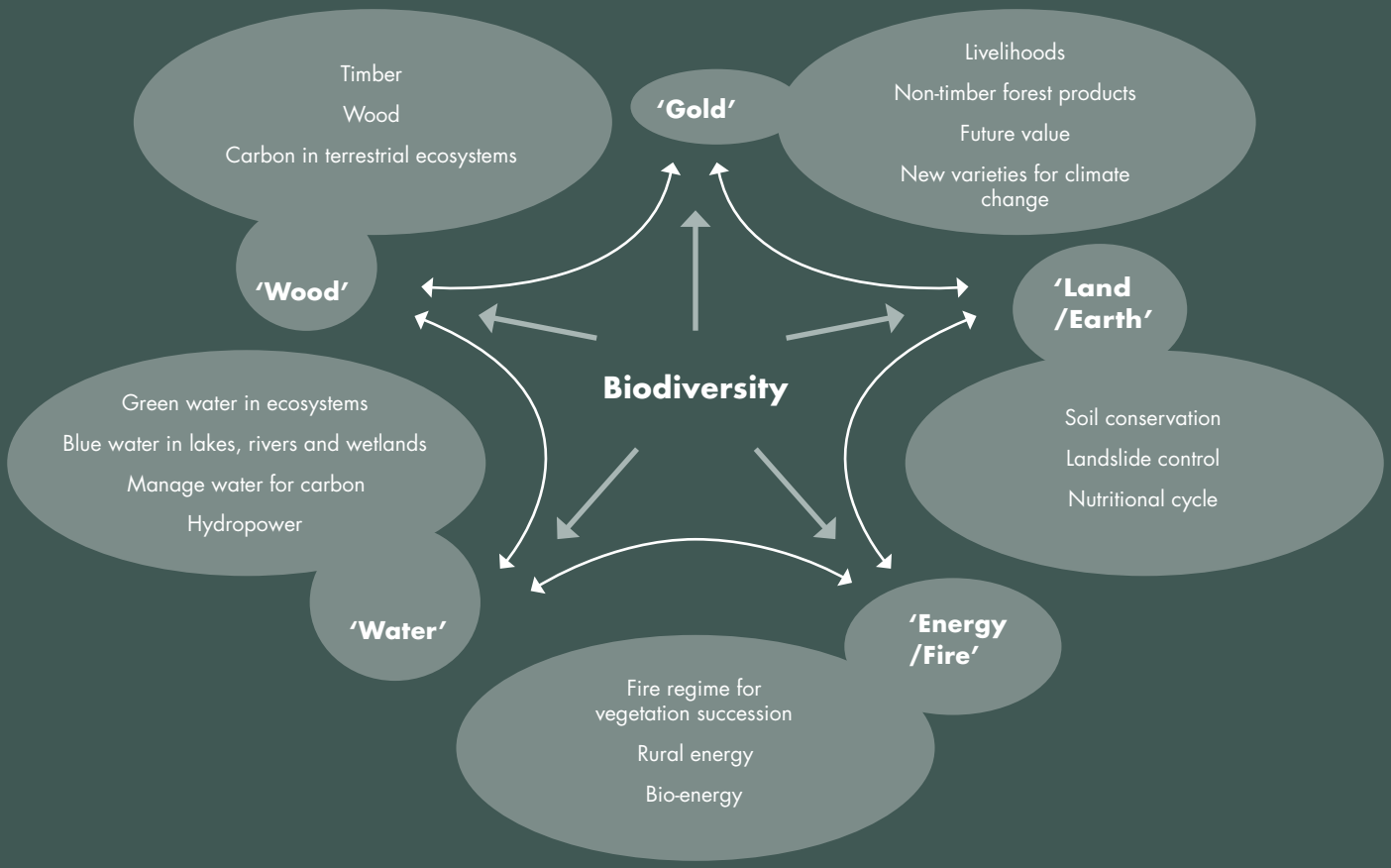
What role can mountain protected areas play in biodiversity management?

It is most notable that 39% of the Hindu Kush-Himalayan region has been set aside as protected areas. In spite of this, loss of biodiversity remains a challenge.

The role of direct and indirect drivers has already been outlined; however, whereas some of these drivers can be held at bay in protected areas, others, like climate change, are pervasive and can have an impact on species' persistence leading to the disproportionate distribution of species along ecological zones both within and beyond the borders of the protected areas.

Aspects of biodiversity

(Redrawn from the presentation by Xu Jianchu)



What role do wetlands play in managing biodiversity in the region?

Wetlands account for approximately 17% of the total area of the Hindu Kush-Himalayan region. They are critical links between terrestrial and aquatic ecosystems and are characterised by a high degree of primary productivity. Among the richest sources of biodiversity on earth, wetlands support community and ecosystem resilience, store and purify water, recharge groundwater aquifers, trap sediments, and improve water quantity and quality.

Wetlands can also play an important role in capturing and retaining melting snow or ice and, wherever possible, rainfall, releasing water progressively and therefore acting as suppliers and regulators of water for an entire basin. In some cases their associated peatlands act as carbon stores preventing the release of carbon into the atmosphere.

What implications does climate change have for wetland functions and biodiversity?

Himalayan wetlands are of global importance. Wetlands provide ecosystem services as well as facilitating atmospheric circulation, biodiversity, water and hydrological cycles, and beautiful landscapes. Climate change, by disturbing the ecological structure and function, could cause the loss of high-altitude wetlands, which would directly impact hydrological regimes and the wetland associated biodiversity. There could be serious ramifications in terms of an increase in natural disasters such as glacial lake outburst floods (GLOFs) and loss of livelihoods for wetland communities: unsustainable management strategies also pose threats.

What adaptation strategies will work in wetland areas?

An integrated multidisciplinary approach supported by an intensive capacity-building process involving wetland managers, policy planners, decision makers, and local stakeholders to enable effective wetland management and restoration could work in wetland areas. Research and policies should be linked to livelihoods and local knowledge.

Payment for ecosystem services is emerging as a tool to support wetland communities in conserving high-altitude wetlands. Best practices need to be identified and developed based on evaluation of current examples. Practitioners and policy makers should be engaged in funding research and in encouraging a development agenda that takes wetland communities and their livelihoods into consideration.

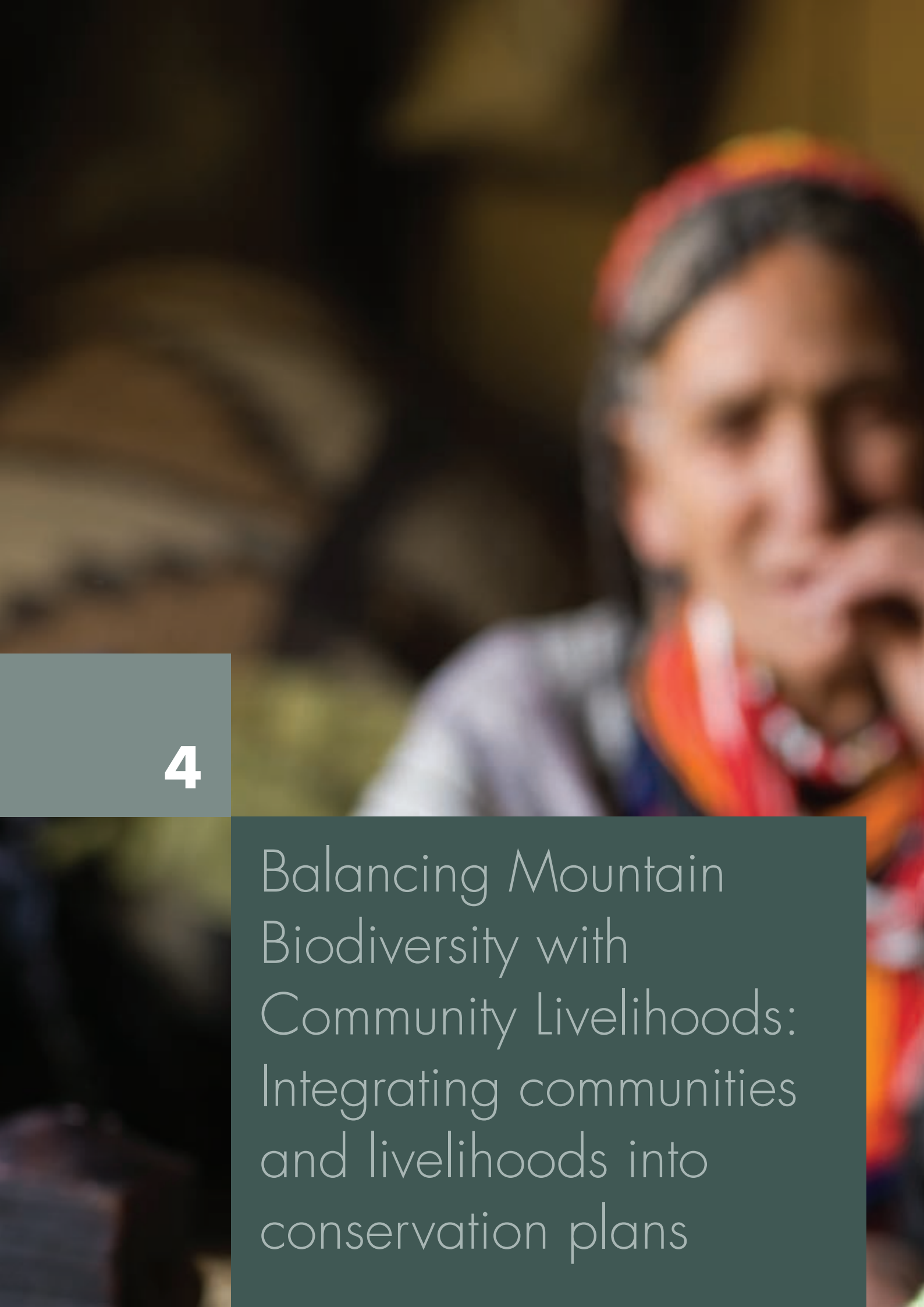
"An integrated multidisciplinary approach involving wetland managers, policy planners, decision makers, and local stakeholders could work in wetland areas."

"Understanding of the functioning of high-altitude wetlands and the relationship between climate change and water management will be essential."

What responses can best deal with climate change in wetland areas?

Apart from historical, structural approaches, integration of wetland ecosystem functions and services is a potential adaptation strategy against the emerging pressures of climate change. Wise use and conservation of wetlands provide an alternative to structural approaches. Understanding of the functioning of high-altitude wetlands and the relationship between climate change and water management will be essential. Research on hydrological data is important for understanding how the water sources of the wetlands are connected to river systems, and for their sustained maintenance.

At present, both worrying and positive trends are seen in siltation and debris-filled dams and reservoirs (for example, in Pakistan) and the potentially positive impacts from glacial melt, both of which imply a change in wetland types.



4

Balancing Mountain Biodiversity with Community Livelihoods: Integrating communities and livelihoods into conservation plans

Why is it important to balance biodiversity conservation with community livelihoods?

Loss of biodiversity will have global impacts. Human beings cause degradation and this has to be redressed by balancing conservation and livelihoods. Community ownership and understanding of the value of biodiversity should be secured by using interventions that build on local culture, traditional knowledge, and experience and the use of local species for sustainable livelihoods.

"…poverty is not responsible for landscape decline. There is a danger of interlinking poverty, biodiversity, and climate change and each case should be considered separately. What is needed is a transdisciplinary approach, which includes local people and which is either bottom-up or top-down as needed."

P.S. Ramakrishnan, Jawaharlal Nehru University, India

What is the link between poverty and loss of biodiversity?

The relationship between poverty and biodiversity in the region is not clear. Areas rich in biodiversity are also often those where human poverty is prevalent; the dilemma is how to promote conservation without depriving people living in subsistence economies of their livelihoods. Conservation measures need to be mindful not to interfere with regional sociocultural values that have historically been used to conserve biodiversity.

There are many driving forces behind the loss of biodiversity, not least of which are the acute human impacts on local resources and market-driven globalisation. Previously, poverty and population issues were thought to be the agents: it is now realised that they 'stand at the end of a long chain of causes and effects' and are 'messengers' of unsustainability rather than its agents.

Mountain Transboundary Protected Area and Connectivity Conservation

Isolated protected areas do not provide the possibilities for migration and ranging needed by many species for survival. They also limit the possibilities for migration of plant and animal species as they adopt to changing climatic and other conditions. Linking these areas with 'conservation corridors provides away of extending the potential range for species enormously, but can only be successful if the people living within the corridor area are fully involved in the plans and also benefit.

Effectively managed large-scale corridors of connectivity in the mountains can provide a basis for improved species' conservation as well as healthy environments for humans threatened by climate change. Connectivity conservation management, assisted by transboundary protected area management, can help to minimise species' extinction and maintain healthy environments and catchments, an aim common to all three participating institutions, i.e., IUCN, WCPA, and ICIMOD. The Mountain Transboundary Protected Area and Connectivity Conservation Workshop* discussed ways to facilitate the Convention on Biological Diversity's Programme of Work on Protected Areas for transboundary protected areas and connectivity conservation initiatives in the mountains by reviewing a draft conceptual framework and tools for Connectivity Conservation Management (CCM) and developing action plans for specific connectivity corridors.

Two positive workshop outcomes were achieved. The first is that the conceptual framework for CCM was improved and ten CCM tools were proposed and verified as important. This essential advance in theoretical knowledge for CCM will help create order and a process for potential, significant international investment in large-scale conservation initiatives and, consequently, will contribute to meeting the CBD 2015 PoWPA targets**. The second is that several large mountainous areas containing important ecosystems and species were either recognised as corridors or their defined areas were improved. A very large connectivity corridor was established in the heart of Asia, the 'Altai-Sayam Connectivity Conservation Corridor'; major corridor improvements were suggested for the Karakoram-Pamir Transboundary Area of China and Pakistan; and focused connectivity conservation improvements were suggested for the Brahmaputra-Salween Transboundary Area for India, China, and Myanmar. Important advances in improvement and consolidation were also seen to have taken place in the Greater Virunga Landscape, the Terai Arc Landscape, and the A2A Connectivity Conservation Corridor.

*Workshop convened by the IUCN World Commission on Protected Areas (WCPA) Mountains Biome and Transboundary Area Task Force in partnership with the International Centre for Integrated Mountain Development (ICIMOD) and the World Wide Fund for Nature (WWF). The Workshop was held at Dhulikhel (near Kathmandu) Nepal, 11-15 November 2008, the full summary of the workshop is included in the CD which accompanies this booklet.

**This theoretical work will be published in 2009 in the new book by IUCN and Earthscan entitled Connectivity Conservation Management: A Global Guide.

What is the way forward for protected areas?

Protecting an area is the traditional way of doing things but concepts are changing. Containing as they do small portions of ecosystems, protected areas are vulnerable to climate change in proportion to how limited an area they cover. Conservation strategies must anticipate the prevalent impacts of climate change to make conservation efforts more effective. Allocating land resources for protected areas seemed good enough at the time these areas were established, but now comprehensive and holistic approaches are needed.

The new paradigm of landscape-level interconnectivity between protected area systems takes a more inclusive perspective on expanding the biogeographic range so that natural adjustments to climate change can proceed without being restrictive. The suggestion is to design large protected areas with flexible boundaries (boundaries could be changed seasonally or as per the need). In many cases, corridors and transboundary protected areas could be established to assure sufficient area and connectivity for effective biodiversity conservation and to ensure people's livelihoods. The benefits of translating the concept into action have yet to be realised.

Research Strategy on Global Change in Mountain Biosphere Reserves*

The Global Change in Mountain Regions Project (GLOCHAMORE) has developed guidelines to help scientists and managers of mountain biosphere reserves to test, monitor, and assess the impacts of global change on the biophysical environment and the livelihoods of mountain people. The 'Research Strategy on Global Change in Mountain Biosphere Reserves' workshop brought together protected area managers from the region to discuss how the GLOCHAMORE Research Strategy could be deployed in the Hindu Kush-Himalayan region. The participants welcomed ICIMOD's 'transects' concept as a useful structure that would facilitate the link to global programmes and would make sharing and comparing data easy. Within this framework, they decided that the themes that would be most appropriate for implementation in the Hindu Kush-Himalayas were changes in land use, availability of water, biodiversity, and mountain economies; and that it would also be necessary to monitor relevant data on climactic trends and develop climatic scenarios. Standard protocols for monitoring and research, which build on the GLOCHAMORE Research Strategy, as well as clear policies for managing and sharing data are needed before any work can begin. Initially, the main sites for implementing the GLOCHAMORE Research Strategy should be those Mountain Biosphere Reserves that are either GLORIA sites or which already have a tradition of research.

* A workshop convened by UNESCO's Man and the Biosphere Programme in partnership with the International Centre for Integrated Mountain Development (ICIMOD). The Workshop was held at ICIMOD Headquarters, Kathmandu, Nepal, on 19 November 2008.

What is the change in approach to protected area management?

Experiences with isolating protected areas have shown that the local people often lose access to their prime alpine pastures, source of medicinal herbs, and the tourist trade in one fell swoop. When there are insufficient opportunities for livelihoods, the threat to biodiversity increases and the foundations of local culture are threatened because people are deprived of their rights and their roles as natural guardians.

People's adaptations to changes in the environment are at the heart of biodiversity-related issues and efforts and determine the effectiveness of conservation. Involving people within and near protected areas is a key factor in conserving biodiversity. The local community's sense of ownership is vital so governments and policy makers need to be convinced of the value of integrating local communities into conservation plans.

What are some examples of sustainable conservation approaches in mountain areas?

UNESCO's 'Biosphere Reserve' approach is a site-based concept that combines biodiversity conservation and community-based development with scientific studies on human-environment interactions and ecosystem studies, thereby combining conservation with sustainable development. Biosphere reserves include protected areas (natural or near-natural environments), areas inhabited by human beings and used for economic activities, and research infrastructure.

Biosphere reserves remain under national sovereign jurisdiction but share their experience and ideas nationally, regionally, and internationally within the World Network of Biosphere Reserves.

How can the CBD 'access to genetic resources and the sharing of benefits arising out of their use' work in the Hindu Kush-Himalayas?

Access to genetic resources and benefit sharing (ABS) can be a driving force for development. ABS can promote conservation of traditional knowledge, innovation, and practices of indigenous communities that possess in-depth knowledge about the ecology and economy of plant species.

It can also promote the emergence of institutions and governance structures essential for sustainable use of biological resources.

How can eco-tourism favour both biodiversity and the economic well-being of the local population?

Spectacular scenery, a clean environment, rare and endangered species, and cultural uniqueness are all assets that favour tourism as a means of balancing biodiversity conservation with community livelihoods. Local communities can enjoy long-term benefits from the income generated when tourism mutually reinforces biodiversity conservation and community livelihoods. Ecotourism leaves only a marginal ecological footprint, creating a win-win situation, and has been implemented with success in several mountain biosphere reserves and protected areas around the world.

What about areas where tourism is not an option?

Where tourism is not possible, one approach, which is based on a process of participatory research and broad-based stakeholder consultations, is to improve the social and economic well-being of rural communities by enhancing the transboundary ecosystem through promotion and mainstreaming of tools and practices for sustainable land management.

To conserve ecological and cultural diversity, new adaptive land-use systems are identified in a participatory manner to increase capacity and give ownership to local communities over their natural resources.

Trekker in the Everest region, Nepal

What particular payment for ecosystem services schemes are potentially available to mountain communities in the region?

Under the Clean Development Mechanism, afforestation or reforestation projects represent a potentially important payment for ecosystem services (PES) mechanism which can make substantial contributions to biodiversity conservation in the Hindu Kush-Himalayan region. In this scheme, farmers are compensated for growing trees on-farm, because this directly reduces pressure on forests, wildlife, and biodiversity, while sequestering carbon from the atmosphere into biomass and soils.

Maintaining and improving existing forests have been identified by the IPCC as being among the least expensive climate-change mitigation options: the 'Reduced Emissions from Deforestation and Forest Degradation' (REDD) PES scheme in developing countries is a central component of the global climate protection regime currently being discussed for inclusion in the post Kyoto Protocol era.

Water and hydropower related PES, and ecotourism enforced payments to mountain communities are potential schemes that are being piloted and tested in the Hindu Kush-Himalayan region.

What is needed to make PES schemes work in the Hindu Kush-Himalayas?

Development of a regional knowledge base, based on multi-scale research, and advanced remote-sensing and modelling approaches, are needed to foster understanding of the implications, complexities, and benefits of PES among regional and national partners.

The Hindu Kush-Himalayan region has a set of unique conditions which require mountain-specific approaches that recognise and value biodiversity conservation. Improved understanding of the drivers and impacts of deforestation and forest degradation and ecosystem-level management options will help countries in the region to adopt policies and negotiate positions that address the needs of poor mountain communities. Participatory approaches and capacity building to meet these challenges will also be required.

" …the question remains how to respond to global challenges at local level…"

P.S. Ramakrishnan, Jawaharlal Nehru University, India

5

Institutionalising Long-term Mountain Research: Using transects to coordinate data sharing

Why is long-term mountain research important?

The Himalayan region is remote and isolated, but this does not protect it from the global ravages of climate change. Rising temperatures are a threat to biological diversity in this ecologically-sensitive region: its loss will threaten mountain livelihoods and regional security. Good research is needed to plan conservation and development strategies. By institutionalising long-term continuity in mountain research, the countries of the region can benefit from early warning indicators, from the results of global climate change science, and by having the heritage of their biodiversity secured as a resource for the world.

What data are needed for a better understanding of how climate change impacts mountain biodiversity?

Monitoring change using climatic, physical, and biological parameters, as well as sociocultural and livelihood data, is essential to generate consistent, comparable, and representative data. Basic data requirements include a database of species and ecosystems; an inventory of the distribution range of plants and animals as well as the movement of alien, invasive species; critical landscape and land-use linkages to flagship species; adaptability of entities of biodiversity; and documentation of indigenous knowledge and practices for adaptation to climate change and understanding of ecological resilience. This is in addition to basic knowledge about factors related to climate and climate change per se.

Conservation initiatives active in the region need to be coordinated and policies reviewed to make them more sensitive to linkages between biodiversity and climate change. Economic and socioeconomic studies are also needed to assess what factors characterise community resilience to climate change. Capacity building will be needed to carry out specific research in taxonomy, conservation biology, impact assessment, and livelihood

How has ICIMOD promoted the collection and sharing of scientific data on biodiversity and climate change in the Hindu Kush-Himalayas?

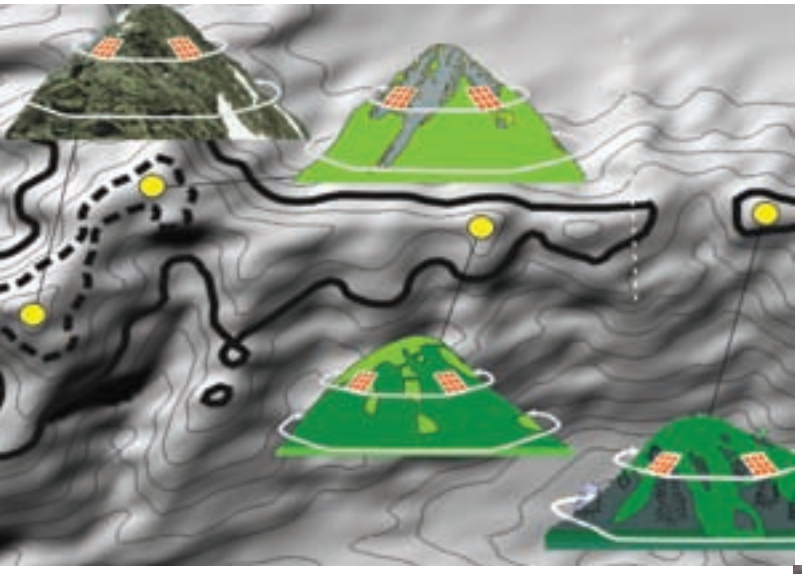
ICIMOD has been a knowledge, learning, and enabling centre for the Himalayan region for the past 25 years. As such, it has fostered sharing of data and information among scientists and policy makers and has contributed to reducing scientific uncertainty about climate change in the region. The International Mountain Biodiversity Conference (IMBC), which took place at ICIMOD in November 2008, provided an opportunity for climate change experts and global programmes to come together to discuss issues with the countries of the Himalayan region and develop a common strategy for conservation of mountain biodiversity.

What are the benefits of a regional approach?

The Hindu Kush-Himalayan region is understudied and there is a dearth of information and knowledge about it. The central reasons for this are that research in the poorly accessible, poorly protected, and extreme terrain areas typical of the region is difficult, and that this mountain region is shared between eight different countries. A regional approach is more promising if progress is to be made. The mountain areas of the different countries share the same type of terrain, biological diversity, and climactic conditions and face the same challenges of global change: they also share the fact that none of them has fully benefited from the experiences gained by global institutions and programmes.

The response of global agencies has often been bilateral and, consequently, fragmented. Global institutions can improve their own knowledge on the specific challenges of mountainous regions by engaging regional institutions which have an in-depth understanding of the underlying issues. Both global and regional institutions stand to benefit from interacting more closely with each other and working together to share, exchange, and develop strategies for comprehensive solutions to the challenges of global change in mountain areas.

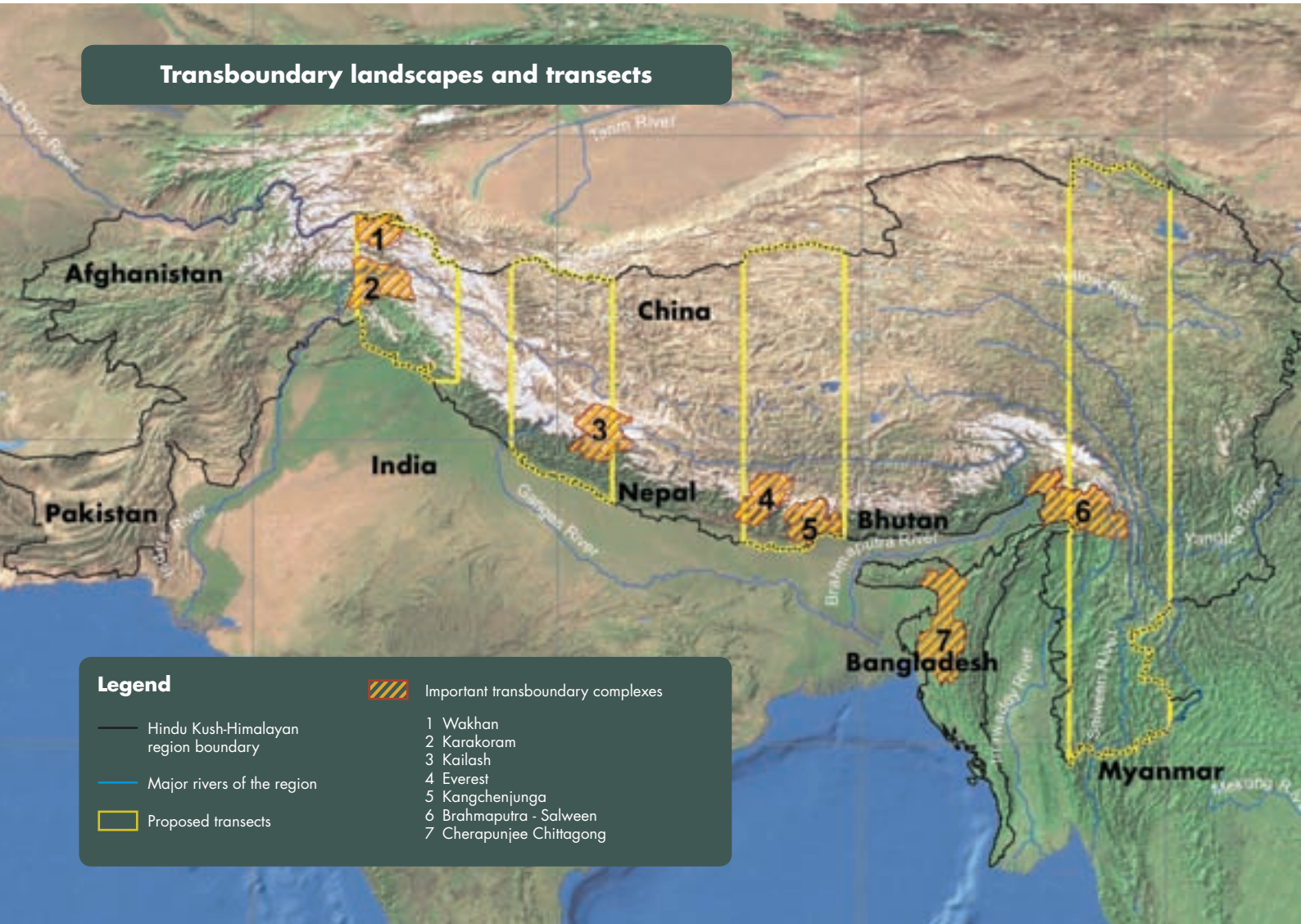
Sampling design for a summit reference site



How can 'transboundary corridors' and 'transects' be used to support systematic collection of data in the Hindu Kush-Himalayas?

Seven critical landscapes from east to west, wet to dry, and with low to high-altitude regimes have been identified by ICIMOD as transboundary landscapes. Comprehensive conservation and development strategies have also been developed for some of these complexes at national and regional levels by focusing on biodiversity status and management aspects. Study of a wider range of parameters related to climate change and latitudinal perspectives is not included, however, and additional transboundary areas are needed covering north-south and altitude????? aspects in 'transect' approaches.

At the IMBC, ICIMOD proposed investigation of the Hindu-Kush Himalayan region by focusing on four representative 'transects' and studying typical test sites within these. These results could then be extrapolated to represent the region. The four transects represent different geoclimatic zones and latitudinal variations essential for studying climate change; and will also serve as a framework for transboundary cooperation in biodiversity conservation. As shown in the figure, six out of seven critical transboundary landscapes are nested within the transects; they account for 32% of the Hindu Kush-Himalayan area. Running from west to east they are the Wakhan, Karakoram, Kailash, Everest, Kangchenjunga, and Brahmaputra-Salween areas. The transects include attributes such as ice and snow cover, wetlands, river basins, hotspots, eco-regions, PAs, IBAs, World Heritage sites, and GLOFs; and include the Global 200 eco-regions found in the Hindu Kush-Himalayas.



What attributes do transboundary landscapes and transects bring to monitoring? How will the approach be implemented?

The transboundary landscapes and transects include most of the biophysical and sociocultural dimensions: altitudinal (foothills to alpine), latitudinal (north-south), and longitudinal (east-west) coverage; dry and wet situations; and all major types of farming systems. They also include mountain cryospheres, wetlands, potential glacial lake outburst floods, and biodiversity rich areas. Since these areas cover all the eight countries of the Hindu Kush-Himalayan region, they provide an opportunity for cooperation.

Typical test sites will make use of and add to the existing protected areas, national parks, important bird sanctuaries, Ramsar sites, World Heritage sites, critical eco-regions, and transboundary areas. Many of these straddle national and international boundaries and ICIMOD can provide the crucial link between international technical support and national institutions in Himalayan countries. Global programmes have also indicated their willingness to provide the needed technical and infrastructural back-up.

What are some of the additional benefits of the approach?

Transboundary landscapes and protected areas use regional cooperation to achieve the goal of conservation of global biodiversity. Over the last decade conservation efforts have moved away from enforcement measures towards a more participatory approach. Transboundary approaches provide opportunities to strengthen socioeconomic development among neighbouring countries, facilitating their fulfillment of obligations under international agreements such as the CBD.

What essential variables should be measured at transect sites?

Interdisciplinary assessment of the impacts of global change on mountain environments did not exist even 10 years ago. The Global Change Mountain Research (GLOCHAMORE) Strategy was created to redress this lacuna in research and to study and monitor the impact of global change in major mountain ranges of the world using a coherent and coordinated approach. The GLOCHAMORE Research Strategy is a blueprint for managers of mountain biosphere reserves and scientists for implementing research on the impacts of global change in mountain areas. It is comprehensive in its aims to study the impacts of global change on the biophysical environment and the socioeconomic conditions of mountain people: in its entirety, it is composed of 10 themes, and 41 sub-themes. The GLOCHAMORE strategy could be the basis for the transect-related research initiatives in the region.

What role can ICIMOD play?

Currently ICIMOD is engaged in a dialogue with GLOCHAMORE to explore and pursue areas of common interest. Also, since the approach using 'transects' and 'transboundary landscapes' crosses national and international boundaries, cooperation with countries of the Hindu Kush-Himalayan region and global actors can be promoted by ICIMOD by proposing trans-Himalayan transects as venues for coordinated and concerted efforts of data collection, research, and knowledge development. ICIMOD's long history in the region can provide the needed continuity.

Following the IMBC conference, ICIMOD hopes to convene a committee of experts and partners to establish research priorities for funding. The focus will be on those aspects most relevant for understanding and developing responses to long-term change, especially change related to climate and ecosystems. A concept note will be prepared in collaboration with ICIMOD's regional member countries and strong national institutions to agree upon a minimum protocol. ICIMOD will make all the information produced available for everyone to use.

Global Programmes in Mountain Areas

6

How can global programmes help in the collection and sharing of data?

Landscapes and transects will be representative of the Hindu Kush-Himalayas. Contributions from global programmes and within the region in the medium and long term can bridge the knowledge gap by providing specialised expertise. The box gives short summaries of 13 global programmes which can help with their particular expertise to supply the missing knowledge on the Hindu Kush-Himalayan region. Concrete examples of how these global programmes can contribute were discussed during the IMBC conference. Full details of these discussions were recorded and are part of the IMBC Conference Report that is provided on the CD included in the back pocket of this publication.

What options are available for capacity building in the Hindu Kush-Himalayan region?

ICIMOD is coordinating The Himalayan University Consortium: it aims to train conservationists, biodiversity scientists, and climate change specialists in expertise in the Hindu Kush-Himalayan region. In addition to this, individual training programmes, in particular specialties such as support for the younger generation of conservationists from UNESCO's Man and the Biosphere (MAB) programme through its young scientist research grants. Also an initiative of the International Programme on Research and Training on Sustainable Management of Mountain Areas (IPROMO) of the Mountain Partnership offers course for young professionals interested in mountains.

Some global programmes working in mountain areas

EvK2CNR – Conducts multidisciplinary high altitude scientific and technological research, and facilitate the use of that knowledge at a management and decision-making level. **www.evk2cnr.org**

FAO – The Food and Agriculture Organization of the United Nations – is a specialised UN agency that leads international efforts to defeat hunger. FAO's focus on mountains is devoted to raising levels of nutrition, improving agriculture productivity, and alleviating poverty and hunger. **www.fao.org**

GLORIA – Global Observation Research Initiative in Alpine Environments is a worldwide long-term observation network in alpine environments – that collects vegetation and temperature data. **www.gloria.ac.at**

GMBA – Global Mountain Biodiversity Assessment is a cross-cutting network of DIVERSITAS which actively explores and synthesizes mountain biodiversity research and acts as a link between science and policy. **http://gmba.unibas.ch/index/index.htm**

MAB – UNESCO's Programme on Man and the Biosphere develops the basis, within the natural and the social sciences, for the sustainable use and conservation of biological diversity, and for the improvement of the relationship between people and their environment globally. **http://portal.unesco.org/science/en**

MP – The Mountain Partnership – MP is s a voluntary alliance of partners dedicated to improving the lives of mountain people and protecting mountain environments around the world. **www.mountainpartnership.org**

MRI – Mountain Research Initiative – promotes and coordinates research on global change in mountain regions around the world and catalyses the interdisciplinary research needed to fill current knowledge gaps. **http://mri.scnatweb.ch**

TMI – The Mountain Institute – has a mission to advance mountain cultures and preserve mountain environments. **http://www.mountain.org/**

UNEP – the United Nations Environment Programme – coordinates the UN environmental activities; assists developing countries in implementing environmentally sound policies; and encourages sustainable development through sound environmental practices. **www.unep.org**

UNU – The United Nations University – is an independent research institution in the UN system that works towards contributing to the resolution of pressing problems facing the global community through network-based research, multi-stakeholder policy dialogues and capacity development. **www.unu.edu**

WCPA – World Commission on Protected Areas – is the world's premier network of protected area expertise. **www.iucn.org/wcpa**

WI – Wetlands International – works at all levels from global to local to achieve the conservation and wise use of wetlands, as a contribution to sustainable development. **www.wetlands.org**

WWF is an international non-governmental organization for the conservation, research and restoration of the environment worldwide. **www.panda.org**

What are some of the scientific studies of climate change that are presently taking place in mountain areas?

Several global programmes are active in mountain areas. The Global Observation Research Initiative in Alpine Environments (GLORIA) is a notable initiative for research into the impact of climate change on mountain areas. It makes use of the sensitivity of mountain areas at high elevations, which are not exposed to direct land-use impacts, to study the ecological effects of climate change.

Since high mountain systems are distributed globally at all latitudes from tropical to polar zones, they provide a common low temperature regime for studying climate change. Other climate research programmes are not specifically geared to mountains but also collect data in mountain areas these include the likes of GCOSS, the Global Climate Observing System and others.

"This [International Mountain Biodiversity Conference] is a significant and tangible first step towards the long-term preservation of the Himalaya's genetic heritage."

Andreas Schild, ICIMOD, Director General

An age without a name – a personal view

Just forty years ago, when the American astronaut Neil Armstrong took the first steps on the moon, much was made of his first step: one giant step for mankind! Perhaps unknown to the space scientists and media who coined the phrase, the statement was an echo coming from over the millennia of human history. To leave one's footprint for posterity, whether you were a great warrior or philosopher or builder, was the ancestral idea of eternity. You would be known by your deeds and the greater your deeds the longer your name would live.

We are about to leave behind an age without a name for our posterity. The only footprints our generation will be remembered by will be the ecological footprints of our greed and our destruction of the riches of our planet, the Earth. If the words and work of the scientists who met together in 2008 at the International Mountain Biodiversity Conference (IMBC) in Kathmandu mean anything at all, they will have sounded the last post on our insouciance. We have reached a point in the Earth's history beyond which there is no return. Unless we take serious 'steps' to conserve our natural heritage today, all that we believe to be humanity's greatest achievements could be swallowed by the black hole of history: swallowed without a trace. We have a long road to travel to achieve all that the IMBC showed us is possible. Remember what the poet said, there are "miles to go" before any of us can sleep if we are to conserve and, hopefully, enrich the natural heritage of this intrinsically good Earth for future generations. Don't just talk, let's act!

Greta Pennington Rana

CD-ROM with PDF files

- Proceedings of the International Mountain Biodiversity Conference Kathmandu, 16-18 November 2008
- International Mountain Biodiversity Conference November 2008: Workshop Reports
- Mountain Biodiversity and Climate Change

About ICIMOD

The International Centre for Integrated Mountain Development, ICIMOD, is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush-Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

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