Secretariat
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Biological Diversity

CBD Technical Series No. 8

STATUS AND TRENDS OF, AND THREATS TO, MOUNTAIN BIODIVERSITY, MARINE, COASTAL AND INLAND WATER ECOSYSTEMS: abstracts of poster presentations at the eighth meeting of the Subsidiary Body on Scientific, Technical and Technological Advice of the Convention on Biological Diversity

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FOREWORD

At its fourth meeting, held in 1998, the Conference of the Parties in its decision IV/16 selected mountain ecosystems as one of the items for in-depth consideration during its seventh meeting. The Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) decided, at its seventh meeting held in November 2001, that mountain biological diversity would be the theme for in-depth discussion at its eighth meeting. It also decided that it would review the programme of work on biological diversity of inland water ecosystems and marine and coastal biological diversity.

Mountain ecosystems are a new topic under this consultation process. They cover about 25 per cent of the Earth's terrestrial surface. About 12 per cent of the world's population lives in the mountains, but over 50 per cent are directly or indirectly dependent on mountain resources. Mountain biological diversity is of high importance for a number of ecological functions. The integrity of soils is the prime capital for ecosystem services and human needs. Soil retention and slope stability are closely connected with the extent of above-ground and below-ground vegetation, both essential to ecosystem resilience after disturbance (e.g., high rainfall, avalanches, trampling). The high plant functional diversity of mountain ecosystems may also add to their resiliency and, should extreme disturbances occur, often provides effective barriers to high-energy events such as rockfalls and avalanches.

There is still no clear picture of the trends of mountain biological diversity. However, while several of the world's mountain areas are in relatively good ecological shape, many face accelerating environmental and cultural decline. Although it is beyond doubt that human land use has greatly altered mountain ecosystems, the exact nature of some of the changes and future trends has yet to be established.

I am very pleased to make available to the scientific community and those actively involved in biodiversity management the eighth publication in the CBD Technical Series. It contains an abstract of the keynote address delivered by Prof. Christian Köerner on "mountain biodiversity: global hot spots, regional insurance, local livelihood" and 27 abstracts on mountain biodiversity, 12 on marine and coastal biological diversity and 7 on inland water ecosystems presented at the eighth meeting of SBSTTA held in Montreal from 10 to 14 March 2003.

It is my hope that this publication will broaden our understanding of the complexity of the issue of mountain biodiversity and at the same time facilitate the implementation of remedial measures to reduce or halt biodiversity loss attributed to many threats.

I wish to express my sincere gratitude to all those who have contributed in one way or another to the preparation and production of this series.

Hamdallah Zedan
Executive Secretary

CONTENTS

Keynote Address

MOUNTAIN BIODIVERSITY: GLOBAL HOT SPOTS, REGIONAL INSURANCE, LOCAL LIFELIHOOD

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The personal safety and well-being of one sixth of the world's human population, and water supply of almost half of all people are directly or indirectly dependent on the functional integrity of mountain ecosystems. The two key components which make mountains so important and sensitive are (1) altitude and (2) slope. With their elevation above the plains, the mountains trap an over-proportional fraction of terrestrial precipitation. In some regions water is almost exclusively intercepted by mountains. Across their slopes and valleys they deliver water to the forelands. In their snowfields, glaciers, but also their rocky interior and their soils mountains store a lot of water and keep delivering it during long dry periods. Mountains, with their 24 % share of global land area, are the water towers of the world.

It is obvious that mountains remain only inhabitable to the extent that their slopes stay where they are, rather than eroding into villages, roads, reservoirs etc. Slope stability in the mountains is also key to the well-being of people in the forelands and plains. There is only one force that can fasten soils on slopes: the roots of plants. Slopes are only as stable and secure as their green cover is. Mountain vegetation does an incredible engineering job for a large fraction of the globe's population. At the same time it provides food and fodder, fiber and other forest products, ensures clean runoff water, offers attractive landscapes, and above all, hosts an enormous diversity of life, beating most lowlands in richness.

Nature meets it's engineering task of fastening soils with a multitude of tools (plant structures), each performing in a different way and each being different in sensitivity to perturbation and stress and its mutual dependancy in animals and microbes. This incredible diversity of plants and their organismic partners is nature's insurance against complete failure, i.e. the loss of substrate on slopes. Humans are well advised to care for this diversity in whatever suitable way. Given that 90 % of the ca. 1 billion people living in and in close proximity of high mountains are very poor, any "care-taking" must account for the local needs of human life.

It is this delicate balance between sustainable use of mountains and the needed integrity of their biota for both, risk control and life support, which makes mountain biodiversity a key issue of international concern. Nowhere else than in mountains can overexploitation of resources under the pressure of poverty cause more damage to both locals and their foreland neighbours. Biodiversity and ecosystem integrity of mountain biota are inevitably linked. In many parts of the world, humans created highly diverse and stable mountain ecosystems by traditional land use, landscapes representing a millenia old cultural heritage. Under economic pressure these sustainable forms of land use get overrun in many areas. They need to be re-installed for the local life support system not to collapse. Biodiversity and the density of ground cover are the best indicators of ecosystem integrity and soil stability.

Mountains most often also represent the last wilderness areas in otherwise fully transformed landscapes. Their conservation for future generations, but also for their own sake is another imperative. Well planned and maintained such conservation areas can produce more local income through visitors than other forms of land use, provided local stakeholders (rather than governments or agencies only) are fully integrated in conservation projects. The amount and quality of water produced by conservation areas commonly exceeds that of transformed land, another revenue locals should share.

Because of the compression of climatic life zones on mountain slopes, mountains represent hot spots of biodiversity. High mountains, tropical ones in particular, host more biological richness per unit of conserved land area than any other terrestrial system. Implementing a mountain plan of the Convention on Biological Diversity offers a triple win option:

(1) sustainable land use and local and regional safety
(2) external benefits by risk mitigation for forelands and supplies of mountain goods and services such as water yielding and electric power, and
(3) preservation of some of the richest biota of the globe.

Mountain Biodiversity

1
ADMIRA Y CONTEMPLALA BELLEZA DEL PELEMPITO

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Keywords: Republica Dominicana, flora, fauna

El Parque Nacional Sierra de Bahoruco

El Parque Nacional Sierra de Bahoruco fue creado mediante decreto presidencial número 1315, del 11 de agosto de 1983, fue incorporado al Sistema Nacional de Areas Protegidas por la Ley General sobre Medio Ambiente y Recursos Naturales, No. 64-00, del 18 de agosto del año 2000. Tiene una superficie de 1126 kilómetros cuadrados.

Esta Sierra constituye el extremo oriental de una cordillera sumergida que parte de América Central, pasa por Jamaica, cruza el Canal del Viento en Haití, y termina en República Dominicana con la Sierra de Bahoruco.

La montaña de mayor altura es la Loma del Toro que tiene una altura de 2,367 metros.

El Hoyo del Pelempito:

Como parte de la Sierra de Bahoruco podemos resaltar el Hoyo del Pelempito, el cual fue siempre un sitio misterioso para las pocas personas que oyeron hablar de él.

Este singular fenómeno natural es el resultado de varias fallas geológicas y el hundimiento de un inmenso banco de coral emergido del océano. El hoyo tiene una forma triangular de 2.5 kilómetros de ancho por 7 de largo. El fondo del mismo se encuentra a 348 metros sobre el nivel del mar, en tanto que los bordes más altos de las montañas circundantes sobrepasan los 1800 metros de altura, lo que indica una depresión de mas de 1500 metros de profundidad.

El fondo del hoyo tiene una superficie de 10.28 kilómetros cuadrados, mientras que la cuenca tiene un área total de 177 kilómetros cuadrados.

Las temperaturas de este lugar oscilan entre los 25 grados centígrados, al medio día, y cero grado durante la noche, según las estaciones. La precipitación anual es de unos 1200 milímetros, pero la humedad relativa es alta debido a la presencia de neblinas en determinadas épocas del año.

Una de las especies vegetales prevalecientes es la hierba llamada aceitillo (Schyzachyrium gracile), y de ahí vienen los nombres de Loma del Aceitillar y Hoyo del Aceitillar, para esta parte de la Sierra de Bahoruco.

La Secretaría de Estado de Medio Ambiente y Recursos Naturales construyó un Centro de Visitantes y una torre de observación para garantizar los servicios y facilidades que allí pueden brindarse a público en general y de manera especial a investigadores de la naturaleza. Este centro está ubicado en uno de los bordes intermedios a una altura de 1165 metros sobre el nivel del mar.

Se han publicado dos guías, una botánica y otra ornitológica para describir las especies de la flora local y las aves que se observan en los alrededores del Centro de Visitantes.

Flora y Fauna:

La Sierra de Bahoruco es una de las áreas de mayor riqueza florística en la Isla Española. Según los estudios realizados existen alrededor de 1,434 especies de plantas, sin incluir grupos como hongos y musgos. Cuenta con aproximadamente 439 especies de plantas endémicas de la Isla Española. La vegetación del Parque Nacional Sierra de Bahoruco es de excepcional importancia, la altitud determina variaciones climáticas que contrastan fuertemente y crean una amplia gama de nichos ecológicos que van desde el bosque seco hasta bosques nublados, bosques latifoliados mixtos, sabanas, pinares y bosques semihúmedos.

De la misma forma, la fauna asociada a las diferentes asociaciones vegetales es muy diversa y presenta un alto endemismo. Se han reportado 21 especies de anfibios, 96 especies y subespecies de reptiles, de los cuales 1 especie y 11 subespecies son endémicas de la Sierra de Bahoruco. También se han reportado 17 especies de mamíferos.

De alta importancia también es la gran diversidad y densidad de aves, se han reportado 108 especies de aves. La Sierra de Bahoruco es el único sitio de la Republica Dominicana donde es posible observar 26 de las 27 especies endémicas de aves en la isla, lo cual resalta el alto valor turístico de la zona, especialmente para los observadores de aves.

Amenazas

Las principales amenazas que afectan los recursos naturales del Parque Nacional Sierra de Bahoruco son la agricultura migratoria en terrenos no aptos, la extracción ilegal de madera, los incendios forestales, la cacería ilegal y el contrabando de especies amenazadas.

Referencias:

SEA/DVS 1994. Reconocimiento y Evaluación de los Recursos Naturales de la Sierra de Bahoruco. Secretaría de Estado de Agricultura, Departamento de Vida Silvestre. Santo Domingo, República Dominicana.

Secretaría de Estado de Medio Ambiente y Recursos Naturales, 2002. Centro de Visitante del Hoyo de Pelempito: Historia y Descripción.

Secretaría de Estado de Medio Ambiente y Recursos Naturales, 2002. Guía Botánica del Centro de Visitantes del Hoyo del Pelempito.

Secretaría de Estado de Medio Ambiente y Recursos Naturales, 2002. Guía Ornitológica del Centro de Visitantes del Hoyo del Pelempito.

Secretaría de Estado de Medio Ambiente y Recursos Naturales, 2002. Parque Nacional Sierra de Bahoruco. Brochure.

2
ALTAI-SAYAN ECOREGION: DESPITE OF THREATS IT HAS A FUTURE

Alexander Bondarev*; Chimed Ochir**

* Alexander Bondarev – manager for UNDP-GEF PDF- BLOCK B "Regional biodiversity conservation in the Altai-Sayan Mountain Eco-region: Phase I"

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Keywords: Ecoregion, biodiversity, threats, sustainable development, Altai-Sayan

Overview of the Altai-Sayan Ecoregion

Altai-Sayan mountain country undoubtedly is one of the most valuable Ecoregion of global value. This region is included in "Global 200" – the list of the preserved virgin or little changed ecoregions of the world determined by the WWF experts.

Altai-Sayan Ecoregion occupies a large territory in the Central Asia of nearly 1.065,000 sq. km and straddles 4 countries. 62% of the Ecoregion territory is situated in Russia, 29% in Mongolia and 5% in Kazakhstan and 4% China respectively.

The population consists of appr. 4.5 million people, with the majority living in urban areas. Most of the territory still remains scarcely populated. The average density is among the lowest in Eurasia. Most of the Altai-Sayan region remains among the least economically developed regions of Russia and Mongolia as well. In general, people in the Altai-Sayan Ecoregion rely heavily upon local natural resources for their livelihood.

The Altai-Sayan Ecoregion encompasses a mountains (22% of total territory), surrounded by steppes (24%) in the north and east, deserts and semi-deserts (4%) in the south and west. The region includes the mountain systems of Altai, Sayan and vast intermountain depressions.

Forests are the most important biotope for biodiversity conservation in the Altai-Sayan Ecoregion. They contain the world's largest unbroken stretches of Siberian Pine forests of the highest quality.

The flora and fauna diversity of the Altai-Sayan region is unique for temperate latitudes. It includes 3726 vascular plants in total. Among them 700 are rare and endangerous. As a natural dividing line between the Siberian boreal forests and the central Asian deserts, the Ecoregion hosts 143 mammal species, 425 bird species, 77 fish species. 8,5% of plants and 5,7% of animals are unique (endemic) to the Earth ecosystems.

The Altai-Sayan Ecoregion forms the world's northernmost habitat of the Snow Leopard, locally called Irbis (Uncia uncia) and the Altai mountain sheep Argali (Ovis Ammon ammon), the world's largest specie of wild sheep. These two "flag" species are among the rarest and most vulnerable, and are thus indicative of the overall health of the Altai-Sayan mountain country ecosystem. The species are listed in the "endangered" species category of the Red List for the International Union for Conservation of nature (IUCN).

The Altai-Sayan Mountains are also an area of rich cultural heritage, where humans first emerged in the region about a million years ago. There are historical monuments of burial mounds dating back to the fifth century BC, numbering more than 1000.

The Ecoregion remains relatively unaltered and underdeveloped and thus the living standards of the local population are rather low and economical opportunities limited. UNDP Human Development Index for the Altai-Sayan is among the lowest in Russia.

As a result of the diagnostic "threats-underlying causes" analysis undertaken within the framework of UNDP/GEF project the following primary threats to biodiversity were identified:

1. Poaching, hunting, and trading of rare and endangered species.

Population of "flag" species such as Snow Leopard and Argali Sheep have been drastically reduced due to poaching. Today, there are not more than 200 leopards and 150 Argali in the Russian part of Altai-Sayan left. It is estimated that 70 percent of the endangered species trade to Europe from Asia now passes through Central Asia.

2. Loss of habitats (mining, transport and energy development projects, deforestation due to catastrophic forest fires and clear cuttings).

3. Habitats degradation (overgrazing, fodder collection, fuel wood collection, uncontrolled tourism).

It is clear by now that Altai-Sayan Ecoregion will be included in the 50 of the most vulnerable regions in the world demanding assistance. Climate changes are already being traced quite vividly there. These are anomalous floods, retreat of glaciers, warm winters with much snow, and changes of forest specie composition on a tree line in mountain areas.

There are also the most dangerous trends to:

- unique landscapes degradation;
- rare and endangered plants and animals species reduction and extinction;
- climate changes.

Sustainable Use Focus

The activity of the World Wide Fund For Nature (WWF) and the United Nations Development Programme (UNDP) in the Altai-Sayan Ecoregion is a vivid example of a complex approach to the solution of the global task of long-term biodiversity conservation. Since 1998 a large-scale WWF project "Ensuring Long-term Biodiversity Conservation of the Altai-Sayan Ecoregion" has been implemented. Starting from 2001 climatic aspects were also included in the project. The creation of an "ecological net" of protected natural areas is one of the most important tasks of the project. The ecological framework of the system of protected areas of the region has been developed. WWF's project finally led to initiation of a larger regional UNDP/GEF initiative in three countries of the Ecoregion, Russia, Mongolia, and Kazakhstan. It is considered to be one of the first GEF projects, which is based on the Ecoregional approach to biodiversity conservation, thus emphasizing the importance of ecological patterns and processes over and above those of political and administrative boundaries. At the same time the project promotes community-based local conservation measures and focuses more on ensuring sustainable use of resources rather than their full conservation.

Sustainable approach to resources use originates from the understanding of the values that natural resources bring to the people of the region. Preliminary economic assessment of biodiversity conducted during the project development phase proved that those benefits represent not only the cost of direct use of natural resources, but also their indirect values and alternative options. For instance, some of the alternative sustainable use options in the Altai-Sayan Ecoregion can be:

1. Restoration of local traditional community home craft business aimed on sustainable use of non-timber products and game resources (based on traditional knowledge).

2. Development of non-timber products processing at the territory of traditional land use practice supported by local government.

3. Collection and processing of traditional medicinal plant resources and promotion of local goods at the national markets (products certification, protection of local trade marks and intellectual property).

4. Support sustainable forest management following FSC principles and criteria.

Despite the problems the region faces, Altai-Sayan Ecoregion is among the most politically stable region in Asia. Local communities tend to play an active role in the types of development activities taking place in the region.

In order to tie together the efforts of biodiversity conservation and sustainable resource management, the enabling frameworks need to be strengthened in order to ensure sustainability.

The strengthened capacities will in the long term significantly reduce the need for external inputs in order to sustain global environmental benefits achieved by conserving globally significant transboundary biodiversity.

References

A.N.Severtsov Institute of Ecology and Evolution Russian Academy of Sciences, WWF (World Wide Fund For Nature) Russia. (2002). *Strategy for Conservation of the Snow Leopard in the Russian Federation*.WWF Russia, Moscow.

Kokorin A.,Ph.D, Kozharinov A., Prof., Minin A., Prof. (2001). *Ecoregional Climate Change and Biodiversity decline, Issue 1, Altai-Sayan Ecoregion*, WWF Russia, Moscow.

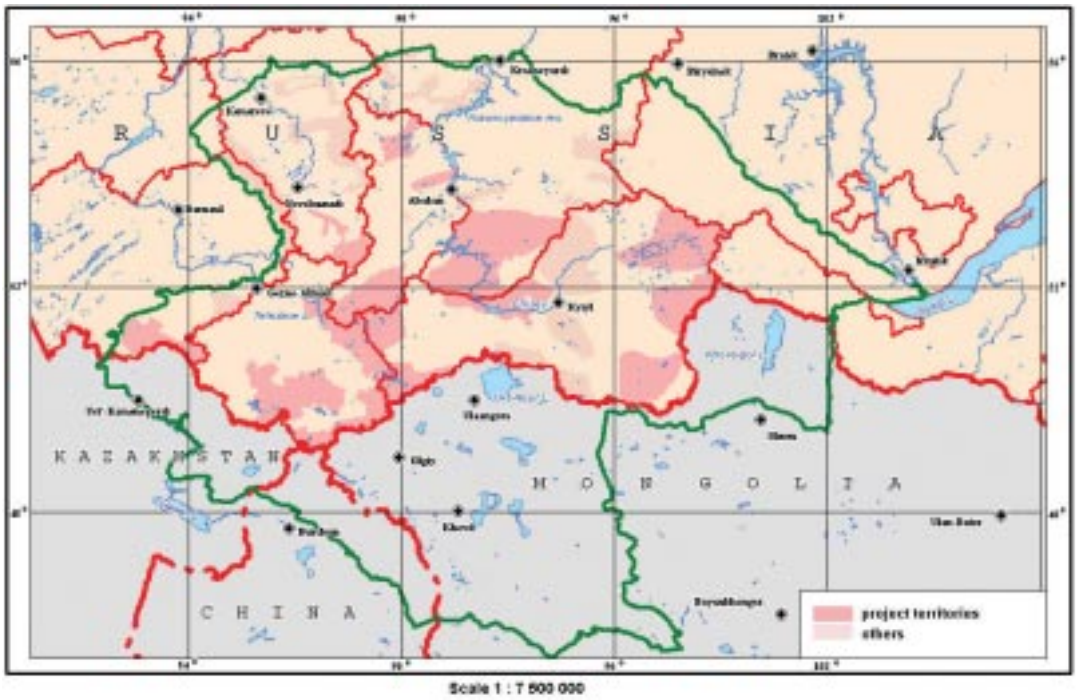
Plusnin Y., Kalugina Z., Soboleva S., Popkov Y. (2002). *The Conceptual Framework of the Sustainable Development of the Altai-Sayan Ecoregion*. Novosibirsk State University, Russia.

Protected Areas of the Altai-Sayan Ecoregion. (2001), edited by Kupriyanov A., Prof.. Publishing House Asia, Kemerovo, Russia.

Regional biodiversity conservation in the Altai-Sayan Mountain Eco-region: Phase I, UNDP-GEF PDF- block document, UNDP-GEF Reference No: 6022a, UNDP-GEF pims code: 1685

Figure 1.

ALTAI-SAYAN ECOREGION: Key territories for the biodiversity conservation



3
APPLYING THE ECOSYSTEM APPROACH IN HIGH-MOUNTAIN ECOSYSTEMS IN GERMANY: EXPERIENCES WITH THE ALPINE CONVENTION

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Keywords: Alpine Convention, Implementation, Management, Germany

High Mountains in Germany: The Alps

The study prepared within the scope of the R&D project "Developing Concepts for Sustainable Use in Selected Subdomains of Biological Diversity" of the German Federal Agency for Nature Conservation aims at analysing the current state and use of high mountain ecosystems in Germany, considered as a case-study. It investigates the compatibility of the sustainability principles of the Ecosystem Approach of the CBD with the implementation of the Convention on the Protection of the Alps (Alpine Convention).

The Alpine Convention is a legally binding document signed by all states participating in the mountain range of the Alps. In no other mountain range of the world a comparably binding framework for protection and sustainable use exists for the time being. The Alpine Convention covers an area of 190.912 square kilometres (Bätzing 2002) inhabited by 14.2 million people in 8 states, 53 regions and 5800 communities (Figure 1). Figure 2 indicates the share of states in the area of the Alpine Convention. The convention consists of a frame and thematic protocols. The frame defines the aims of the convention and the formalities of regular meetings and reports. The protocols cover specific thematic issues in depth. For the time being nine protocols have been agreed to: the Nature Conservation and Landscape Management Protocol in 1994, the Mountain Agriculture Protocol in 1994, the Regional Planing and Sustainable Development Protocol in 1994, the Mountain Forest Protocol in 1996, the Tourism Protocol in 1998, the Energy Protocol in 1998, the Traffic Protocol in 2000, and the Conflict Solving Protocol in 2000.

The Alps consist of a mosaic of different types of ecosystems along a vertical gradient of increasing altitude: valley bottoms with river beds, meadows, mountain forests, alpine pastures, alpine grasslands above timberline, and rocks in the summit regions. Together with the bogs in various altitudes, the Alps host about 3.000 plant species, 400 of which are endemic (Lauber & Wagner 1998). Thus the Alps comprise about one third of the whole European flora. Figure 3 shows the distribution of ecosystems throughout the Alps, whereas Figure 4 indicates the distribution in the German part of the Alps.

Comparison of the Ecosystem Approach and the Alpine Convention

The aim to create a balance between conservation efforts and sustainable use is fundamentally integrated in the Alpine Convention and the protocols (BUWAL 2000). The different protocols recommend financial support for traditional and sustainable ways of land-use, forestry and agriculture if the overall market situation renders these ways less profitable. With respect to tourism as a main economic factor and main cause of environmental problems, a balance between strict protection and more or less intense use has to be found. This perception initiated the Tourism Protocol.

The convention as a whole considers protection of ecosystem functioning of greater significance for the long-term maintenance than just protection of species. The connection of alpine national parks into a network of protected areas expresses this understanding. Nevertheless, measures to strengthen or rebuild populations of single species threatened by extinction are added to the efforts (e.g. for the Bearded Vulture Gypaetus barbatus). As all states partitioning at the mountain range of the Alps are members of the Alpine Convention, it can be seen as a perfect example of guaranteeing the adequate spatial scale for any measure.

The convention as well as the protocols argues, that measures have to be taken for ecosystems as a whole with no respect to national borders. Projects and networks throughout the Alps show, that initiative is taken on a local scale as well as on a national or a regional scale (Allianz in den Alpen 2002). It is also agreed on respecting the limits of ecosystem functioning, knowing that mountain ecosystems are even more vulnerable and take longer to recover than other systems.

The convention and the protocols call for sharing of experience between all Parties and different data networks are already implemented (Scheurer 2001). Participation of non-governmental organisations was essential in formulating the convention and protocol text and still is in coordinating measures and spreading information. Nevertheless, an announced protocol "People and Culture" is still missing. This protocol might then help to gather even more traditional knowledge and prevent traditional techniques from vanishing. With respect to scientific knowledge, the basic information about species and species communities is available. Investigation of ecosystem functioning and development of monitoring systems has to be improved. Parties are well aware of the fact, that climatic change will have more dramatic effects in the Alps than in lowlands and the Mountain Forest and Soil Protocols urge parties to prevent soil erosion and avalanches by planting and protection of forests. Many changes that occurred in alpine systems in the last decades are man-made and hence not inevitable. The convention sees the need to stop these changes (e.g. by limiting road construction or expansion of skiing areas, by supporting traditional farmers).

Resume

Although the Alpine Convention was not formulated under the impression of the Rio summit in 1992, but years before, it generally covers the aims of the CBD, especially the first two, conservation of biological diversity and the sustainable use of its components.

As a result it can be observed that the holistic approach of the Alpine Convention and its protocols reflects very much what is formulated in the 12 guiding principles of the Ecosystem Approach of the CBD. The conceptual framework offers all possibilities to implement management measures that help to protect and sustainably use mountain biodiversity. The Alpine Convention may also serve as an example for regional cooperation in other mountain areas.

References

Allianz in den Alpen 2002: 5 Jahre Gemeindenetzwerk, Allianz in den Alpen" 1997-2002.- Info-Rundbrief, Mäder, Österreich

Bätzing, W. 2002: Die aktuellen Veränderungen von Umwelt, Wirtschaft, Gesellschaft und Bevölkerung in den Alpen.- BMU, Berlin

BUWAL 2000: Alpenkonvention- Die Alpen schützen und nutzen, Bundesanstalt für Umwelt, Wald und Landschaft (BUWAL).- Bern

Güthler, A. 2001: Daten zu Flächennutzung und Bodenbedeckung.- In: Internationale Alpenschutzkommission CIPRA 2001: Alpenreport 2 – Daten, Fakten, Probleme, Lösungsansätze.- Verlag Paul Haupt, Bern, Stuttgart

Lauber, K. & G. Wagner 1998: Flora Helvetica.-2.Auflage, Haupt Verlag, Bern

Scheurer, T. 2001: Forschung alpenweit- das Internationale Wissenschaftliche Komitee Alpenforschung.- In: Internationale Alpenschutzkommission CIPRA 2001: Alpenreport 2 – Daten, Fakten, Probleme, Lösungsansätze.- Verlag Paul Haupt, Bern, Stuttgart

Figure 1.

Area covered by the Alpine Convention

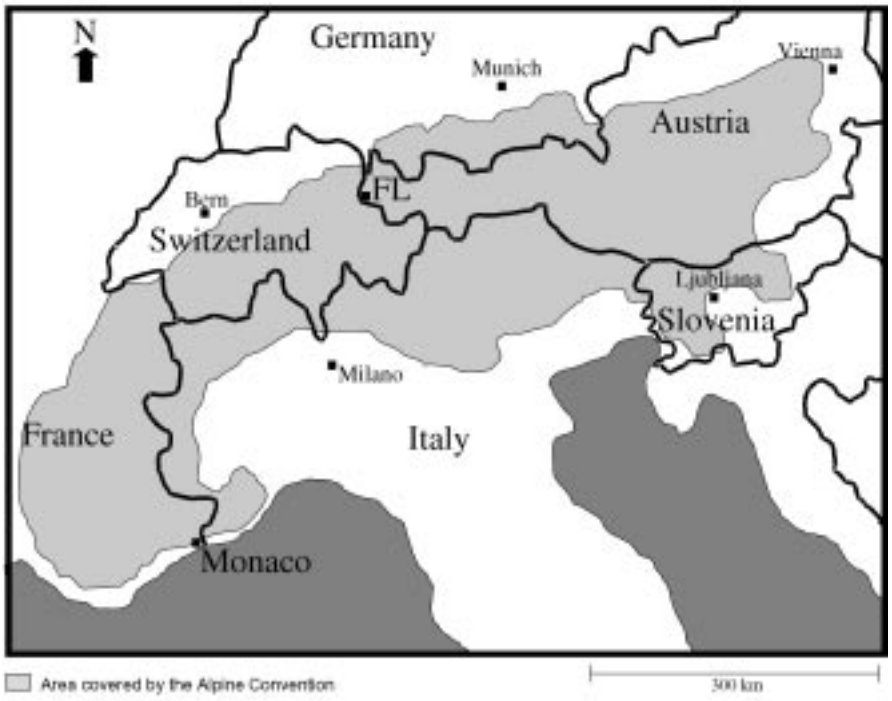


Figure 2.

Share of alpine states in the area of the Alpine Convention (A= Austria, F= France, D= Germany, I= Italy, FL= Liechtenstein, SI= Slovenia, CH= Switzerland), MC= Monaco, (data from www.CIPRA.org)

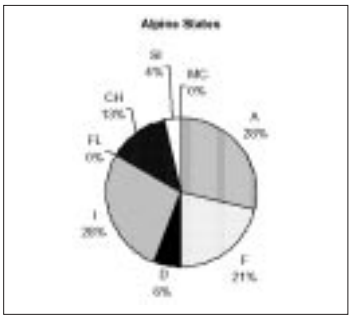


Figure 3.

Alpine Ecosystems throughout the Alpes (Based on Güthler 2001)

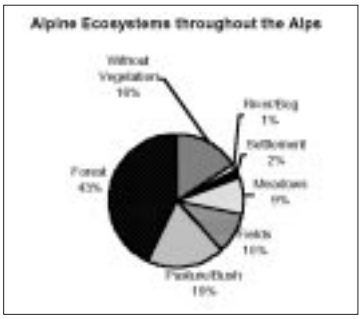
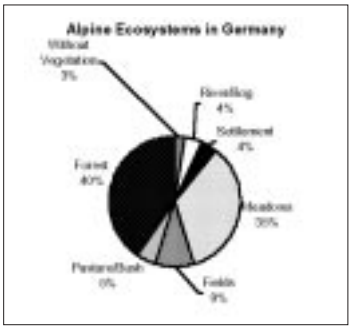


Figure 4.

Alpine Ecosystems in Germany (based on Güthler 2001)



4
BIODIVERSITY CONSERVATION IN THE EASTERN HIMALAYA: PAST, PRESENT AND FUTURE

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Keywords: Himalaya, conservation, poverty alleviation

Introduction

The Eastern Himalayan region is known for an outstanding biological diversity, rich socio-culture and poor economy, and complex political conditions. All the countries of the region (Bhutan, China, India, Myanmar, and Nepal) face numerous conservation threats from human activities (e.g., deforestation). Because of these challenges, biodiversity conservation approaches and programs in the Eastern Himalaya have become quite dynamic. Nepal, located in the central part of the Himalaya can be a good example of this. The main objective of this paper is to analyze the trend of biodiversity conservation in Nepal from historical perspective and predict its possible course and impacts in the future. Specifically it will explore: a) changes in conservation practices or approaches through time until present, b) strengths, weaknesses, and impacts of various approaches of conservation, and c) lessons learned and future direction. These objectives, important for planners, managers, and researchers involved in biodiversity conservation and protected area management are explored by using available literature (HMG 1973, IUCN 1991) and recent field studies in the mountain and *tarai* parks, and unpublished case studies and reports (HMG 2001, 2002). Three different conservation periods have been separated: a) before 1950s, b) 1950s-1990s, and c) 2000s-2050s and beyond. Qualitative stepwise analysis of the information collected for the first two conservation periods is used to predict for the future.

Evolution of conservation approach in Nepal

Literature review and situation analysis shows that the concept of natural resource conservation prevailed even before 1950s in Nepal. However, the conservation efforts were limited to personal interests and public initiatives for religious or other communal purposes. Although this *ad hoc* approach of resource conservation generated a strong cooperation following unwritten social laws and involved no direct costs, it lacked institutionalization and long-term goals. Since 1950s, the concept of conservation of wildlife and its habitats emerged strongly and since 1970s conservation history of Nepal is dominated by protected area system approach (WWF 2000). Thus during, 1970s-2000, Nepal created and managed 16 protected areas (national parks, wildlife reserves, hunting reserves, conservation areas, and their buffer zones) which cover more than 18% of the total area of the country (Table 1). Most of these protected areas were small and managed in isolation without the local involvement until mid 1990s. The concept of conservation area and buffer zone in 1980s and 1990s respectively changed the scenario of biodiversity conservation by accommodating the areas and people outside the protected area for conservation through community development. But still a large number of biological and socio-economical issues (e.g., corridor for wildlife movement) were ignored. This has led to the development of a landscape level conservation planning (e.g.,ecoregion-based conservation) since early 2000s to accommodate a wide range of conservation issues outside and between the protected areas. The goal of the large-scale conservation approach is to conserve the full range of species, natural habitats, and ecological processes together with socio-culture and economy. With long-term goals and vision, the conservation approach and practices in Nepal have evolved to the highest level at present. But because of the scale and size, landscape level approach of conservation may face several challenges including a) lack of

resources (e.g., funds) to implement programs, and b) lack of proper coordination, communication, and commitment. In that case, new issues are likely to emerge. They include i) more theoretical and paper work than actual programs in the field and ii) scattered and superficial actions without solid outcome due to larger scale.

Lessons learned and future direction

Since the landscape level conservation planning is quite recent, it is too early to list down the lessons learned from its implementation. Its outcome will guide the course of the biodiversity conservation approach in the future in Nepal and other Eastern Himalayan countries. Successful biodiversity conservation requires i) long-term vision, planning and programs with adequate resources for implementation, ii) orientation and conservation education to local partners and stakeholders, and iii) linkage between biodiversity conservation and poverty alleviation of local people.

Table 1.

Total Land Covered by Protected Areas (PAs) of Nepal

Period	Total area	Percent of the total land area	Number of protected areas in each decade
Until 1970s	4,376 Km^2	2.97	Four national parks and two wildlife reserves
Until 1980s	18,721 Km^2	12.72	Three national parks and reserves each and one conservation area
Until 1990s	27,591 Km^2	18.75	One national park and two conservation areas and six buffer zones of the existing PAs
Until 2000	27,866 Km^2	18.93	One buffer zone of a PA

References

HMG 1973. National Parks and Wildlife Conservation Act 2029. Nepal Gazette 2029/11/28. (Amendments in Nepal Gazette:2031/6/20 (1974), 2039/9/8 (1982), 2046/6/11 (1989), 2050/2/27 (1993). Ministry of Law and Justice, Kathmandu.

HMG 2001. Royal Chitwan National Park and Buffer Zone Management Plan (2001-2005). Ministry of Forests and Soil Conservation, Park People Program and UNDP, Kathmandu.

HMG 2002. Shey Phoksumdo National Park and Buffer zone: A five-year Management Plan 2002-2006 (draft). Ministry of Forests and Soil Conservation and WWF Nepal Program, Kathmandu.

IUCN 1991. Background papers to the National Conservation Strategy for Nepal. Volumes 1 and 2. National Planning Commission, HMG/Nepal and the World Conservation Union.

WWF 2000. WWF in Nepal: Three Decades of Partnership in Conservation (1967-2000). WWF Nepal Program, Kathmandu.

5
BIODIVERSITY AND CONSERVATION ISSUES IN THE HIGH MOUNTAIN FORESTS IN RWANDA

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Keywords: Biodiversity, conservation, mountain forest, Rwanda

Introduction

Rwanda is a small, mountanous, landlocked country (26338km^2) located in the equatorial highlands of the Albertine Rift Valley. It is bordered by the Democratic Republic of Congo(DRC) to the west, Burundi to the south , Uganda to the north and Tanzania to the east.

In general, the topography of the country is rugged with an exceptional degree of relief.
The west is mountainous, the east is mainly rolling terrain and the centre of the country is dominated by a plateau.

The western half of the country is dominated by the Congo-Nile watershed, a chain of highlands running north-south at between 2.000-3.000m and which separate Congo and Nile bassins. The northernmost part of this highland is of volcanic origin and contains five pleistocene volcanic peaks.

Part of these highlands is covered by the remaining montane forests, with a surface of almost 1,030 km^2.
The most important forests are Nyungwe forest in the south and Volcans National Parc in the north.
These mountain forests lie in the Afromontane region (White,1983) and form part of the forest of the Albertine Rift wich is extended in Uganda, DRC and Burundi.

The flora and fauna of this region show a high degre of endemism (Kanyamibwa, 2001).
Although the forests are under various threats due to the human disturbance, largely in the form of agricuture and grazing.

Biodiversity

- *Nyungwe National Parc*

The Nyungwe forest National Parc is one of the most biologically important rainforests in central Africa.

The forest supports an abundance of plant and animal life. More than 260 species of trees and schrubs have been found at Nyungwe, including at least 24 that are believed to be endemics to the Albertine Rift (Dowsett,1990).

It is also one of the most important sites for bird conservation in Africa with a total of 260 birds species, 25 of which are endemic to the Abertine Rift.

Thirteen species of primates are known to inhabit the forest, including chimpanzees(*Pan troglodytes schweinfurthii*); owl-faced guenon (*Cercopithecus hamlyni*) and Angolan black and white Colobus monkeys (*Colobus angolensis ruwenzorii*) (Plumptre et al., 2002).

There are also some plant species endemic such *Pentadesma reindersii* and a few herbaceous species (specically orchids) currently only known from Nyungwe.

• *Volcans National Parc*

The natural vegetation occuring in this area is distributed in zones according the altitude. In the lowest elevation, there is a mountain forest with a mixture of trees and bambou (*Arundinaria alpina*).

The zone is under National Parc status since 1929 and is hosting a rich avifauna including many of the Albertine Rift endemics.

The Parc is best known for the mountain gorilla (*Gorilla gorilla beringei*), a subspecies endemic to the Virunga mountains and Bwindi forest in Uganda.

For its international importance, the site is recognised as a Biosphere Reserve (Kanyamibwa, op.cit.).

Conservation issues

With the human population size estimated to be more than 7 millions and an average of more than 300 inhabitants/km^2, Rwanda has one of the highest human population densities in Africa.

A large part of population(97%), provide the livelihood prior by agriculture. This lead to a high pressure on high mountain forests within wich large area are reduced by encroachment. The nearest example is the case of Gishwati forest, a part of the former large mountain forest that covered the western zone of Rwanda, wich has been degradated during the return of refugees after the civil war in 1994.

Despite the fact that the high mountain forest are under protection status, National Parcs are still vulnerable. The mains threats include demand for agriculture land, firewood and timber for woodwork, gold mining, animal poaching and fires.

However, there is an effort aimed to reach an effective conservation of these ecosystems.

Two organisations are working in this matter in relationship with the Government. One (PCFN acting for WCS) in Nyungwe National Parc and an other(Karisoke Research Center) in Volcans National Parc.

To enhance the chance of a sustainable conservation, there is a need to more involve public-awareness compaigns and stimulate support within local populations. Advocacy must also be increased to promote understanding and best legislation about the National Parcs and natural reserves status.

References

Dowsett, R.J., Ed. (1990). *Survey of the fauna and the flora of Nyungwe forest, Rwanda*. Tauraco research report 3. Tauraco, Liege, Belgium

Kanyamibwa, S., (2001). " Rwanda " in Important bird areas in *Africa and the associated islands:Priority sites for the conservation* edited by Fishpool, D.C. and Evans, M.I., Eds. Pisces publications and Birdlife International (Birdlife Conservation series n°11). Newbury and Cambridge, U.K.

Plumptre, A. J., Masozera, M., Peter, J.F., Mc Neilage, A. Ewango, C., Kaplin, B. and Liengola, I. (2002). *Biodiversity survey of the Nyungwe Forest Reserve*. WCS working paper n°19. Wildlife Conservation Society, New York, USA

White, F. (1983). *The vegetation of Africa*. Paris :UNESCO

6
CO-MANAGEMENT OF JAMAICA'S BLUE AND JOHN CROW MOUNTAINS NATIONAL PARK

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Keywords: co-management, Jamaica, national parks, land use

Introduction

Dominating the physiography of the eastern end of the island, the Blue Mountains and the John Crow Mountains are regarded by the people of Jamaica as national icons. Protection of these mountains was first conferred when they were gazetted in 1938 as the Blue Mountain Forest Reserve under the 1937 Forest Act. The Reserve, under the management of the Forestry Department (FD), was categorised as a "protection reserve" with no or limited commercial harvesting permitted. In 1993, the Reserve gained greater protection when it acquired National Park status. The area of the Park is 48,835 hectares (4.5% of the total area of the island) with a perimeter of approximately 290 km.

Description of the Park

The Park contains two contiguous but strikingly different ranges: the Blue Mountains range, which extends roughly from east to west, and, at its eastern most end, the massif of the John Crow Mountains, extending from south-east to north-west.

The Blue Mountains are characterised by steep-sided valleys and deeply gorged rivers. The Grand Ridge, which forms the backbone of the range, extends for 16 km, much of it over 1800 metres. The highest point of the Blue Mountains peak is 2256 metres. The John Crow Mountains rise gently from the east to a maximum height of 1140 metres and end abruptly along a steep escarpment to the west. The summit of the John Crow Mountains is a slightly tilted plateau with an unusual landscape of sinkholes and outcrops.

The Park supports a diverse plant and animal community. Apart from the large number of tree varieties, there is an extensive variety of flowering plants (over 600), ferns, (over 500), herbs and mosses, with a high degree of local endemisim (flowering plants-over 20%, ferns-over 10%). The fauna include numerous bird species (25 endemic), bats, rodents (including the Jamaican Coney), snakes, lizards, frogs and insects (including the rare and endangered Giant Swallowtail butterfly).

Land Use

At the time it was first gazetted the purpose of the Blue Mountain Forest Reserve was to serve as a protection forest. The surface drainage from the Blue Mountain range was (and remains) the main source of water for Kingston, the capital and main city of Jamaica.

Coffee was first introduced into Jamaica in 1728 and, through the centuries, has been a mainstay of the island's agriculture sector. Areas such as Abbey Green and Silver Hill on the slopes of the Blue Mountains were major coffee growing areas. In the 1970s tracts of land within the Blue Mountain Forest Reserve were leased to a parastatal coffee production company which sub-leased parcels for coffee growing. Coffee profitability declined in late 1990s leading to the abandonment of many of these leased coffee lands.

Cultivation of Caribbean Pine (*Pinus caribaea*) within the confines of the Blue Mountain Forest Reserve started in the early 1950s. Between 1974 to 1977, 3000 hectares of natural forest were converted to pine plantations. Plans to expand the programme were well underway when Hurricane Gilbert, in 1988, destroyed over half of these plantations and resulted in the abandonment of commercial reforestation activities. Many areas of the ruined plantations have regenerated and the resulting landscape is a mosaic of pine, broadleaf forest, coffee, and abandoned (ruinate) lands.

In July 2001 Cabinet approved the adoption of a 5-year *National Forest Management and Conservation Plan* prepared by the FD. In keeping with the present forest policy, the Plan explicitly recognises that the Reserve and National Park areas must be preserved and enhanced for watershed protection, biodiversity and eco-tourism.

Threats and Solutions

The main threats to the integrity of the biological and physical resources of the Park are: illegal cutting of trees; clearing of forest for subsistence farming and housing; commercial coffee farming; cultivation of short-term crops on steep slopes; trafficking in some rare species; increasing and uncontrolled recreational activity; invasive alien species; and fire outbreaks. Illegal encroachment of Reserve/Park land is a serious problem in some sections, particularly those with road access. Captured land is used for commercial coffee production, vegetables and residential purposes.

In the less environmentally sensitive areas of the Park the FD is attempting to work with illegal occupants to regularise their situation through the negotiation of leases under terms of strictly controlled land use, eg, the requirement for the lessee to maintain permanent tree cover on steep slopes of the leased land. The FD provides training and technical advice to hillside farmers about incorporating agroforestry techniques to reduce soil erosion. Free timber tree seedlings are provided to farmers to help establish permanent cover.

Co-Management of the Blue and John Crow Mountains National Park (BJCMNP)

Several institutions were involved in the setting up and management of the Park:

- The Protected Areas Resource Conservation (PARC) Project
- The National Environment and Planning Agency (NEPA)
- The Jamaica Conservation Development Trust (JCDT)
- Local Advisory Committees (LACs)

The Forestry Department (FD) has a major interest by virtue of its powers and responsibilities in respect of declared forest reserves and that the Park is defined on the boundaries of the Blue Mountains Forest Reserve. Figure 1 illustrates the relationship between the above institutions. Note that ownership of all Crown Lands, including reserves, is vested in the Commissioner of Lands.

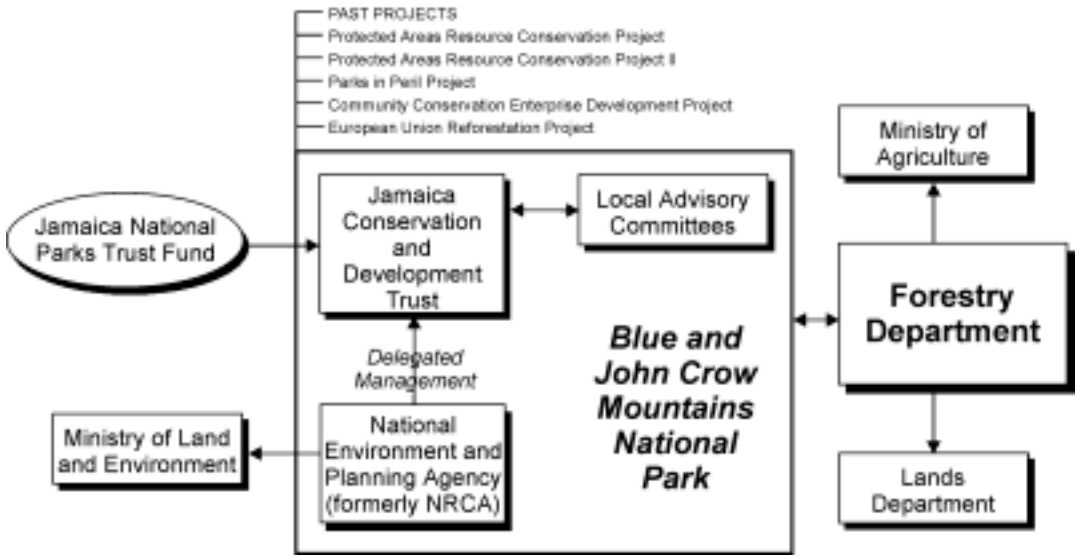
Hiking to the Blue Mountain peak is the most common recreational use of the Park and is a popular activity for residents and visitors. The picnic sites and cabins (built by the Forestry Department) at the Hollywell Recreation Area located in the Park, attracts day trippers and overnight visitors, mainly from nearby Kingston. A well-marked nature trail around Hollywell is maintained by JCDT, the managers of the site, and they also give presentations on Park ecology to school groups and to park visitors. The Forestry Department maintains a custodial presence in the Reserve/Park and has forest wardens deployed there who participate in joint patrols with JCDT park rangers.

The Way Forward

Renewed efforts are underway to seek a sustainable mechanism "To manage the National Park for its cultural and natural values integrating biodiversity conservation with sustainable economic development for the well being of Jamaica".[1] Focus is being placed on threat abatement strategies which reduce/manage the stresses on protected areas, including: zoning and enforcement; research and monitoring; community conservation; education and public awareness; and buffer zone management.

Figure 1.

Institutions involved in the management of the Blue and John Crow Mountains National Park



[1] Mission statement for the management of the Blue and John Crow Mountains National Park.

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CONSERVATION POLICY FOR WILDLIFE IN VIRACHEY NATIONAL PARK, NORTH-EASTERN CAMBODIA

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Keywords: Cambodia, wildlife, species, public awareness

Over the past two decades, Cambodia has suffered civil war and unstable political situation. This has put pressure not only to human being but also to wildlife in terms of hard-living conditions and consequences for the wildlife. One of the consequences resulted from the former communist regime was "a policy of self-defence" led to poaching and illegal logging. Moreover, when the country has opened for a free market economy in the early 1990s the expansion of the international trade and the intensity of wildlife hunting for additional income have dramatically emerged. This subsequent policy has affected many protected areas in Cambodia, particularly areas in the northeastern Cambodia i.e. Virachey National Park. This has voiced concerns by the Director of the Department of Nature Conservation and Protection over the wildlife, which led to threatened, endangered and extinct of some species such cat spp., banting, gaur, Asian elephant, green peacock, sun bears, eastern sarus crane and Kouprey (Bos Sauvali). Some of these species are the global international significant species i.e. Eastern Sarus Crane. The problem is mainly related to poaching, shifting cultivation and illegal logging. Therefore, what policy is required to conserve wildlife in this national park?

14 questions have been sent out to 30 key stakeholders in dealing with management of the wildlife in order to design a clear policy picture for conservation of wildlife in the national park. Most questions have been delivered by email and interviews. Regarding to a question of measures to conserve wildlife in the national park, 59% of the respondents showed their support in banning all unsustainable activities inside the park with a qui-pro-quo approach to deal with a local community. 31% indicated their support of the law enforcement and 10% do care about promote public awareness.

Two policy scenarios have been developed for a client (Director of Dept. of Nature Conservation and Protection). The first scenario is focussing on the status quo with limited budget from the government to deal with the alternative policy, which is (1) banning of unsustainable activities inside the national park; (2) improving law enforcement and (3) promote public awareness. The second scenario deals with the sufficient budget from all sources including potential donors and NGOs that will apply to the same alternative policy.

In the status quo scenario, alternative policy of "improving the law enforcement" is best because of limited budget that could only accommodate the law enforcement related activities. Awareness option is not selected because it will give outcome in the long term. Banning of all unsustainable activities inside the park would affect political constituencies and local livelihood although it can stop most of the illegal activities. Then the park would be left in a lessez-fair approach. In the second scenario, option 1 is selected because the remained problems could be solved through other activities such as integrated community forestry program to improve local community livelihood, no more political constituency problem and the park would have a better protection through local community participation and ownership promotion. Option 2 and 3 is not selected because they are not quite effective and even yield outcome in a longer period, which is not the national park wanted in the short time.

Recommendations are proposed for the client to consider in making a decision to choose alternative policy developed with incorporation of the constraint analysis beyond the client's jurisdiction. In the scenario I, the alternative policy " improving law enforcement" is recommended but a decision maker should not consider this option as a stand-alone mean to deal with a problem. With limited budget promoting public awareness could be employed to help stir up people mind for a long-term support and their understanding on biodiversity and its value. In the second scenario, even though, option 1 is recommended other activities should be taken into account to ensure the least consequence from this option. Community forestry would be an essential integrated approach to deal with shifting cultivators and poachers to abandon their unsustainable practice of harvesting on non-timber forest product and wildlife from the park and increase their livelihood. Cooperation with involved NGOs and involved project would be a stimulus to help strengthen the conservation policy.

8
CREATING ECONOMIC INCENTIVES FOR BIODIVERSITY CONSERVATION: AN EXIGENCY FOR SUSTAINABLE MOUNTAIN DEVELOPMENT

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Keywords: Management; Economic Valuation; Economic Incentives; Upstream-downstream Conflicts; Paying for Environmental Services

Mountains are hotspots of biological diversity. They are the habitat for many of the world's endemic and endangered species. Biological diversity in the mountains is one of mankind's most valuable natural resources (Stone 1992). Its conservation provides benefits at various levels-local, national and global. However, it is under imminent threat of environmental degradation and loss. A natural question is: why biodiversity is so threatened? This paper is an economic investigation into this question. It has been pointed out that together, market and policy failures are the main underlying causes of biodiversity loss. Absence of adequate economic incentives (positive as well as negative) or existence of 'perverse incentives' have played a distressing role in inducing unsustainable behaviour that results in depletion of biodiversity. As Article 11 of the Convention on Biological Diversity has rightly stated, it is important to adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity. This paper discusses why incentive mechanisms are significant for managing natural resources in mountain areas.

Mountains have been a locale for constant conflicts between environment and development objectives. The starting point for the evolution of an approach to sustainable development is to bring to an end to the conflicts between environment and development (Bandyopadhay 1992). Conserving biodiversity in mountain areas either through ecosystem approach or protected areas generates both costs and benefits. While major part of cost is borne by local mountain community, most of the benefits are accrued at national and global level. At local level, one major reason for unsustainable use of resources is this lower benefits and higher opportunity costs of conservation. (Perrings 1995). The existence of external costs leads to unsustainable way of managing mountain resources. Due to market failure, together with policy failures, mountain people do not have economic incentive not to take unsustainable type of land-use practices which may result in loss of ecosystem values and may have adverse impacts on non-local economy and environment. Since it is mountain communities' management of natural resources which determines the manner in which ecosystem services are available for development in the lowland communities, it is important to develop incentive mechanism to induce them to take sustainable land-use practices. This upstream-down stream resource use conflicts could be resolved to some extent by capturing and demonstrating economic values of mountain biodiversity. Economic valuation approach has been an important tool in identifying and quantifying some of the mountain ecosystem values. A review of various types of values and methods of valuation are discussed in this paper. It is to be noted, however, that mere valuation is not a panacea for solving resource use conflicts. Most important is to develop innovative incentive mechanisms by which mountain land users are compensated for the environmental services they generate. Paying for Environment Services (PES) is one such incentive mechanism, which is based on beneficiary pays principle, for solving upstream-downstream resource use conflicts. Costa Rica has the most advanced system of payments for environmental services. Land users who protect natural forests or reforest their land receive payments of about US $ 50/ha/year, financed from energy taxes, the sale of Carbon offsets and international donations for biodiversity conservation. Creating markets for environmental services raises challenging issues in policies and implementation. This paper discusses some of the major incentive mechanisms which have been developed and applied in some countries of the mountain world.

References

Bandyopadhyay, J. (1992). "The Himalaya: Prospects for and constraints on sustainable development". In The State of the World's Mountains edited by Stone, P.B, Zed Books, London.

Bandyopadhyay, J. (2000). Vision Statement for the Buxa Tiger Reserve in the Eastern Himalayan Region. Report submitted to West Bengal Forest Department under World Bank Project.

Bandyopadhyay, J. (1992. "Sustainability and Survival in the Mountain Context," Ambio 21(4) : 297-302.

Stone, P.B. (ed.) (1992). The State of the World's Mountains: A Global Report, Zed Books, London.

Perrings, C. (1995). "The Economic Value of Biodiversity," In Global Biodiversity Assessment, edited by Heywood, Cambridge University Press, London.

Chomitz, K.M; Esteban Brences and Luis Constantino (1998) Financing Environmental Services: The Costa Rican Experiences and its Implications.
http://lnweb18.worldbank.org/ESSD/essdext.nsf/44DocByUnid/6B8781730D0A31BA85256B750002812D/$FILE/FinancingEnvironmentalServicesTheCostaRicanExperienceandItsImplications1998.pdf

Bieberstein Koch-Weser Maritta R.v, and Walter Kahlenborn (2002). "Legal, Economic, and Compensation mechanisms in Support of Sustainable Mountain Development". Thematic Paper for Bishek Global Mountain Summit, UNEP.

9
DIVERSIDAD BIOLÓGICA EN LAS MONTAÑAS

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Keywords: Indigenous communities, Indigenous knowledge, Perú

Presentación

La presencia y supervivencia de los pueblos indígenas en el mundo es un hecho sin cuestionamientos, suman sólo el 4% de la población mundial, y viven en su mayoría en extrema pobreza. A pesar de su porcentaje reducido en relación al resto del mundo en sus territorios aún se mantiene el 95% de la diversidad biológica del planeta1. De ellos, unos 50 millones de indígenas viven en áreas de alta diversidad biológica, como lo son las selvas tropicales de la Amazonía y las zonas de Montaña.

El reconocimiento de las montañas como zonas de alta diversidad biológica, fue declarado en la "Reunión mundial de ecosistemas de montañas al 2002: Agua, vida y producción", realizada en la ciudad de Huaraz, y fue suscrita por Argentina, Austria, Bolivia, Colombia, Chile, Ecuador, Estados Unidos, Francia, Italia, México, Nepal, Países Bajos, Perú, Sudáfrica, Suiza y Venezuela. Además, de los pueblos y/o comunidades indígenas que viven en ellas y, de las cuales se ha reconocido la importancia del rol que cumplen sobre el manejo sostenible y conservación de esta diversidad.

El Perú, ha sido mencionado como uno los países megadiversos más importantes del planeta, debido a su gran capacidad para mantener en su territorio una diversidad de pisos ecológicos y un conjunto de microclimas (desde la región Chala o costa hasta la Cordillera); además, de ser considerado pluricultural y multilingüe, con una población indígena mayor al 30% del total de habitantes peruanos (9´000.000 hab.), con 14 familias lingüísticas y al menos 44 etnias distintas, de las cuales 2 se encuentran en la zona andina y 42 en la Amazonía.

En este sentido, esta diversidad expresa su inmenso potencial en recursos naturales en los que conviven diversos grupos indígenas, que poseen históricamente conocimientos importantes respecto a usos, propiedades, y técnicas de manejo de las especies provenientes de la diversidad existente. Ejemplo de ello, es el registro de **4400 especies de plantas nativas**, destacando las de propiedades alimenticias (782 especies), medicinales (1300 especies), ornamentales (1600 especies). Además, del uso de algunos productos como condimentos, tintes, cosméticas, etc.

Es por ello, que las políticas y acciones que se aprueben para los ecosistemas de montañas, deben considerar la presencia e importancia de la participación de los pueblos que las habitan, en la promoción y desarrollo sostenible a beneficio de estos pueblos.

Acciones y perspectivas de la CONAPA

El Gobierno del Perú, como parte de su política de disminución de la pobreza, y considerando que es deber del Estado, el propiciar la promoción, desarrollo e integración de las diferentes etnias y culturas que forman parte de la nación peruana, creó la Comisión Nacional de los Pueblos Andinos, Amazónicos y Afro peruanos – CONAPA, para apoyar los procesos de concertación con los diferentes sectores de la administración pública y privada, relacionadas con el tema, y dar participación directa a los representantes de los pueblos indígenas, a fin de lograr su desarrollo con identidad de manera sostenible.

El accionar de la CONAPA, se desarrolla en dos niveles: un nivel directivo, que la integran 25 miembros: una presidencia, 9 representantes de los pueblos indígenas y afro peruanos, 10 representantes del Estado peruano, y 5 reconocidos estudiosos de la temática indígena. El nivel operativo, organizado a través de una Secretaría que asiste técnica y administrativamente a la Comisión y a la Presidencia.

La finalidad de esta Comisión es: promover, coordinar, dirigir, ejecutar, supervisar, y evaluar las políticas, programas, y proyectos correspondientes a las poblaciones comprendidas, dentro del marco de las normas y principios establecidos en los Tratados Internacionales sobre la materia de los que sea parte la República del Perú.

Uno de los aportes realizados por la CONAPA para con los pueblos indígenas, fue la presentación de la propuesta ley sobre un régimen que establece la protección de los conocimientos colectivos de los pueblos indígenas vinculados a los recursos biológicos, ley que fue promulgada en agosto del pasado año. En la ley **N° 27811** "el Estado peruano reconoce el derecho y la facultad de los pueblos y comunidades indígenas de decidir sobre sus conocimientos colectivos".

Dentro de los objetivos de la ley, podemos mencionar los siguientes:

- Promover el respeto, la protección, la preservación, la aplicación más amplia y el desarrollo de los conocimientos colectivos de los pueblos indígenas.
- promover la distribución justa y equitativa de los beneficios derivados de la utilización de estos conocimientos colectivos.
- Promover el uso de estos conocimientos en beneficio de los pueblos indígenas y de la humanidad.
- Garantizar que el uso de los conocimientos se realice con el consentimiento informado previo de los pueblos indígenas.
- Promover el fortalecimiento y el desarrollo de las capacidades de los pueblos indígenas y de los mecanismos tradicionalmente empleados por ellos para compartir y distribuir beneficios generados colectivamente, en el marco del presente régimen.
- Evitar se concedan patentes a invenciones obtenidas o desarrolladas a partir de conocimientos colectivos de los pueblos indígenas del Perú, sin que se tomen en cuenta estos conocimientos como antecedentes en el examen de novedad y nivel inventivo de dichas invenciones.

Así mismo, esta ley establece principios generales para el acceso a los conocimientos colectivos con fines de aplicación científica, comercial e industrial previa consulta y proporcionando la información respectiva a los representantes de los pueblos.

En caso de acceso con fines de aplicación comercial o industrial, estipula que, se deberá suscribir una licencia donde se prevean condiciones para una adecuada retribución por dicho acceso y se garantice una distribución equitativa de los beneficios derivados de los mismos.

Por otro lado, esta ley muestra los siguientes beneficios:

- Reconoce a los pueblos indígenas.
- Inalienabilidad e imprescriptibilidad de los derechos: Patrimonio cultural.
- Fondo Indígena manejado por indígenas.
- Licencias de uso establece condiciones mínimas para el acceso.
- Reconoce rol del derecho consuetudinario.
- INDECOPI vela por la prevención de la biopiratería.

Referencias bibliográficas

Grupo Internacional de trabajo sobre asuntos indígenas. Copenhague.2000.125p

10
DIVERSITAS: AN INTERNATIONAL PROGRAMME OF BIODIVERSITY SCIENCE

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Keywords: biodiversity, international programme, social and natural sciences, policy

Why do we need an international programme on biodiversity?

During the long history of life, Earth has experienced several periods of mass extinction. But the current extinction "crisis" differs from the previous ones in that it is occurring at an unprecedented rate, and is the direct result of human activities. Erosion of biodiversity occurs at various levels, from the genetic diversity of many natural and domesticated species to the diversity of our planet's ecosystems and landscapes, through the tremendous richness of species. Biodiversity loss is a matter of concern, not only because of the aesthetic, ethical or cultural values attached to biodiversity, but also because it could have numerous far-reaching, often unanticipated, consequences for our life-support system. The capacity of natural and managed ecosystems to deliver ecological services (e.g. production of food and fibre, resistance to climate and other environmental changes) could be reduced. Assessing the causes and consequences of biodiversity changes, and establishing the bases for the conservation and sustainable use of biodiversity, are major scientific challenges of our time.

The past decade has seen the birth of the Convention on Biological Diversity (CBD), of many conservation programmes aimed at protecting biodiversity, as well as many national research programmes dedicated to developing biodiversity science. Scientific efforts, however, need international co-ordination to address the complex scientific questions posed by the loss and change of biodiversity globally, as well as a research framework integrated across disciplines. DIVERSITAS provides such an international framework.

The missions of DIVERSITAS are:

1) to promote integrative biodiversity science, linking biological, ecological and social disciplines in an effort to produce socially relevant new knowledge;
2) to provide the scientific basis for an understanding of biodiversity loss, and to draw out the implications for policies for conservation and sustainable use of biodiversity.

To achieve this mission, the DIVERSITAS Science Plan is articulated around three complementary and interdisciplinary core projects (Figure 1).

Core Project 1 "Discovering biodiversity and predicting its changes"

Core Project 1 addresses the following questions:

3) How much biodiversity is there? (Focus 1.1)

Despite the growing interest in biodiversity during the last decades, our knowledge of the true diversity of life that inhabits our planet is still very limited and fragmentary. This focus was designed specifically to promote research on poorly known organisms, and on habitats and geographic areas that have received insufficient attention. Of special importance are micro-organisms, including, bacteria, archaea, and many protist and fungal lineages, which are currently discovering thanks to new molecular techniques (e.g., Lopez-Garcia et al. 2001) and which probably fulfil important functions in biogeochemical cycles.

4) How and why is biodiversity changing? (Focus 1.2)

The assessment of the state and change of biodiversity requires monitoring at the relevant scales of space and time. These scales can vary from days to years and from fractions of a metre to thousands of kilometres. Monitoring is essential to evaluate the success or failure of conservation and restoration measures (e.g. in the framework of the Convention on Biological Diversity) and to calibrate and validate models and scenarios.

The objective of this focus is to develop the scientific basis for monitoring biodiversity, as well as the tools of monitoring and their use.

5) How can we predict biodiversity changes? (Focus 1.3)

The aim of this focus is to improve our capacity to predict and hence to respond to biodiversity loss. The basic knowledge obtained will help identify the likely biodiversity effects of anthropogenic changes at different spatial and temporal scales, and the sensitivity of those effects to variation in climatic and economic conditions. This knowledge is essential if decision makers are to be able to assess the relative costs and benefits of different resource use options. It will support a range of decision-tools, including scenario building.

Core Project 2 "Assessing impacts of biodiversity changes"

The goal of Core Project 2 is to understand the consequences of biodiversity changes on ecosystem functioning and goods and services (Focus 2.1). It investigates how the biodiversity changes studied and predicted in Core Project 1 affect ecosystem functioning and ecosystem services, thereby influencing strategies for the conservation and sustainable use of biodiversity (Core Project 3). A particular emphasis, within the context of ecological services, is placed on impacts of biodiversity changes on human health (Focus 2.2). Historically, approaches to the study of emerging diseases in humans have focused on treating infectious agents and producing medicines to combat them. These approaches have not generally placed infectious agents (virus, parasites, microbes) in their ecological context, nor examined the complex factors leading to emergence of diseases. The ultimate goal of this ecological approach is to contribute to developing a broader, predictive science of infectious diseases.

Core Project 3 "Developing the science of conservation and sustainable use of biodiversity"

Core Project 3, assesses the effectiveness of current regulatory measures and incentives to protect biodiversity, investigates alternative social, political and economic motivators for biodiversity protection, and establishes a scientific approach for optimising multiple use of biodiversity, considering possible trade-offs between economic and environmental goals. The first focus of Core Project 3 has two objectives:

1) the scientific evaluation of the effectiveness of existing conservation measures;
2) the identification of the socio-economic causes of the failure of conservation measures.

The two objectives of the second focus (Focus 3.2) are:

1) to identify the economic consequences of biodiversity change in particular systems or landscapes, to evaluate the trade-offs involved in alternative strategies, and to identify the scope for biodiversity enhancement;
2) to develop the scientific basis of precautionary decision-making, and to apply this in specific cases.

Cross-cutting networks

In addition to these three thematic core projects, a few integrated cross-cutting networks, which embrace issues addressed in all the core projects, are currently being developed around particular topics or ecosystems.

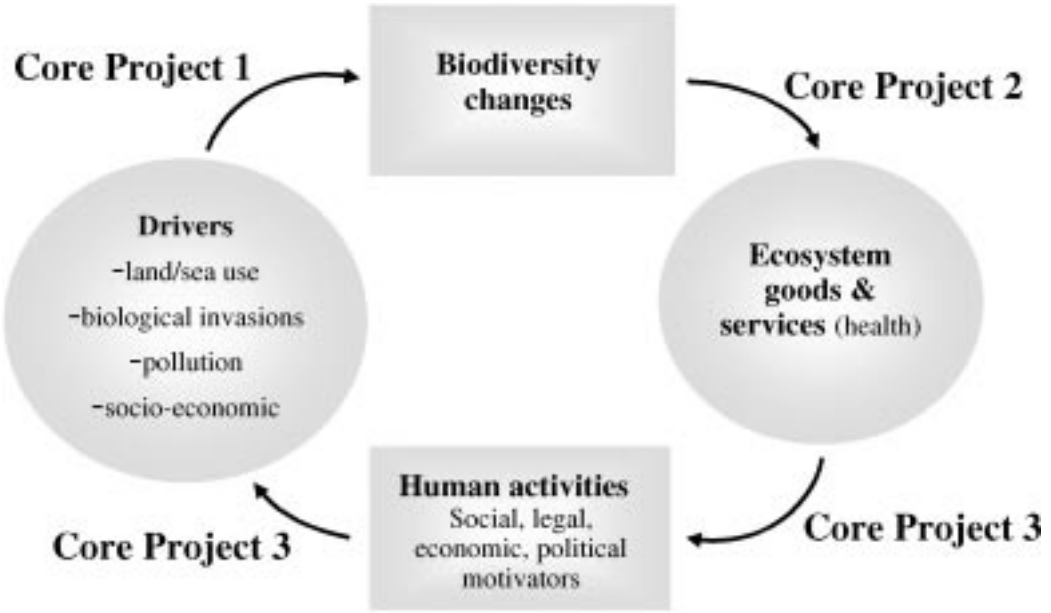
1) The Global Mountain Biodiversity Assessment (GMBA) just released the first assessment of mountain biodiversity (Körner & Spehn 2002) and is currently contributing to the Convention on Biological Diversity in the context of the International Year of the Mountain (see the poster from E. Spehn and C. Körner "Global Mountain Biodiversity Assessment (GMBA): a DIVERSITAS network") and to the Millenium Assessment.
2) The Global Invasive Species Programme (GISP): a framework for international cooperation and capacity building to address the issues of invasive alien species.
3) The International Biodiversity Observation Year (IBOY): a window in time (2001-2002) in which scientists and educators across the world are joining forces to increase communication of important science-based information about biodiversity to a broad audience.

References

Körner, C., and Spehn, E. (2002). *Mountain Biodiversity - A Global Assessment*, Parthenon Publishing, Switzerland, 350 pp.
Lopez-Garcia, P., Rodriguez-Valera, F., Pedros-Alios, C., and Moreira, D. (2001). "Unexpected diversity of small eukaryotes in deep-sea Antartic plankton" *Nature* 409: 603-607.

Figure 1.

The three Core Projects of DIVERSITAS



11
ECONOMIC COMPENSATION MECHANISMS IN SUPPORT OF SUSTAINABLE USE OF MOUNTAIN ECOSYSTEMS

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Keywords: compensation schemes, payment for environmental services, prevention

Introduction

Mountain forests still stretch over 9 million square kilometres and represent 28 % of the world's closed forest area. The observable global trend towards environmental degradation in mountain areas is partly caused by the extreme fragility of mountain ecosystems, which is due to its high geomorphic energy, steepness, isolation, and low temperatures, which cause vegetation growth and soil formation to occur very slowly. Thus, soils are usually thin, young, and highly erodible. Mountain ecosystems also need hundreds of years to recover. These conditions set mountain ecosystems apart from all other global ecosystems and foster the quick emergence of scenarios of environmental imbalance and un-sustainable use. Mountain communities are often very poor, isolated and uneducated about sustainable forestry and agricultural practices, while population growth forces them into even higher, more fragile areas.

Despite the benefits that mountain forests provide to people, they have been disappearing at a startling rate in the last decade. The results of mountain ecosystem degradation through clear-cuts and unsustainable forestry and agricultural practices are tremendous and costly to downstream water users. Besides decreasing biodiversity, results include drier aquifers and wells, siltation of hydropower and irrigation reservoirs through erosion, and less water in the dry season. Agricultural run-off spoils the purity of renewable sources of freshwater. It also increases the likelihood of natural hazards such as avalanches and landslides. Floods that start in deforested mountain ranges cause the highest costs. Damages on property and infrastructure sum up globally to tens of billions of Dollars every year.

Case studies: Payment for environmental services

Environmental services provided by mountains are often only noticed when they are lost as in the case of downstream floods caused by upstream deforestation. For half of humanity depends on fresh water that originates in mountain watersheds, solving these problems is highly important for global environmental security. One promising instrument are payments for environmental services (PES). Although it is still little known and rarely used, the cases known follow an easy principle. Water users compensate the watershed's upstream forest owners and land holders for e.g. forest conservation or reforestation, or to maintain or improve water quantity or quality downstream. By giving an economic value to the environmental services provided by forests, ecosystem protection becomes an equal alternative to other land uses pursued by the forest owner.

Most of the cases worldwide that involve payments for environmental services are in South America, but experiences exist in other regions of the world as well. Those cases were considered that involve compensation schemes between downstream beneficiaries and upstream suppliers of environmental services in mountain regions. In most cases, either hydroelectric companies, which are highly dependent on forest cover in the upstream areas of the watershed in order to avoid siltation of their dams, or public or private entities which depend on high water quality for drinking purposes, compensated upstream forest owners or farmers for sustainable management resp. farming practices.

Result

Apart from the particular scheme, the cases assessed (see table 1) have some common features. Firstly, the environmental service underlying the different agreements is almost always water, although when facing siltation of irrigation channels soil erosion is the major issue. Especially under public payment schemes, upstream landowners might also be compensated for the protection of biodiversity and scenic beauty (e.g. the FONAFIFO program in Costa Rica). Secondly, there is usually little interaction between upstream communities and downstream water users. Thirdly, problems in the lowlands of watersheds served as incentives for setting up a scheme that compensates upstream land owners for the environmental services of their forests, i.e. the agreements are problem-driven. Fourthly, in most cases the expected benefits have not been evaluated. The price paid for ecological services has rather been set by political or budgetary considerations.

In the case of self-organized private deals government involvement is minimal or non-existent and payments are made voluntarily by the downstream partner, which is either a private company or a farmer association. Those cases can be found on the (sub-)watershed level where an agreement provides private downstream entities with water services at a lower cost than traditional treatment approaches. Trading schemes occur where governments set either a very strict water quality standard or a cap on total pollution emissions. In Australia, the government aimed at addressing a national problem by replanting forests and trading salinity reduction credits to downstream farmers. Public payment schemes are the most common mechanism. A government entity finances upstream conservation activities or reforestation from general tax revenues or water user fees. The money usually goes into a fund which is managed by a public-private council (see New York).

Conclusion

Downstream water users such as farmers and hydroelectric companies have an interest in watershed protection. An existing strong legal and regulatory framework as the FONAFIFO Fund in Costa Rica helps setting up local schemes because it reduces transaction costs of establishing and maintaining the mechanism.

Public-private partnerships seem to work well in this sector. Private participation is usually high and participants are highly motivated. Public-private partnerships are most likely to occur when the private side is well organised and the public institution involved has an interest in watershed protection. In most cases, it is the Ministry for the Environment or an associated regional or local authority.

Payments for environmental services must be granted for many years in order to guarantee a long-term change to sustainable land uses and agricultural practices. Ideally, the contract states that the upstream partner has to sustainably manage his resources for a certain time, even after the payments will have ended as it is part of the FONAFIFO agreements in Costa Rica. Otherwise, farmers might be tempted to clear-cut their forests after they stopped receiving compensation for their services.

Although Payment for Environmental Services Schemes in mountain regions are not much different from similar schemes dealing with water resources in the plains, they are even rarer. An option to quickly raise their numbers would be to integrate mountain areas into existing comprehensive environmental payment programs as the Conservation Reserve Program in the USA (CRP). Similar programs exist in many countries.

“Overall, there is no blueprint mechanism that fits all situations – innovative mechanisms will be site-specific, will often involve elements of different approaches, and will vary depending on the nature of the ecosystem services, the number and diversity of stakeholders, and the legal and regulatory framework in place” (Johnson/White/Perrot- Maître 2001).

References

Johnson, Nels; Andy White; Danièle Perrot-Maître (2001): Developing Markets for Water Services from Forests: Issues and Lessons for Innovators.
Koch-Weser, Maritta R. v. Bieberstein; Walter Kahlenborn (2002): Legal, economic, and compensation mechanisms in support of sustainable mountain development. Bishkek Global Mountain Summit, Thematic Paper B1; *http://www.globalmountainsummit.org/papers/B1.doc*

Table 1.

on the various cases of Payments for Environmental Services

	Problems downstream	Nature of the environmental service upstream	Who pays (categories)	Who receives	Involvement of public authorities	Kind of compensation	Legal set-up
Australia Murray-Darling watershed	Soil salinisation	Reforestation	Downstream farmer association	Government agency, private up-stream land owners	Major involvement; public agency reforests and sells salinity reduction credits	Yearly payments per ha reforested land for 10 years	Trading scheme
Colombia Cauca river basin	water scarcity, siltation of irrigation channels, floods	Reforestation, erosion control, spring & stream protection	Downstream farmer associations	Government agency, private Àup-stream land owners	Minimal; Agency only designs management plans and distributes the money	Individual contracts	Private deal
Costa Rica Hydroelectric companies	Siltation of hydro-electric dams, irre-gular stream flow	Reforestation, sus-tainable forestry, forest preservation	Hydroelectric companies, go-vernment fund	Private upstream land owners	Minimal; provides frame-work for payments, serves as mediator, increases pays	Yearly payments per ha enrolled land for 5 years	Private deal, (F-onafifo)
Ecuador Watershed con-servation fund, Quito	Decreasing water quality & quantity	Patrolling the reserve, change in land use practices	Water users	Fund, private upstream land owners	Major involvement; agency collects fee and undertakes compensation measures	Individual contracts	Public payment scheme, fee
France Rhin-Meuse watershed	Decreasing quality of spring water	Reduction of nutrient runoff and the use of pesticides	Private bottler of mineral water (Perrier)	Upstream farmers	Non-existent	Yearly payments / ha for 18-30 years, pays new equipmnt	Private deal
Philippines Makiling Forest Reserve	Decreasing water quality & quantity		Users of recre-ation facilities, water users	Fund	University plays a major role		
Germany Mangfall Valley Munich	Decreasing quality of drinking water	Sustainable dairy far-ming and agricultural practices (eco-farms)	Private water supplier	Upstream farmers	Non-existent	Yearly payments / ha for 18 years, finances prof. advice	Private deal
USA Catskill/Delaw-are watersheds - New York City	Decreasing quality of drinking water	Implementation of Whole Farm Plans and best management practices	City and water users (tax on water bills)	Upstream farmers	Major involvement; NYC completely finances the program	Covering of additional costs of mana-gement change, re-duced property tax	Public payment scheme, tax
USA CRP	Soil erosion, decreasing water quality	Reforestation, implementation of conservation practices	Government	Farmers	Major involvement; the government completely finances the program	Yearly payments per ha for 10-15 years	Public payment scheme

12
GEF PROJECTS IN MOUNTAIN REGIONS

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Keywords: Management, cooperation, funding

The Global Environment Facility (GEF) funds projects focused on biodiversity conservation, climate change, degradation of international waters and ozone depletion. GEF was the only new funding source to emerge from the 1992 Earth Summit. In its first decade it has allocated $4 billion, supplemented by $12.4 billion in co-financing, to over 1000 environmental projects in developing countries and those with transitional economies.

The GEF mountain biodiversity portfolio is wide-ranging, with over 100 projects. Topics range from renewable energy generation for isolated mountain communities to in-situ conservation and sustainable forest management. Most focus on protected areas and their surroundings. The projects are mapped based on a descriptive dataset of GEF project locations rather than a set of co-ordinates.

This map was compared with the map of areas of exceptional biodiversity generated for Mountain Watch (UNEP-WCMC 2002). In Latin America, three major projects focus on the Andes region, Sierra Nevada and other montane forest in Colombia, with two more at the Southern end of the Andes in Ecuador. The Cordillera de Talamanca in Costa Rica forms another exceptional area with GEF projects. Other projects cluster around the important areas in Bolivia and Peru. The concordance is true for other continents: for example, three projects were identified around the exceptional biodiversity area in the Caucasus mountains of Armenia and Georgia.

Some exceptional areas do not appear to have GEF mountain projects, but research indicates that past funding or present projects that are excluded by the dataset definition have occurred there. This is true for the Guayanan highlands of Suriname, Atlantic forests of Brazil and montane fynbos of South Africa. The Bornean montane rainforests truly do appear to represent a gap in provision: this might be an excellent site for a future GEF project.

References

UNEP World Conservation Monitoring Centre. (2002). Mountain Watch. UNEP-WCMC, Cambridge, UK.

ILLUSTRATIONS

Figure 1.

This map illustrates the approximate locations of large and medium-sized GEF projects 1) that are categorised under the GEF mountain ecosystem operational program (OP4) and 2) whose project area includes mountains, but which are categorised under other operational programs in the Biodiversity Focal Area. Projects operating over a global scale, or for which it was otherwise difficult to locate a centre point, were omitted from this map. The following definition of "mountains" was employed to identify these projects:
Three-dimensional towering features that have conspicuity and are over 1000m above sea levels.
As this is a more narrow definition than that of *Mountain Watch*, some GEF projects within our mountain regions may have been omitted.

13
GLOBAL ANALYSIS OF VALUES AND PRESSURES IN MOUNTAIN ECOSYSTEMS

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Keywords: Biodiversity status, pressures and threats

Many mountain ecosystems have high biodiversity, in terms of species richness and degree of endemism, in comparison with adjacent lowlands. In more developed regions, this difference is accentuated by the extensive modifications that have been made to lowland ecosystems for agriculture, settlement and infrastructure.

The compilation of six pressure maps identified mountain areas undergoing multiple severe pressures. The pressures considered here were fire occurrence, seismic hazard, human conflict, future impacts of infrastructure, climate change simulations and suitability for rain-fed crops. This information was brought together with three datasets on areas of importance for biodiversity: BirdLife International Endemic Bird Areas (Stattersfield et al., 1998), Centres of Plant Diversity (WWF & IUCN, 1994), and areas of significance for global amphibian diversity (Duellman, 1999). The map featured here uses a simple overlay to show the number of pressures experienced in important areas for these three types of organism in mountain regions worldwide.

This is a preliminary analysis: several pressures of known significance for mountain systems have not been included. Ideally, a measure of deforestation risk and an assessment of suitability for other agricultural practices such as grazing would be included. Habitat fragmentation and invasive species also have direct impacts on biodiversity. Future analyses should incorporate comprehensive assessments of different pressures, including those of particular importance within specific regions. Assessments of the area affected or likely to be affected by different pressures could be used as indicators of sustainable development. In future, it would be useful to integrate data on pressures with other values and services, to assess the impacts of change on the provision of water, forest resources or food.

This analysis identified several areas of concern, which experience or are projected to undergo at least three severe pressures, and fall within three priority areas for biodiversity conservation. They are located primarily in South America and Eurasia, with a third group in North America, and constitute a very small proportion of total land area. These areas for particular concern include:

- The North-Western Andean moist forest and Magdalena Valley of South America
- The Caucasus mixed forests ecoregion
- Several montane ecoregions in California

References

Duellman, W.E. (1999). *Patterns of distribution of amphibians: a global perspective*. John Hopkins University Press, Baltimore, USA.

Stattersfield, A.J., Crosby, M.J., Long, A.J. & Wege, D.C. (1998). *Endemic bird areas of the world.* Birdlife International, Cambridge, UK.

UNEP World Conservation Monitoring Centre (2002). *Mountain Watch.* UNEP-WCMC, Cambridge, UK.

WWF & IUCN (1994). *Centres of plant diversity. A guide and strategy for their conservation.* IUCN Publications Unit, Cambridge, UK.

ILLUSTRATIONS

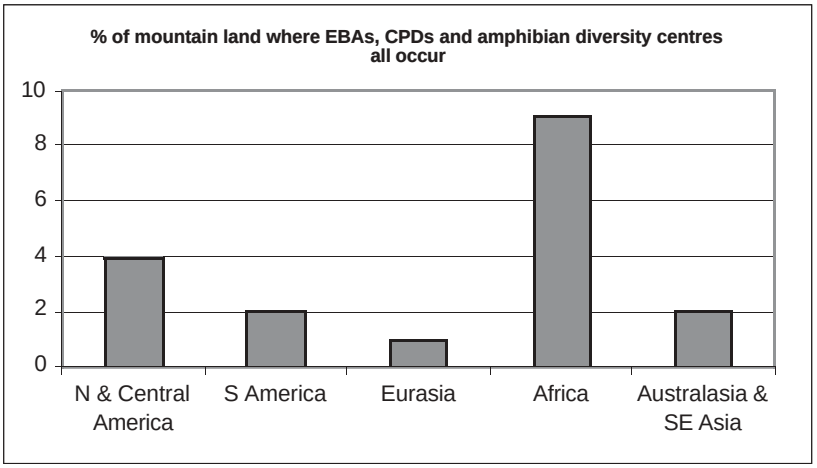
Figure 1.

Severe pressures in mountain areas of importance for biodiversity.

Mountain pressure and valus synthesis

Figure 2.

Percentage of mountain land where Endemic Bird Areas, Centres of Plant Diversity and Amphibian Diversity Hotspots all occur.



14
GLOBAL MOUNTAIN BIODIVERSITY ASSESSMENT (GMBA): A DIVERSITAS NETWORK

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Keywords: research network, biological richness, global change, slope stability, ecosystem function

The GMBA network- aims and activities

The Global Mountain Biodiversity Assessment (GMBA) of DIVERSITAS aims at a global assessment of the biological richness of high elevation biota (Fig. 1), including all organismic groups and all hierarchical levels of biodiversity (from gene to landscape). Beyond description, GMBA aims at explaining the causes of biological richness in mountains and its change in time. Mountains provide an excellent opportunity for such a global research network, as they exist in every climatic zone. GMBA was initiated by the Swiss Academy of Sciences and inaugurated under the patronage of DIVERSITAS, at the 1st International Conference on Mountain Biodiversity in Rigi-Kaltbad (Switzerland) in Sept. 2000. In 2002, GMBA became part of the new DIVERSITAS science plan.

The GMBA network activities aim at:
- documenting and synthesising knowledge on the great biological richness of the mountains of the world and the change of this richness through direct and indirect human influences ("global change")
- investigating the mechanisms which create and maintain mountain biodiversity and the functional consequences in both natural and rural high-elevation terrains
- stimulating new research activities with a comparative emphasis and of a large scale scope
- forming of consortia for joint research and platform for peer evaluations of contributions for coordinated research initiatives (e.g. in the frame of DIVERSITAS, the Mountain Research Initiative (MRI) of IGBP, IHDP, GTOS and UNESCO MAB, GCTEs Focus 4, UNEP)
- shaping a corporate identity of the global scientific community on mountain biodiversity research
- communicating findings and engage in dialogs with national and international policy forums

Workshops are hold on specific mountain biodiversity topics (land use, genetic diversity, ecosystem function, climate change, alpine invertebrate diversity). Further, we are told to give scientific advise in the process of preparing documents for the Convention on Biological Diversity on "Mountain Biodiversity". GMBA members will also be actively involved in developing the Chapter 28 on "Mountain ecosystems" for the Millenium Ecosystem Assessment (Conditions and Trends).

Mountain Biodiversity

The montane and alpine zone together cover nearly 5% of the global terrestrial land area (or nearly twice as much if cold and hot deserts are disregarded). The treeless alpine life zone alone accounts for ca. 3% of the land area. Often considered barren, it hosts a vast biological richness, exceeding that of many low elevation biota. The overall global plant species richness of the alpine life zone alone (i.e. above the treeline) was estimated to be around 10,000 species, 4% of the global number of higher plant species. No such estimates exist for animals, but based on flowering plants, high elevation biota are richer in species than might be expected from the land area they cover. Within the alpine zone, the total plant species diversity of a given region commonly declines by about 40 species of vascular plants per 100 m of elevation (Körner, 2002). The upper montane forest, its substitute pasture land and the often fragmented treeline ecotone also host a wealth of organismic diversity, often exceeding that in the alpine life zone.

The causes of high biological diversity are manifold. Mountain terrain is commonly highly fragmented and topographically diverse and this high geodiversity is strongly related with biological diversity, as it reflects the multitude of life conditions in a given area. Other causes of high biological richness in mountains are the small size of organisms, geographical isolation and moderate disturbance. Biological richness is considered essential for the persistent functioning and integrity of mountain ecosystems and this dependency is likely to increase as environmental conditions change.

Mountain biodiversity is perhaps the best indicator value of the integrity of mountain ecosystems. Functional implications of high mountain biodiversity for ecosystem integrity are largely related to slope stability, the centrepiece of any mountain ecology (Körner 2002). Traffic routes, settlements, streams and lakes, but also water reservoirs depend on the integrity of upslope systems and mountain hydrology is strongly influenced by the type of vegetation and its stability.

Land use change and biodiversity in tropical and subtropical mountains

Given that changes in biodiversity most often result from human land use, a specific GMBA agenda is the assessment of land management consequences. It is encouraging that traditional upland grazing systems and land management have contributed to the establishment of rich biota in a sustainable way. This traditional knowledge currently either becomes lost as traditional landuse modes disappear or gets overrun by population pressure and poverty, mainly in the tropics and subtropics. In general, sustainable land use in mountains should mainly target the integrity of soils, the prime capital for both human needs and biological richness. It commonly needs a suit of taxa to fulfill these mechanical demands of soil protection in steep terrain under varying environmental conditions and herbivory pressure. This is where the maintenance of biodiversity, soil conservation and sustainable agriculture merge and become partners.

GMBA, in cooperation with FAO, UNESCO and the Swiss Agency for Development and Cooperation organise two workshops on the biological richness of upland biota under human influence, trying to link mountain diversity with fire, grazing and erosion. The first workshop was held as part of the 6th international conference of the African Mountains Association in August 2002 in Moshi, Tanzania. A similar workshop will be organized in the Andes (La Paz, August 2003), with hopes to link experiences on mountain research from both continents. Insights from these symposia and activities will be published in a synthesis book and hopefully feed into the Millennium Ecosystem Assessment and CBD.

Future Biodiversity Research in Mountains

Biodiversity reseach is often seen as an inventory effort and we certainly need more and better (i.e. in terms of comparability) documents of what the biological richness of regional mountain biota is. However, science needs to underpin the functional significance of biodiversity with facts, on top of the general esthetical, aesthetical, cultural and economic attributes.
In other words,

1. both available and future inventories of biological richness need to be analysed by quantitative methods in order to distill functional linkages to abiotic and biotic determinants.
2. We do need empirical evidence for the insurance hypothesis, the strongest scientific foothold for the need of diversity for the sustained integrity of ecosystems.
3. Diversity driven ecosystem services, such as productivity of upland pastures or erosion control need to be demonstrated and quantified, which requires experiments.
4. Research needs to explore management scenarios, which serve both the sustained integrity of diverse mountain biota and human needs.

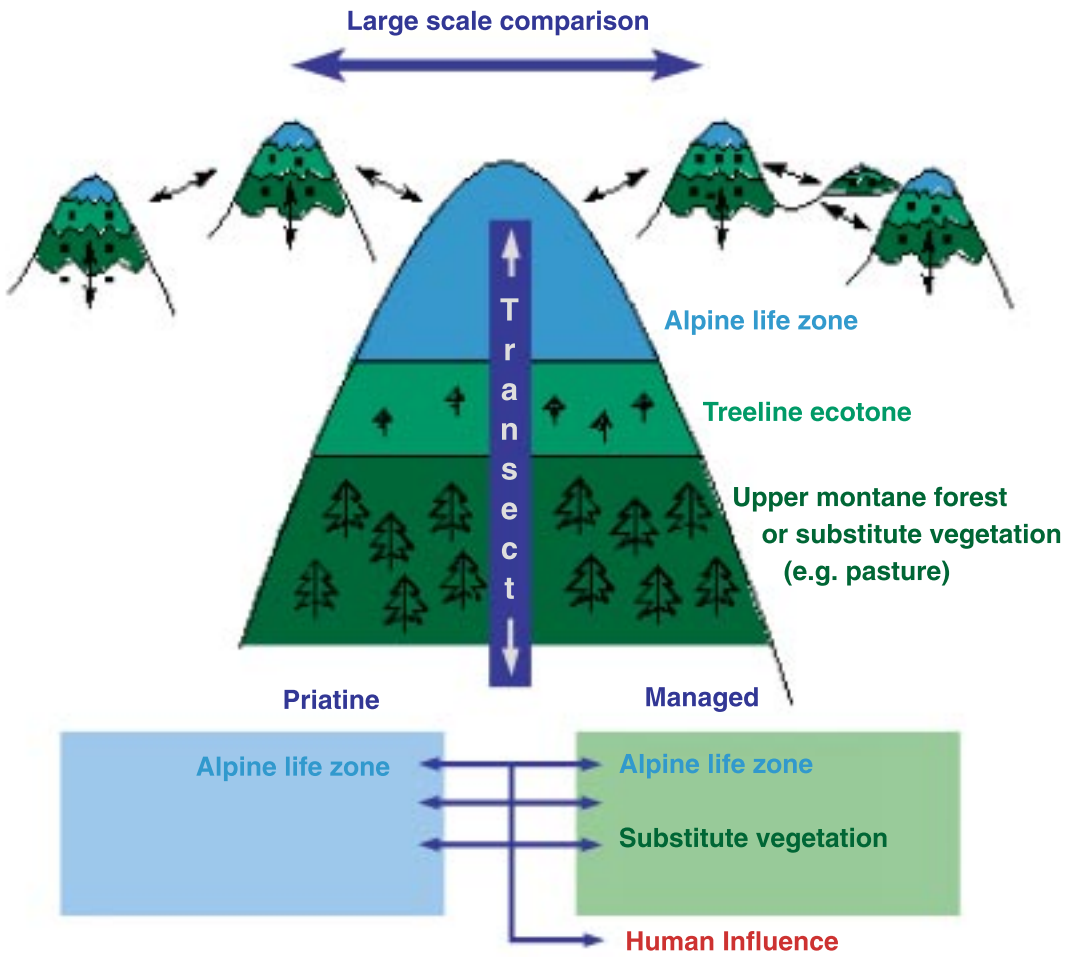
The current basis on which the benefits of diversity and the potential drawbacks of change can be judged is thin. Much of the current debate leans on observational, plausibility oriented and theory based reasoning. Future assessments of mountain biodiversity need to develop a deeper and more functionally oriented search for answers, one of the major tasks of the Global Mountain Biodiversity Assessment and its international networking activity.

References

Körner, Ch. (2002). "Mountain biodiversity: its causes and function," in Mountain Biodiversity: a global assessment, edited by Körner Ch and Spehn EM, Parthenon, London, New York

Figure 1.

GMBA focuses on biodiversity of high mountains worldwide



15
HIGH-MOUNTAIN VEGETATION OF THE CAUCASUS: DIVERSITY, ECOLOGY

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Keywords: Caucasus, vegetation, plant communities

The high-mountains of the Caucasus, in contrast with other mountain systems of Western Eurasia, are distinguished by strongly contrasted physical-geographical and especially climatic conditions that contribute to the high diversity of vegetation communities. This area is represented with relict (Neocene) thermo-mesophilic and hygrophilic (Kolkhida) as well as xerophilic vegetation (Southern-Eastern part of the Caucasus).

The flora of the Caucasus comprises 6350 native species of vascular plants, 900 mosses and 1500 lichens. Of the 6350 vascular plants, 1600 species are endemic. For example, in the Kazbegi region, 203 of the 761 high mountain (>1900 m a.s.l.) vascular plant species are endemic. The highest percentage of endemism is estimated to be in the subnival zone.

All latitudinal belts characteristic for mountains are well represented in the Caucasus. Timberline vegetation of Kolkhida (especially southern Kolkhida) are developed in super-humid conditions (> 4000 mm precipitation). Peculiarity of this vegetation is Krummhoz and prostrate life form of trees (*Betula litwinowii, B. medwedewii, Quercus pontica, Sorbus boissieri*) and evergreen shrubs (*Rhododendron caucasicum, R. ponticum, R. ungerni, Laurocerasus officinalis,* etc.) with dominance of local-endemic species (Fig. 1). Drastically different is southern-eastern part of the Caucasus (500-600 mm precipitation) – typical xerophilic vegetation (steppe, tragacanth, junipers, etc.) is spread up to the alpine belt (2500-26000 m a.s.l.). Timberline (2200-2600 m a.s.l.) is shifted down for about 300-400 meters – direct anthropogenic influence.

One of the distinguishing features of high-mountain vegetation of the Caucasus is developing of subalpine tall-herbaceous plant communities which are characterized by high diversity and endemism (*Heracleum sosnowskyi, Gadellia lactiflora, Lilium monadelphum, Angelica tatianae,* etc.). Tall-herbaceous plants (megaphorbia) are well developed in conditions of high humidity of air and soil (especially during high horizontal precipitation). At one unit of area (e.g. 1 m^2 or 25 m^2) the diversity is not high (6-15 species). Most peculiar feature of this vegetation is their ability to develop quickly (reaching 2,5-3 m in height) in a short period of time.

Meadows are abundant in open forest in areas with a moist temperate climate. Herb meadows typically occupy level sites, depressions and slopes of northern and north-westerly exposure but often slopes of southern exposures at the treeline ecotone (*Scabiosa caucasica, Anemone fasciculata, Betonica macrantha,* etc.). Their dominants are mainly broad-leaved herbaceous plants. Xero-mesophytic grass meadows are predominantly found on southern slopes and on plateaux. They often ascend beyond the treeline ecotone up to 2700 m. Wet meadows occur near springs, streams and rivers. Steppe-like meadows (mountain steppes) develop in more humid and less warm climatic conditions. Feather-grass steppes (*Stipa pennata, S. capilata,* etc.), which in some places reach the alpine zone, are mostly found in the Minor Caucasus (Fig. 2) and in the eastern part of the Greater Caucasus (e.g. Daghestan and Pirikita Khevsureti).

The alpine zone is dominated by short grass meadows, carpet-like alpine meadows, alternating with *Rhododendron caucasicum* dwarf-shrub and open rock and scree vegetation. The alpine meadows include tussock grass and sedge meadows, herb-rich meadows and tussocky grass-herb meadows (Fig 2). Snowbed communities occur in the upper part of the alpine zone usually as patches among large boulders. Short-cropped secondary carpet-like vegetation, caused by heavy grazing and enriched in meadow elements (especially *Alchemilla* species), occupy considerable areas. Steep northern slopes are covered by shrubs of *Rhododendron caucasicum* ("Dekiani" in Georgian) up to 2700--2800 m. Chionophilous communities of *Daphne glomerata* are very characteristic of

Kavkasioni. Prostrate shrub communities of *Dryas caucasica* favour cold stony slopes of northern exposure. The rock and scree vegetation shows a strong similarity to the upper alpine meadows and dwarf-herb meadows. They are characterized by a high degree of endemism, which reaches its highest rates in Dagestan, Eastern Caucasus, and the Colchis, Western Caucasus.

Despite the harsh environment, over 200 species of vascular plants occur in the subnival zone of the Greater Caucasus with 109 of them exclusively growing there. The upper limit of plant distribution varies; in the highest regions of the Caucasus (Svaneti, Kazbegi) it reaches 3950 m a.s.l., while it is 3600 m in the continental Daghestan and 4000 m on Mount Aragats, Minor Caucasus. The total number of phanerogamic plant species above 3200 m is 94 for the whole of the Caucasus; in the Central Caucasus, 34 species grow above 3350 m, whereas in the Minor Caucasus only nine species reach 3800 m (Aragats). Local endemic species grow in close proximity to the snow line. For example, in the Western Caucasus, the Caucasian endemic *Saxifraga scleropoda* reaches 4000 m altitude, with Cerastium kazbek at 3950 m in the Central Caucasus, and Draba araratica at 4000 m on Mt. Aragats. Typical subnival species found at 3600--3800 m are, e.g., *Alopecurus dasyanthus, Cerastium pseudokasbek, Colpodium versicolor, Draba supranivalis, Pseudovesicaria digitata, Saxifraga moschata, S. exarata, S. flagellaris, Senecio karjagini, Tripleurospermum subnivale, Veronica minuta* and *V. telephiifolia*. A number of endemic species and genera occur in the subnival zone: monotypic genera -- *Pseudovesicaria* (Brassicaceae), *Symphyoloma* (Apiaceae), and *Pseudobetckea* (Valerianaceae). From Caucasian-Asia Anterior genera there are found oligotypic *Coluteocarpus, Didymophysa, Eunomia* (Brassicaceae) and *Vavilovia* (Fabaceae). They are mainly distributed in high mountains of the Minor Caucasus and Asia Anterior.

The biological diversity of herbaceous plant communities is directly correlated with their structure; e.g. most species-rich are communities with relatively low growing canopy, whilst the less rich in species composition are communities with high canopies.

Subnival (3000-3500 m a.s.l.) vegetation of the Caucasus is distinguished through high ratio of endemic plant genera and especially species.

The pastures are drastically changed - due to the extensive pasturing practice; e.g. the canopy height of pasture is 20-25 times lower, LAI is 3 times less and biomass is 5-6 times less then that of protected meadow. Over 98% of aboveground phytomass is situated 0-2 cm layer. Absorbed PhAR values at the pasture are as low as 50% - in contrast with 80% in case of protected meadow. There are also drastic differences in ecological-physiological indices (transpiration, CO_2-gas exchange, water potential, diffusive resistance of leaves, etc.).

Figure 1.

Profile through the Colchis mountains

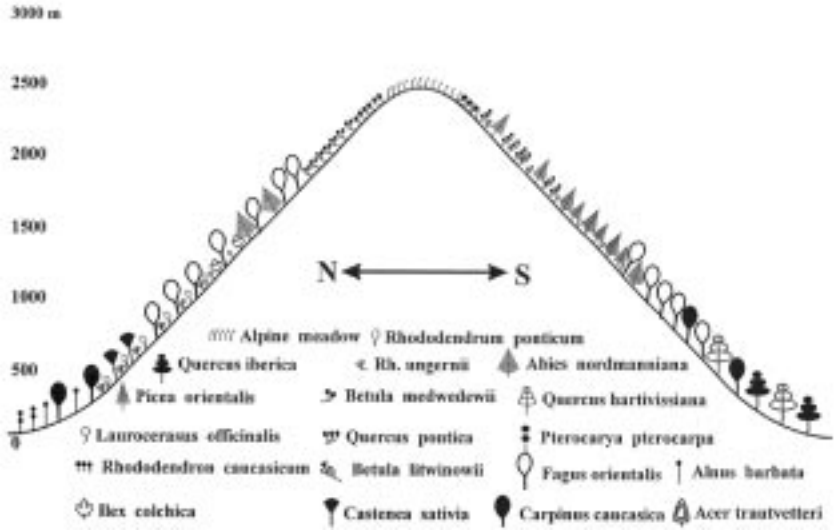
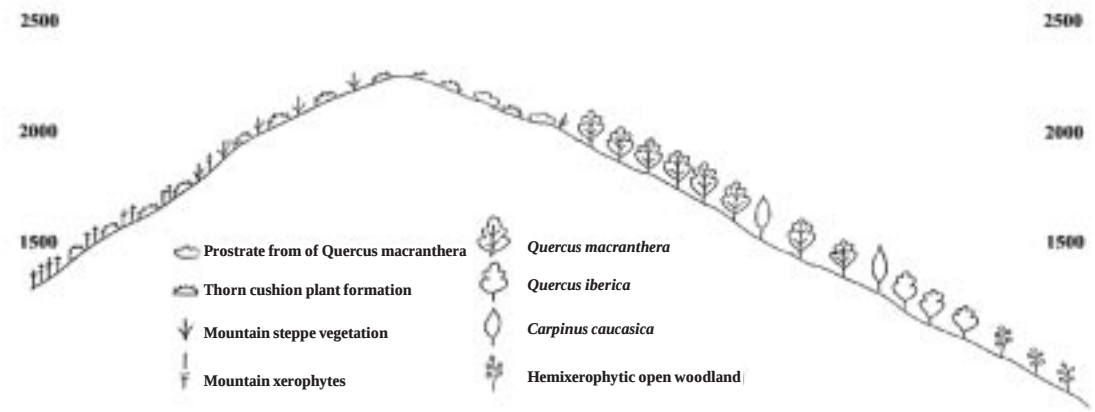


Figure 2.

Profile through the Zangezuri mountain range (The Minor Caucasus)



16
INTEGRATING INDICATOR SYSTEM FOR THE ALPS TO INCLUDE BIODIVERSITY
- RESULTS OF AN INTERNATIONAL WORKING GROUP UNDER THE ALPINE CONVENTION

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Keywords: Biodiversity, Indicators, sustainable use, sustainable management

Introduction

The Alpine Convention is a framework agreement for the protection and sustainable development of the Alpine region. It was signed by Austria, France, Germany, Italy, Switzerland, Liechtenstein, Slovenia, Monaco and the EU. The Convention entered into force on March the 6th, 1995.

The conventional framework includes 9 protocols which were signed by the governments of the Alpine states, and partly are ratified:

1. Spatial planning and sustainable development
2. Mountain Farming
3. Conservation of nature and the countryside
4. Mountain forests
5. Tourism
6. Soil Protection
7. Energy
8. Transport
9. Protocol on the Settlement of Disputes

As a result of the UN Conference on Environment and Development (Rio de Janeiro, 1992) the model of sustainable development in a few years time became a new paradigm of environmental and developmental policy. Contrasting the prevailing principles of the environmental policy so far, the new model stresses the close interrelations between ecological, economic, social, and cultural development. The model of sustainable development is accepted as obligatory by the Alpine Convention.

The Goals of the Alpine Convention

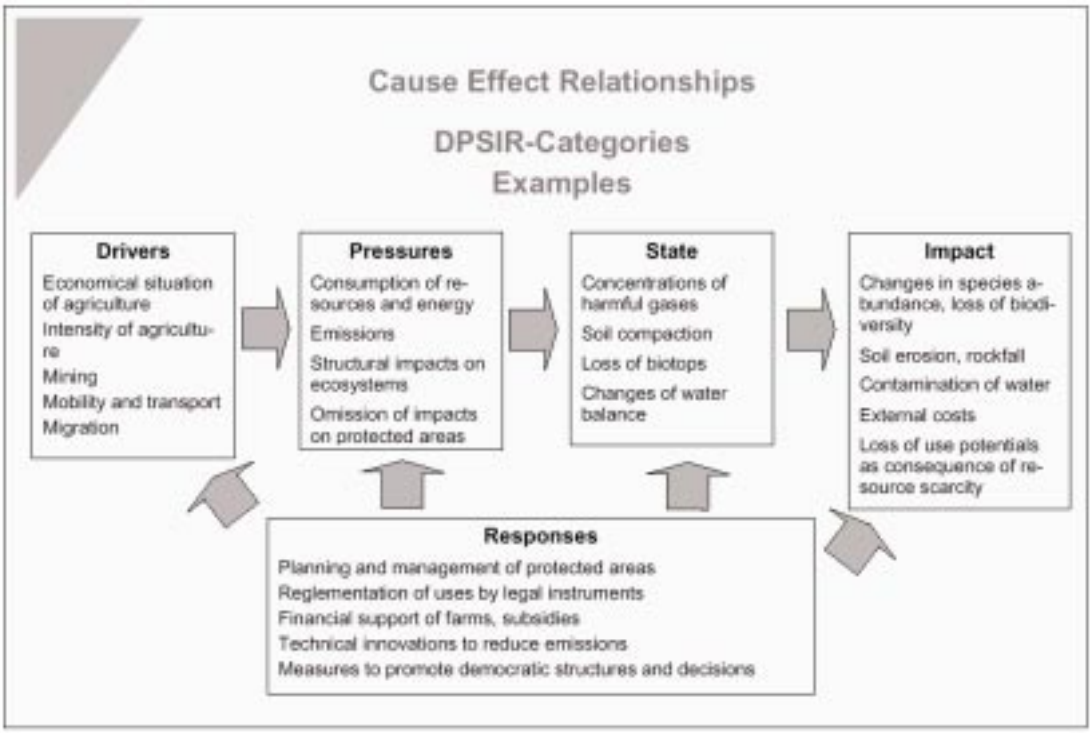
On the background of growing complexity and globality of environmental problems, the effective protection and the sustainable development of the Alpine economic area call for integrative conceptions on protection and development. The term integrative, in this context, is meaning to pay specific regard to the various sectors and components of the complex system man and environment, such as traffic, agriculture, energy. It is including the various environmental compartments and subjects of protection e.g. animals, plants, biodiversity, human health, which are threatened by environmental changes. It is also including the transboundary harmonisation of political measures. All this is regulated by the Alpine Convention. The integrative description of the environmental condition and the environmental policy are complementing other approaches, that are oriented medially or sectorally. These approaches consider the systematic cover of, and pay regard to, the cause-effect-relations or environmental changes. The elucidation of causes and possible consequences of environmental changes is required by the environmental policy to meet desired or undesired developments in a suitable way.

Working group "Mountain-specific Environmental Quality Objectives" – how to implement the Alpine Convention

Regarding these demands, and in the frame of the Alpine Convention, the working group "Mountain-specific Environmental Quality Objectives" has elaborated and suggested a model. For each protocol of the convention those factors, which are relevant for causes or effects, were compiled and arranged according to their relation (see Figure 1). This model of the system closely follows the DPSIR-Approach (Driving Forces – Pressure – State – Impact - Response), which is the basement for the system of indicators suggested by the European Commission and the European Environmental Agency (EC, EEA).

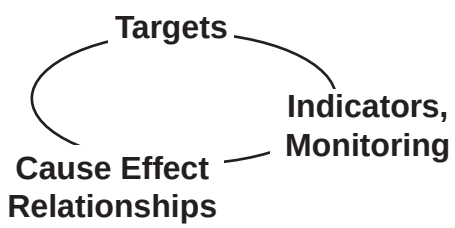
Figure 1.

Cause effect relationships



Indicators – Figures to assess the environmental policy and the implementation of the Alpine Convention

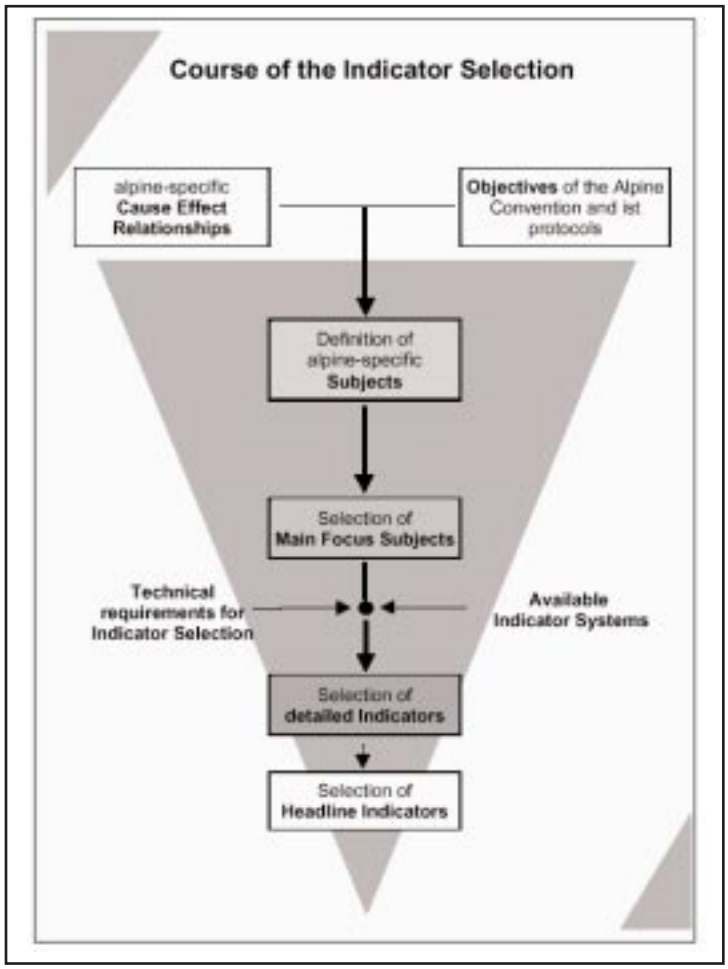
The Alpine Convention and its annexed protocols focus on the formulation of targets. For this reason certain subjects and issues of concern are covered repeatedly and by several of the protocols. As the system of indicators shall aid in assessing the implementation of the Alpine Convention, the selection of main focus subjects will be reflected by corresponding indicators.



Compiling all the subtargets from the framework convention, from its protocols, and from the issues of concern, it will be possible to elaborate the main focus subjects and to orient the system of indicators on these subjects (see Figure2).

Figure 2.

Course of the indicator selection

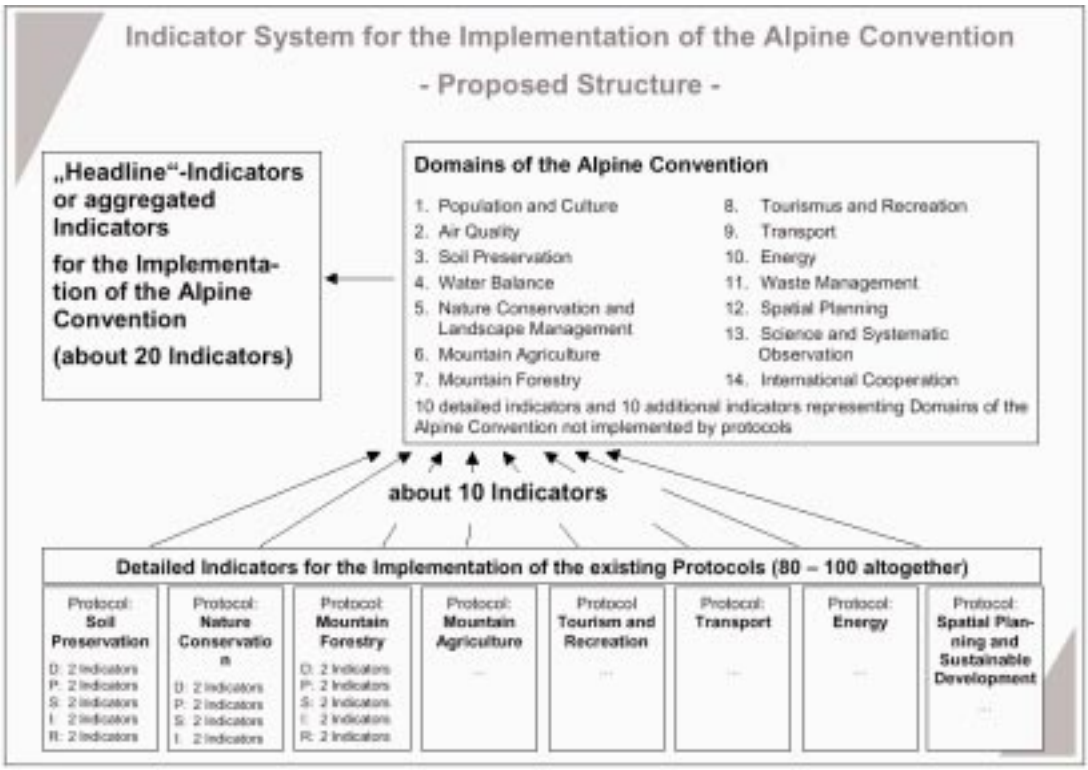


The system of indicators, as suggested by the working group, will serve as a basement to develop a monitoring approach that will assess the quality objectives that have been reached already, e.g. the conservation or restoration of Alpine biodiversity (see Figure 3). The elaboration of indicators for controlling the degree of fullfillment of the objectives of the Alpine Convention and the annexed protocols will be the keystone for the implementation of the Alpine Convention and political decisions. Indicators will allow to compare the regional as well as the transboundary development of the Alpine States in space and time. In addition they can serve as a basement for harmonised reports on the development in the Alpine region along with the implementation of the Alpine Convention.

To improve the social and political communication on the set of indicators headline-indicators will be selected from the elaborated specific indicators, that will describe the crucial themes. The selection of this set will orient to the criteria of specifity and plausibility. It will refer to the goals of the Alpine Convention, and will allow statements under the categories Driving Forces, Pressure, State, Impact and Response. Headline-indicators will give an overview on the development in essential issues and will express relevant information in a simplified and selective way.

Figure 3.

Indicator System



References

Umweltbundesamt 2000 (Federal Environmental Agency): Environmental quality objectives for the alpine regions – 1.Report of the working group " Mountain-specific Environmental Quality Objectives " of the Alpine Convention. URL: *http://www.jahr-der-berge.de/uqz_alpen.html*

Umweltbundesamt 2002 (Federal Environmental Agency): Environmental quality objectives for the alpine regions – 2.Report of the working group " Mountain-specific Environmental Quality Objectives " of the Alpine Convention.

17
MAJOR CONFLICTS AND THREATS TO MOUNTAIN WETLANDS OF MINOR CAUCASUS (ON THE EXAMPLE OF ARMENIA)

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Keywords: mountain wetlands, threats, degradation, national wetland policy, restoration, Armenia

Introduction

High vulnerability of mountain ecosystems creates difficulties in the sustainable use of the land and requires constant realization of complex protective measures. Mentioned above have a certain attitude toward the all diversity of mountain wetlands. All major wetland threats in Armenia are human induced. During the historical period the wetlands for a long time remain undisturbed, especially on the background of heavily exploited forests, steppes and meadows. In the Soviet period all more or less large wetland areas had been crossed with drainage canals or drainage pipes. The flow of many rivers had been regulated by building a dams and reservoirs. The main reason of draining the wetlands in Armenia was land reclamation into agricultural and urban. It is necessary to admit that wetland-draining activities were supported by the general public as an important step in combat against such kind of diseases as malaria, dysentery and cholera. Estimated area of wetland (according the Ramsar definition of wetlands) loss in the country is approximately 40,000 ha.

Materials and methodology

Studied Area

Armenia is situated in the heart of Minor Caucasus and is 0.5 km higher than the neighboring Asia Minor and Iranian Plateau. Geographical coordinates of Armenia are 38°50'-41°18'N and 43°27'-46°37'E.
Armenia is a mountainous country with a minimum altitude 375 m and maximum 4095 m (Mount Aragats) above sea level. The average altitude across the country is 1850 m above sea level.
Folded relief of Armenia has given rise to 5 principal natural landscapes: 1. Semi-desert with fragments of desert; 2. Steppe; 3. Forest; 4. Sub-Alpine and Alpine; and 5. Azonal (mainly wetlands and rocks).

Data collection

Various methods of data collection had been used for inventory of Armenian wetlands and wetland biodiversity. All wetlands had been classified according to the *Ramsar Classification System for Wetland Types*. Of total 29 types of inland wetlands 24 exist in Armenia with exception of permanent saline/brackish/alkaline lakes **(Q)** and marshes/pools **(Sp)**, tundra wetlands **(Vt)**, forested peatlands **(Xp)**, and of 'man-made' wetlands salt exploitation sites **(5)**. All major conflicts and threats to wetlands had been identified and corresponded to relevant wetland types.

Results

Conflicts and threats

At the heart of conflicts regarding the use of wetlands is underestimation of their economical and especially ecological values (insufficient information on important natural processes that underpin the various values generated by the wetlands). The conflicts itself comes from diverse views on the wetland values by various stakeholders in decision-making process. The analysis of numerous interviews with people concerned shows that depending on position of given person, his position and relation with the wetland(s), his approach to the wetland values could differ and even contradict to public opinion. This could be because of differences in understanding, judgments, preferences, priorities, precedence and positions as in examples on **Table 1**.

The major threats to Armenian (and Minor Caucasian) mountain wetlands are the following:

Water loss. Wetlands have commonly been drained mainly in Ararat Valley to enlarge the area of agricultural and urban land. Another type of water loss was artificial increase of the outflow from Lake Sevan with the purpose to obtain hydropower and irrigation water for Ararat Valley farmlands including newly drained lands. As a result the level of the lake dropped on 19.88 m (from 1916.20 to 1896.32 m above sea level as of January 1, 2002), the volume decreased from 58.5 to 32.9 km^3 (44%), the surface from 1416 to 1236 km^2 (13%).

Water balance disturbance. Water balance disturbance happens because of uncontrolled water use for irrigation. As a result of human usage water level disturbance descend sharply throughout the nesting period producing disturbance to the breeding waterfowl and fish.

Soil deterioration. Exposure of wetland soils to drying brought to their salination. At present the area of lands exposed to salination is 15000 ha. Some currently agricultural lands experience secondary salination after deterioration of drainage system.

Soil erosion. Soil erosion on riverbanks is a natural process, which is pronounced while human induced, as in case of former bottom of Lake Sevan. Soil erosion frequently aggregated by ***Deforestation***.

Sedimentation. Sedimentation is another natural process, which became serious when induced by human beings. Currently sediments filled up considerable parts of volumes of most reservoirs and canals.

Mudflows. Seasonal and regular rivers and creeks with drained wetlands in their catchments run highest degree danger of mudflows. Mudflows occurrence here is once in a 3 years and more often.

Waterlogging. Only 400 ha are under the waterlogging. The gravity of the problem is that waterlogging experience a number of settlements.

Pollution. The discharge of industrial pollutants, domestic sewerage and agricultural run-off into wetlands increases the organic loading of the wetlands waters. Decomposition of organic matter decreases the oxygen concentrations of the water body. Worsening of oxygen conditions may seriously contaminate the water, endangering the plant and animals living in or near the wetland.

Over-exploitation. Extensive use of water resources associated with increased ***Pollution*** of Lake Sevan had a negative effect on the ecosystem of the lake, from physical conditions to primary production and fish community. As a result of over- fishery endemic fish species *Salmo ischchan* in Lake Sevan is at the edge of extinction. Livestock overgrazing on wetlands brought to degradation of vegetation and serious deterioration of the waterfowl habitats.

Factor of disturbance. People and cattle access in the wetland areas influenced adversely on the waterfowl. Waterfowl is especially sensitive to the factor of disturbance during the breeding period.

Deforestation. Deforestation is comparatively new threat originated in early 1990's during the blockade and energy crisis. Deforestation resulted in increase of surface run-off and ***Sedimentation***. This reduces light penetration in wetlands water and results in loss of primary productivity.

Invasive species. Introduction of Crucian Carp (*Carassius auratus*) in Lake Sevan influenced negatively on the quantity of endemic fish *Varicorhinus capoeta sevangi*. Their fries are food competitors. There is also the constant risk of new introductions as it had been happened recently with the Muskrat (*Ondatra zibethica*) in Lake Ardenis (10 ha, 2040 m a. s. l.). The Muskrat completely destroyed the Rush (*Juncus*) stands around this sub Alpine lake. Currently, Muskrat lodges had been found 50 km downstream.

Health problems. During the contact with static and unpurified water an increase in the incidence of transmissible diseases can be expected. This already happened in a number of settlements around the foul canals of degraded drainage systems. High summer temperatures are favorable to development of *Anopheles spp*. larvae and overgrown vegetation provide with secure sanctuary against predators.

Solutions to dissolve the problem

Armenia and other countries of the region (Azerbaijan, Georgia, Iran, Turkey) need to develop and implement national wetland policies that promote wetland conservation and envisaged in the implementation of the wise use concept of the Ramsar Convention. Wetlands, and especially mountain wetlands of the region should be involved in the network of protected natural areas taking into account the interests of all stakeholders, whether governmental or private, on national or local level. All valuable but degraded wetlands should be assessed with further practical solutions for restoration.

Table 1.

Different approaches to the wetland values

Conflict cause	Interested/opponent party 1	Interested/opponent party 2
Different understanding of the term *waterfowl*, which brings to conflicts in setting the dates of opening and closing of hunting season	Ministry of Nature Protection – *waterfowl* are all birds dependent on wetlands	Hunters Union – *waterfowl* are only game waterbirds
Different judgments of how to maximize profits from the water of Lake Sevan, which brings to conflicts in elaboration of water balance strategy	Ministry of Nature Protection – use for recreation and potential drinking water	Ministry of Energy, Ministry of Agriculture –use for hydropower and irrigation
Different preferences between biodiversity and biological products, which brings to conflicts in conservation of piscivorous birds in Armash fish-farming ponds	Ministry of Nature Protection – preference of biodiversity	Owners and wage earners – preference of fish production
Different priorities in how to restore Lake Gilli, which brings to conflicts in how many hectares to flood	Nature conservationists – to flood as much as possible land in order to restore conditions close to natural	Peasants – to flood only those lands, which are not private in order to retain land and to obtain additional profits from new created wetland
Different precedence of what is profitable in Noradus fish-farming ponds, which brings to conflicts in management measures of the site	Owner – everything, including tourism and frog collection, what is more profitable	Wage earners – traditional fish-farming and grazing
Different positions on water-level management of Lake Arpi, which brings to conflicts in water use and protection of the largest world colony of Armenian Gull	Peasants – water use for irrigation regardless what will happened with the colony	Nature conservationists –to retain as much water as possible in order to avoid disturbance to the colony

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LA MONTAGNE MAROCAINE : UN RESERVOIR NATUREL DE LA BIODIVERSITE

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Keywords: Morocco, Mountains, Ecosystem, Biodiversity, Degradation

Introduction

Le domaine montagnard au Maroc est caractérisé par une altitude supérieure à 500 m associée à une forte déclivité. Ce dernier caractère exclut les hauts plateaux de l'Oriental plats ou à faible pente bien que situés à environ 1000 m d'altitude. Cependant des conditions climatiques difficiles conditionnant un raccourcissement de la période de végétation et/ou une forte déclivité peuvent aussi servir à définir le domaine de la montagne. Cette réalité physique est aussi associée aux dimensions historique, culturelle et sociale.

Les phytogéographes distinguent les basses (entre 500-1500 m), moyennes (entre 1500-2500 m) et hautes (au-delà de 2500 m) montagnes. Les massifs essentiellement concernés sont le Rif, le Moyen Atlas, le Haut Atlas, l'Anti-Atlas, les montagnes de l'oriental (Bni Snassène, Jerada et Debdou), auxquels il faudrait rajouter Zerhoun et les Jbilet (Figure 1).

Selon ces critères, la montagne couvre environ le quart de la superficie totale du pays (21% du territoire national soit environ 100.000 Km^2). Elle abrite dans 19% de sa superficie, soit 3,6 millions d'ha, 62% du domaine forestier total du pays et elle est considérée par excellence comme le domaine exclusif de la forêt. Les essences végétales dominantes qui façonnent son paysage appartiennent aux Conifères et aux Fagacées, accessoirement aux Sapotacées et Draceancées. La biodiversité y est riche et non moins originale, les massifs du Rif, du Moyen Atlas et du Haut Atlas abritent en effet le plus haut taux d'endémisme. La physionomie générale montre une mosaïque complexe d'écosystèmes ; elle est le résultat de l'interaction entre les variations climatiques et l'action anthropozoogène. Les bioclimats qui y règnent vont du semi-aride au perhumide. Les étages de végétation s'étalent depuis le thermoméditerranéen jusqu'à l'oroméditerranéen, en passant par le mésoméditerranéen, le supraméditerranéen et le montagnard méditerranéen. A côté des formations forestières, on trouve celles préforestières, présteppiques ou même localement steppiques.

Les biodiversités écosystèmiques de la montagne marocaine

La forêt

Les forêts humides se cantonnent dans la Péninsule tingitane, le Haut Rif occidental, le Moyen Atlas central et oriental et le Haut Atlas oriental. La pluviométrie annuelle est de 650-2000 mm, l'enneigement y est important. On trouve parmi les essences forestières principales, *Abies maroccana, Cedrus atlantica, Quercus faginea, Quercus pyrenaica, Pinus pinsater var. maghrebiana, Quercus suber et Quercus ilex*.

Les forêts sclérophylles couvrent le Rif oriental, les montagnes de l'oriental, le Moyen Atlas, le Haut Atlas et l'Anti Atlas, avec une pluviométrie annuelle de 350-800 mm. Les étages bioclimatiques représentent le thermoméditerranéen, le mésoméditerranéen, le supraméditerranéen et le montagnard méditerranéen. Les essences principales sont *Quercus ilex, Quercus suber, Quercus coccifera, Tetraclinis articulata, Juniperus phoenicea, Pinus halepensis, Pinus pinaster var. maghrebiana*.

Les steppes des hautes altitudes se rencontrent à une altitude supérieure à 2700 m et concernent le Haut Atlas, le Moyen Atlas oriental et le Siroua, avec une pluviométrie annuelle de 500-700 mm. Le paysage est dominé par des plantes épineuses en coussinet : *Astragalus boissieri, Astragalus numidicus, Erinacea anthyllis, Arenaria pungens, Vella mairei, Bupleurum spinosum*.

Les formations arborées steppiques et présteppiques couvrent les flancs sud du Haut Atlas et de l'Anti Atlas. La pluviométrie annuelle est de 100-300 mm. Les espèces végétales dominantes sont *Juniperus thurifera, Juniperus phoenicea, Quercus ilex, Fraxinus dimorpha*.

Les écosystèmes montagnards

Le domaine montagnard abrite un très grand nombre d'écosystèmes méditerranéens naturels, très diversifiés, essentiellement forestiers et préforestiers, ainsi que d'écosystèmes steppiques de hautes montagnes. Les grands types d'écosystèmes méditerranéens naturels sont représentés par les phytocénoses organisés par les essences forestières suivantes : les sapinières (Photo 1), les cédraies (Photo 2), les chênaies caducifoliées, les suberaies, les chênaies vertes, les tétraclinaies, les juniperaies rouges, les cupressaies, les arganeraies, les thuriféraies, les steppes de hautes montagnes et les pelouses de hautes montagnes (Benabid, 2000)
(Tableau 1).

Les problèmes de dégradation de la montagne

La montagne marocaine souffre de plusieurs faiblesses, inhérentes à son enclavement. L'insuffisance d'infrastructures de base (écoles, dispensaires sanitaires, routes, habitat salubre, eau, électricité) aggrave encore plus son isolement et accuse le retard de son développement. Avec 30% de la population totale du pays et 40 habitants par km^2, elle souffre aussi du poids de la charge démographique.

La pression anthropozoogène se traduit par le surpâturage, les prélèvements illégaux du bois, les incendies, etc. Le résultat de ces pratiques associées à un aménagement sylvicole inadéquat et à l'urbanisation est l'accroissement de la fragilité de nombreux écosystèmes, se traduit inéluctablement par la déforestation avec tout son corollaire (perte de la biodiversité, perte des sols, envasement des barrages, changements climatiques). Ces effets sont déjà bien visibles dans le Rif central, le Moyen Atlas et le Haut Atlas. Les essences forestières touchées sont principalement le cèdre, le chêne liège, l'arganier et le genévrier thurifère. L'implantation de parcs et réserves nationales et la délimitation de sites d'intérêt biologique, bien que nécessaires ne suffisent pas à maintenir la biodiversité à même de garantir aux populations locales des conditions de vie en harmonie avec la conservation des ressources naturelles.

Conclusion

Malgré la richesse de la montagne marocaine par une diversité écosystèmique, celle ci connaît une dégradation continue. Pour remédier la situation actuelle, il est nécessaire de trouver la solution dans le cadre d'un plan national d'aménagement intégré. Pour conserver les spécificités paysagères et garantir le développement des populations locales, une réflexion englobant les dimensions économique, culturelle, sociale et écologique doit être engagée pour tracer le cadre institutionnel et orienter le type de développement qui doit prévaloir dans la montagne marocaine

Références

Benabid, A., (2000). *Flore et écosystème du Maroc*. Edit. Ibis Press. 357p.

Fennane, M., (1988). *Phytosociologie des tétraclinaies marocaines*. Bull. Inst. Sci., 12 : 99-148, Rabat.

Fennane, M., (1997). *Les ressources végétales des montagnes marocaines : richesse, originalité et problèmes de conservation*. Espace Géographique et Société Marocaine. n°2/1997 : 73-87.

Sauvage, Ch., (1961). *Recherches géographiques sur les suberaies marocaines*. Trav. Inst. Sci. Chérif., sér. Bot., 21, 462p.

Figure 1.

Carte de la répartition des Montagnes

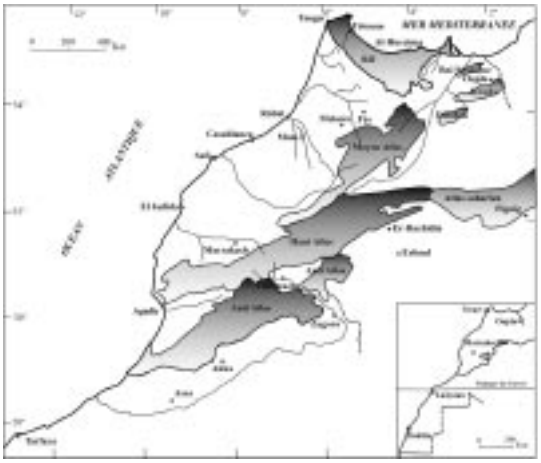

Tableau 1.

Quelques écosystèmes montagnards du Maroc (Fennane, 1998 et1997)

Ecosystème	Description
Les sapinières	Le sapin du Maroc est endémique du Rif. Il est cantonné aux seules montagnes calcaires du Rif occidental. Ses peuplements actuels n'excèdent guère 5000 ha contre 15000 ha jadis. Ils sont généralement infiltrés de Cèdre, de Chênes ou de Pins, avec très souvent un sous-bois comparable à celui de la cédraie (environ de 200 espèces).
Les cédraies	Le Cèdre de l'Atlas est l'essence forestière noble du Maroc, appréciée pour ses valeurs économiques et biogéographique. L'aire potentielle du cèdre peut être estimée au double de son aire actuelle qui est de 115.000 ha environ (Fennane, 1997). La flore vasculaire des cédraies atteindrait un millier d'espèces, avec environ 10% d'arbres, 15% d'arbustes et arbrisseaux et 75% d'espèces herbacées.
Les chênaies caducifoliées	Les chênes caducifoliés occupaient jadis une aire très importante dans les pays méditerranéens. Les espèces présentes aujourd'hui au Maroc sont : *Quercus faginea, Q. pyrenaica* (environ 17.000 ha et 5.000 ha respectivement), *Quercus lusitanica*.
Les suberaies	Le chêne liège (*Quercus suber L.*) occupe une place importante dans la végétation du bassin méditerranéen occidental. En Montagne, le chêne liège couvre 250.000 ha environ.La flore vasculaire des suberaies marocaines est riche et diversifiée (Sauvage, 1961). Elle compte près de 900 espèces et sous-espèce dont une cinquantaine sont endémique du Maroc.
Les chênaies vertes	Le chêne vert est la première essence forestière du pays avec près de 1.400.000 ha. C'est un arbre plastique et rustique, capable de supporter des conditions écologiques difficiles
Les tétraclinaies	Formation de thuya de bérbérie, *Tetraclinis articulata* (Vahl) Masters (= *Callitris articulata* (Vahl) Link;). L'aire actuelle du thuya bérbérie au Maroc couvre 750.000 ha. Il organise des écosystèmes très diversifiés comptant plus de 600 espèces arborescentes, arbustives ou herbacées.

19
MOUNTAIN BIODIVERSITY: A BOTANIC GARDEN'S EXPERIENCE

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Keywords: Cameroon, Indonesia, Lebanon, conservation, taxonomy

Introduction

The Royal Botanic Gardens, Kew is a scientific, amenity and educational organisation devoted to increasing knowledge and public understanding of plant diversity: how it came to be, its current status, and how it can be conserved and used in sustainable ways for future benefit.

Almost 200 scientists work for Kew, on projects around the world. In all aspects of its work, Kew is determined to honour the letter and spirit of the CBD. Kew works closely with partners in host countries and has developed and implemented strong policies on access to genetic resources and benefit sharing. Three case studies are presented to briefly illustrate the various ways in which Kew is working towards the conservation and sustainable use of mountain biodiversity.

Mountain Biodiversiy Convervation Case Studies

Cameroon

Kew has been researching the flora of the mountains of western Cameroon since 1861. This region is thought to be a Pleistocene refugium and harbours over 4,000 plant species; the highest level of biodiversity in tropical Africa (Barthlott et al, 1996). Population growth, logging and clearance of forest for agriculture are the main threats to mountain biodiversity. Intensive surveys and inventories conducted by Kew; the National Herbarium of Cameroon; local conservation NGOs, and Earthwatch have resulted in c. 35,000 collections since 1993. One new genus and nearly 50 new species have been described since 1998. Almost 150 African plant scientists have received in-depth botanical training, including a two-week Herbarium Techniques Course in the Capital city Yaoundé in November 2002.

Two 'conservation checklists' have been published (Cable and Cheek, 1998; Cheek et al, 2000) for the plants of Mt Cameroon (4095 m - 2435 taxa) and Mt Oku (3011 m - 974 taxa), including comprehensive IUCN Red List chapters. These assessments help local conservation projects secure funding to develop protected areas management strategies. Fifteen conservation posters, each focusing on a threatened species, have been widely distributed to disseminate the conservation message locally.

Mt Jaya, New Guinea

Mt Jaya lies at the western end of the central range of New Guinea, in the Indonesian Province of Papua. At 4884 m, it is the highest peak in SE Asia, and is adjacent to the Lorentz World Heritage Area and the PT Freeport Indonesia (PT-FI) mining area - one of the largest copper and gold mines in the world. Kew has been surveying and inventorying the PT-FI area since 1998, when a project funded by Rio Tinto and PT-FI was instigated.

Botanical expeditions, which included training in collection and identification techniques, were conducted with staff from partner institutes throughout the region. Several products have arisen from the project: a series of posters describing vegetation types of Mt Jaya; revision of the taxonomy of mountain groups (Utteridge, 2000), and the formal recognition of new species (Hind and Johns, 2002). In 2003, Kew will publish a checklist of the c. 950 plant species found above 3000 m. This will be vital to the future management and conservation of the PT-FI and Lorentz areas.

The Millennium Seed Bank Project and Mount Lebanon

The Mt Lebanon chain runs parallel to the Mediterranean, rising to 3000 m, and has a variety of different habitats including remnants of the famous cedar forests. Although parts of the mountain are protected, much of the vegetation is under threat from ski resorts and other developments on the lower slopes.

Kew's Millennium Seed Bank Project has been working with Lebanese partners since 1996 to collect and conserve seeds from Lebanon, including the flora of Mt Lebanon. These collections provide insurance against threats to the mountain's flora, and will be available for research, conservation activities, species reintroduction programmes and habitat restoration. The partnership was formalised in July 2000 with an Access and Benefit Sharing Agreement, and by 2010 a significant part of the flora will be conserved. Key to the success of the partnership are the activities relating to training and access to and transfer of technology which are building the Lebanese capacity for seed banking.

Summary

Kew's work with partners in mountain regions is building capacity for the conservation and sustainable use of biodiversity. Projects are based on the precepts of the CBD and in particular aim to help progress towards the targets in the Global Strategy for Plant Conservation, and the Global Taxonomy Initiative.

References

Barthlott, W., Lauer, W., and Placke, A. (1996). Global distribution of species diversity in vascular plants: towards a world map of phytodiversity. *Erkunde Band* 50: 317 – 328 (with supplement and figures).

Cable, S., and Cheek, M. (1998). *The Plants of Mount Cameroon, a Conservation Checklist*. Royal Botanic Gardens, Kew.

Cheek, M., Onana, J.-M., and Pollard, B.J. (2000). *The Plants of Mount Oku and the Ijim ridge, Cameroon*. Royal Botanic Gardens, Kew.

Hind, D.J.N., and Johns, R.J. (2002). A new alpine species of *Ixeridium* (*Compositae: Lactuceae*). Contributions to the Flora of Mt Jaya, VIII. *Kew Bull*. 57: 697 – 703.

Utteridge, T.M.A. (2000). The subalpine members of *Pittosporum* (*Pittosporaceae*) from Mt Jaya, New Guinea. Contributions to the Flora of Mt Jaya, II. *Kew Bull*. 55: 699 – 710.

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MOUNTAIN BIODIVERSITY IN MONGOLIA

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Keywords: Mongolia, Altai Sayan Ecoregion, endangered species

Mongolia's territory ranges from the super-arid deserts to alpine terrain, and supports a wide diversity of living organisms, many of which are endemic to Mongolia. Mongolia harbors the last remaining populations of a number of species internationally recognized as threatened or endangered, including the snow leopard, Argali sheep, wild ass and others.

However, Mongolia's biological resources are facing substantial and increasing threats. Factors like Mongolia's growing population coupled with urbanization economic development, and an increasing per capita demand for natural resources have resulted in expansion and intensification in land use by people and domestic animals and in increasing pressure to develop and utilize the country's natural resources. Threats to mountain biodiversity identified at the national level include overgrazing, deforestation, poaching of and illegal trade in endangered species, mineral exploitation, construction projects, and uncontrolled tourism.

Mongolia seeks to sustain and escalate to the extent possible the standard of living for its people through economic development and growth of free enterprise. However, it also recognizes the importance of its biodiversity heritage as a significant component of the world's overall biological diversity, as an economic resource, and as a source of spiritual enjoyment for people (UNEP, 2002).

Action to safeguard habitats and species alone is not enough. Factors such as human traditions, land-use practices, and other socio-cultural interests related to natural resource management must be an integral part of any conservation approach. Therefore, the interests of local communities will be taken into consideration in order to implement conservation initiatives effectively.

There are about 40 environmental NGOs in Mongolia today with approximately 20 actively involved in conservation and environmental education activities. Union for Mongolian Environmental NGOs (UMENGO) is an ambrella organization for environmental NGO's which was established in 2000.

Local community education and awareness raising activities have become an important part of the Ministry of Nature and Environment. Local workshops and Participatory Rural Appraisal (PRA) meetings attended by local herders, communities, and government representatives have resulted in dramatic increase in local participation in conservation initiatives.

To elaborate a program on national training and education on biodiversity conservation, the 255 resolution of the Parliament on "Ecological Knowledge at all levels" were formulated. Cirrocumuli and standards for environments and ecology at colleges, universities, and mid schools have developed in cooperation with Ministry of Education, Culture and Science, and have started the program implementation.

Altai Sayn Ecoregion

The Altai Sayan Ecoregion is the biggest high mountainous area in the nation, one of Global 200 ecoregions as critical to the conservation of the world's biological diversity. It is one of the last resorts left on the earth with relatively intact ecosystems, large enough to allow ecological processes and wildlife populations to fluctuate naturally. The huge expanse (845, 000 km) runs roughly east-west through the region where Russia, Kazakhastan, China and Mongolia meet (MNE & WWF, 2001).

The Altai Sayan Ecoregion contains geographically distinct biomes and landscapes, consisting of high mountains, taiga, tundra, forest steppe, and steppe and desert steppe. The mountains of Altai Sayan form the extreme upper watersheds of two of the world's ten largest river basins – the Ob and the Yenisey.

Since 4 countries share the natural resources of the Altai-Sayan, conservation efforts have to transcend political borders. A transboundary conservation approach will lead the establishment of a protected area network and will help to preserve the biodiversity of the regions' important ecosystems.

The region is a home to many rare and globally endangered species, such as Altai mountain sheep or argali (Ovis Ammon), snow leopard (Uncia uncia), Siberian ibex (Capra sibirica), and Mongolian saiga (Saiga mongolica). It is also a refuge for rare and threatened birds, such as the Dalmanian pelican (Pelecanus crispus) and great bustard (Otis tarda). Furthermore, endemic and rare plant species thrive in this ecoregion, with more than 213 rare taxa identifies in the Mongolian Altai-Sayan region.

Snow leopard

The snow leopard (Uncia Uncia) is a charismatic flagship species, promoting mountain biodiversity conservation. This beautiful and endangered cat, is a striking symbol of the world's highest places. It is also an environmental ambassador, for encouraging the establishment of transboundary national parks, and as an indicator of healthy mountain ecosystem. They distribute over the central Asian Mountain Ranges, occur in twelve countries, and found 750-3500 m. in Mongolia and Russia. In Mongolia its population is estimated only 1000-1500.

Primary threats to snow leopards are poaching, loss of prey, loss of habitat, depredators, lack of awareness and support.

Priorities for action:

- Strengthen the implementation of Snow leopard Conservation Management Plan of Mongolia.
- Reduce people-wildlife conflicts due to predation of livestock.
- Study wildlife-livestock interactions and enhance pasture use management in core habitats.
- Inform and educate general public on the importance of protecting snow leopards.
- Strengthen the law-enforcement and reduce poaching and fur trade incidents.
- Improve the existing legislative provisions on snow leopard and its prey species.
- Support conservation/development initiatives of the local communities to increase income generation: Irbis Enterprises, Eco-tourism, Resource use and etc.
- Promote the establishment of transboudary protected areas.
- Increase the number of Pas in snow leopard habitat and corridor areas.

References

Mongolian Altai Sayan Region. (2001). Mongolian Ministry for Nature and Environnment and Wordl Wide Fund for Nature

State of the Environments. (2002). United Nations Environment Programme, ISBN-92-87-2145-3

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MOUNTAIN BIODIVERSITY IN NEOTROPICAL CLOUD FORESTS: DISTRIBUTION, STATUS AND TRENDS

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Keywords: Andes, Hotspot, Megadiversity, Meso-America, Tropical Montane Cloud Forest (TMCF)

Introduction

Tropical mountain chains such as the Andes support a forest ecosystem which filters global air masses in such a way that they seize and incorporate water and nutrients from mist and fog into their cycles (Hamilton et al. 1995; Messerli & Ives 1997; Bruijnzeel & Hamilton 2000). This particular forest system, known as the Tropical Montane Cloud Forest (TMCF) is characterized by a tremendous biodiversity. It may be even richer than the tropical rain forests, when diversity is measured as species density on a per-unit-area basis (Henderson et al. 1991; Churchill et al. 1995). TMCFs are well-known for its important fresh-water resources which feed the many rivers which pass through major mountain cities as Bogotá and Quito which in their turn depend on these resources in order to supply their human populations with sufficient drinking water. However, today these fragile forests are among the most endangered ecosystems worldwide (Kappelle & Brown 2001), due to destructive anthropogenic forces causing forest loss and habitat fragmentation, ultimately leading to species extinction (Pounds et al. 1999).

Characterization

TMCFs differ significantly from rainforests in tropical lowlands. Although still little is known about the effect of clouds and mist ('*horizontal precipitation*') on the hydrological input in this ecosystem, it has been widely recognized that the frequent presence of clouds, mist and fog, the high level of atmospheric humidity and the strong diurnal oscillations in temperature, are among the most important environmental factors which cause the large array of differences in forest structure (low stature; gnarled and stunted aspect) and composition (complex epiphytism; species-rich genera) when compared to lowland forests (Hamilton et al. 1995; Bruijnzeel & Hamilton 2000). Without doubt, the abundance of individuals with a epiphytic growth form causes an enormous increase in biomass to the mere crowns of present tree species, thus acting as a sponge retaining water from clouds and fog.

Distribution

TMCFs are found around the globe (Stadtmüller 1987) and are concentrated between 1000 and 4000 m altitude in Central and northern South America (the Andes and other *cordilleras*), Eastern Africa (mountain slopes) and Southeast Asia (e.g., in Irian Jaya and Papua New Guinea). On the American continent, TMCFs are found in Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, Bolivia and Argentina, but also on Caribbean Antilles such as Jamaica and Puerto Rico (Kappelle & Brown 2001). Neotropical TMCFs form a major component of two out of 25 biodiversity hotspots worldwide: the Meso-American and Northern Andean Hotspot; the latter neing the probably most species-rich hotspot on our planet (Myers et al. 2000). At present, TMCF covers some 50 to 75 million hectares in the Neotropics with about a third to half of its whole distribution area in Colombia only (Kappelle & Brown 2001). Further research using satellite imagery is needed to precisely assess the area currently covered by TMCF.

Biodiversity Status

Analyzing the extraordinary biotic richness of the neotropical TMCFs it turns out that its biodiversity decreases with altitude and latitude, with lower per-unit-area values for Mexico and Argentina and highest species diversity levels at mid-elevation, closer to the equator in Colombia and northern Ecuador. The northern Andes appears to be a center of speciation which originated the radiation of countless species into the peripherical TMCF areas further northwest (Central America) and south (Peru). Both plant diversity (Gentry in Kappelle & Brown 2001) and avian diversity (Fjeldså in Kappelle & Brown 2001) are extremely high, as well as the often endemic herpetofauna. As tree species diversity decreases with elevation in TMCF, plant diversity is mainly expressed in the wealth of epiphytic shrubs, herbs (bromeliads, orchids), ferns, mosses, liverworts and lichens.

Biodiversity Conservation

Only about a third (23 million hectares) of the total area covered by TMCF in the Neotropics has some kind of protected status. If we are to preserve a large part of TMCF's variety of life as expressed in its genes, species and ecosystem types on the long term, we will need to elaborate a conservation strategy in which not only networks of protected areas form a fundamental component, but also participatory planning strategies in which different local and regional stakeholder groups are involved, in order to establish a broad-based, consensus-oriented conservation framework. As a prerequisite, this is particularly vital, for it is the recognition of the overall set of environmental goods and services offered by the TMCF to the people, which makes its conservation economically necessary and politically feasible.

References

Bruijnzeel, L.A., and Hamilton, L.S.. (2000). *Decision Time for Cloud Forests.* UNESCO – WWF - IUCN. Paris. 40 pp.

Churchill, S.P., Balslev, H., Forero, E., and Luteyn, J.L., eds. (1995). *Biodiversity and Conservation of Neotropical Montane Forests*. The New York Botanical Garden. New York.

Hamilton, L.S., Juvik, J.O., and Scatena, F.N., eds. (1995). *Tropical Montane Cloud Forests*. Springer. New York. 407 pp.

Henderson, A., Churchill, S.P., and Luteyn, J.L. (1991). Neotropical plant diversity. *Nature* 351: 21-22.

Kappelle, M., and Brown, A.D., eds. 2001. *Bosques Nublados del Neotrópico*. Instituto Nacional de Biodiversidad - Fundación Agroforestal del Noroeste de Argentina - World Conservation Union. Editorial INBio. Santo Domingo, Costa Rica. 698 pp.

Messerli, B., and Ives, J.D., eds. (1997). *Mountains of the World: a Global Priority. Parthenon*. 495 pp.

Myers, N., Mittermeier, R., Mittermeier, C.G., daFonseca, G.A.B., and Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature* 403: 853-858.

Pounds, J.A., Fogden, M.P.L., and Campbell, J.H. 1999. Biological response to climate change on a tropical mountain. *Nature* 398: 611-614.

Stadtmüller, T. (1987). Los Bosques *Nublados en el Trópico Húmedo*. University of the United Nations - Centro Agronómico Tropical de Investigación y Enseñanza. Turrialba, Costa Rica. 85 pp.

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MOUNTAIN WATCH: MAP-BASED OVERVIEW OF ENVIRONMENTAL CHANGE IN MOUNTAINS

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Keywords: Education and public awareness

Mountains occupy a quarter of the Earth's terrestrial surface, and host many areas of international importance for birds and plants. They deserve the level of concern afforded to other global ecosystems, such as wetlands, forests and coral reefs. *Mountain Watch* aims to raise awareness of the importance of mountains in the development and quality of life of people everywhere. As part of UNEP's contribution to the International Year of Mountains, it provides the first map-based overview of environmental change in mountains, and the implications for sustainable development. New global maps are presented to illustrate selected values of mountain ecosystems, and pressures causing environmental change. A set of accompanying case studies promotes awareness of research and sustainable development initiatives in individual mountain regions.

Mountain Watch pools the experience of more than 30 contributors, including FAO, UNESCO, UNDP, CGIAR, ICIMOD and the Mountain Forum, to evaluate the status of mountains worldwide. It is guided by the conceptual framework of the Millennium Ecosystem Assessment (MA) and the 'ecosystem approach' recommended by the Convention on Biological Diversity (CBD). It aims to build partnerships that will seriously address the challenges to mountain environments.

Building a network of partners on mountain issues

The Mountain Watch report marks the start of an assessment process to identify best practice in sustainable development of mountain ecosystems. This will involve a series of regional workshops to be organised during 2003, involving many stakeholders living and working in the mountains. This process will result in a *World Atlas of Mountain Environments*. The Atlas will provide a detailed source of information on mountain environments and lessons learned in sustainable development of mountain ecosystems. Organisations or individuals interested in contributing to the Mountain Watch process are encouraged to contact UNEP Mountain Programme office and UNEP-WCMC at the addresses below.

Supporting information for the report is available through the UNEP.Net Mountains Portal *(http://mountains.unep.net)*.

References

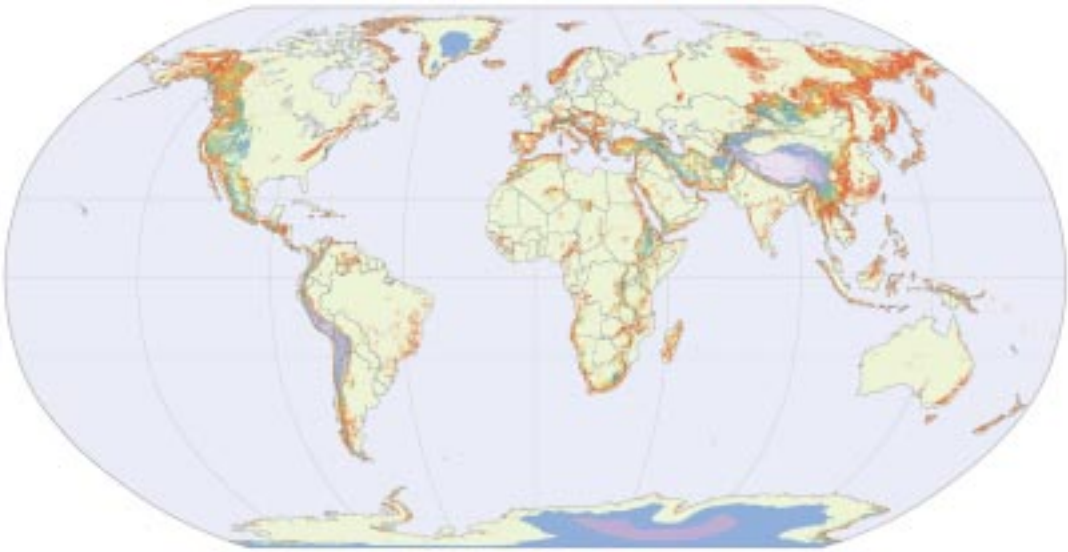
Kapos, V., Rhind, J., Edwards, M., Price, M.F. and Ravilious, C. (2000). "Developing a map of the world's mountain forests," in Forests in sustainable mountain development: A state-of-knowledge report for 2000, edited by M.F. Price and N. Butt. CAB International, Wallingford: 4-9.

UNEP World Conservation Monitoring Centre. (2002). Mountain Watch. UNEP-WCMC, Cambridge, UK.

ILLUSTRATIONS

Figure 1.

Mountains of the World



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BIODIVERSITY OF MOUNT KINABALU

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Keywords: Kinabalu, flora, inventory, phylogeny, ethnobotany, Malaysia

Mount Kinabalu, located on the island of Borneo in the Malaysian state of Sabah, is one of the world's most remarkable landforms. In 2000 Kinabalu Park was inscribed on the World Heritage List. Of origin in the late Pliocene-Pleistocene, Kinabalu rises from near sea level to nearly 4,100 m and is isolated by vast distances from other mountains of comparable elevation. Its exceedingly diverse biota offers outstanding opportunities for research on evolution and diversification of species and vegetation types. An overall programme of research on the flora of Mount Kinabalu has four major objectives outlined in the following sections.

Inventory of Vascular Plants

The Kinabalu flora is now about four-fifths enumerated and published, with over 5,000 species recognized (Beaman, 2001; Beaman et al., 2001). This enormous diversity occurs in an area of only about 1,200 sq km, making the Kinabalu flora one of the richest in the world. Currently the last part of the inventory (dicot families Magnoliaceae to Winteraceae) is nearing completion. A website *(http://herbarium.lsa.umich.edu/kinabalu)* provides searchable databases on ferns, gymnosperms, monocots, and dicot families Acanthaceae to Lythraceae. Four volumes on *The Plants of Mount Kinabalu* have been published; the fifth is in preparation and will complete the inventory of vascular plants.

Geographical Information System

A geographic information system (GIS) serves as a basis for the floristic and phylogenetic studies. Over 500 locally named places, most of which were not previously mapped, are included on a coloured topographic map that is in an advanced state of preparation. There are three components: an introduction and gazetteer, the map itself, and a Landsat TM image of the area. Maps also are being prepared for areas around nine villages where ethnobotanical studies have been concentrated. The GIS technology has been applied to analysing complex phylogenetic and biogeographic relationships, as demonstrated by R. S. Beaman (2001).

Phylogenetic Analyses

Phylogenetic analyses are being carried out on various exemplar taxa in such unrelated groups as the ferns, orchids, stone-oaks (*Lithocarpus*), and nettle relatives (*Elatostema*). Among the conclusions resulting from these independent studies is the idea that the high-elevation, endemic species have been derived from neighbouring species of lower elevations, rather than having originated by dispersal from distant geographical sources. This concept is especially well demonstrated in the study by Barkman (2001) on the orchid genus *Dendrochilum*.

Ethnobotany

An ethnobotanical project (*Projek Etnobotani Kinabalu [PEK]*) is giving particular attention to the collection and description of plants that are economically valuable, ecologically important, and threatened by human activities. Seventeen local collectors have worked extensively around their home villages, contributing some 9,000 specimens that document names, uses, and localities for both used and currently unused plant resources. The overall *PEK* programme is described in detail by Martin *et al*. (2002). A team including local people, Kinabalu Park personnel and visiting researchers is studying patterns of Dusun knowledge of plants.

During the project, research and capacity-building opportunities have been provided for students from Malaysia and other Asian countries, particularly through a series of certificate training courses. The results of the floristic inventory will be returned to local comunities in the form of a *Dusun Ethnoflora*. These efforts should provide a continuing incentive to local communities to carefully manage unprotected forests in buffer zones around Kinabalu Park and to promote the viability of Dusun botanical and ecological knowledge.

Conclusions

Mount Kinabalu has long been regarded as a sacred mountain by the native Dusun people of the surrounding foothills region. In 1998 Kinabalu Park had more than 300,000 visitors, most of whom contributed to the local economy. With settlements now established on all sides, the mountain has become a biological island, protected by the Park boundaries. The Park has five main focus areas: conserving the biological and physical resources, spearheading scientific research and enhancing educational values, increasing recreational and tourist activities, preserving cultural and historical values, and instituting management procedures to support other strategic thrusts. Potential threats to the integrity of Kinabalu Park currently arise from native rights, agriculture and climate change. Several areas in the Park have been claimed by adjacent villagers as "native customary rights." Fruit-tree cultivation and burial grounds form the basis of their claims. Agricultural activities by villagers inside the Park may also result in management concerns in the future. The region is subjected to periods of climatic extremes intensified by El Niño events. Droughts often result, having serious effects on the vegetation. Forest fires have resulted from recent droughts, including nine locations in Kinabalu Park that covered an area of 2,500 hectares. Visitor activities are mainly centred upon three main locations in the Park, representing approximately 5% of the total Park area. Erosion, noise and litter problems occur, but are largely under control.

References

Barkman, T. J. (2001). Evolution of vegetative morphology in Mount Kinabalu high-elevation endemics: insights from the orchid genus *Dendrochilum*. *Sabah Parks Nat. J.* 4: 9–24.

Beaman, J. H. (2001). Enumeration of the Kinabalu flora: present status. *Sabah Parks Nat. J.* 4: 125–135.

Beaman, J. H., Anderson, C. and Beaman, R. S. (2001). *The Plants of Mount Kinabalu. 4. Dicotyledon Families Acanthaceae to Lythraceae*. Natural History Publications (Borneo) Kota Kinabalu, in association with The Royal Botanic Gardens, Kew.

Beaman, R. S. (2001). Phylogeny and biogeography of *Elatostema* (Urticaceae) from Mount Kinabalu. Sabah Parks Nat. J. 4: 71–93.

Martin, G. J., Lee Agama, A., Beaman, J. H. and Nais, J. (2002). *Projek Etnobotani Kinabalu*. *The making of a Dusun Ethnoflora (Sabah, Malaysia)*. People and Plants working paper 9. UNESCO, Paris.

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PUBLIC AWARENESS AND ENVIRONMENTAL EDUCATION IN THE HIGHEST MOUNTAIN AREA OF THE CZECH REPUBLIC (KRKONOŠE NATIONAL PARK)

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Keywords: education and public awareness, Giant Mountains National Park, Czech Republic

The Giant Mountains (Krkonoše) the highest mountain area of the Czech Republic, belonging to the Sudetes mountain system and distinguished by special geomorphology and nature. Peculiar landscape, relatively easy accessibility and numerous tourist and recreational facilities attract many visitors (over 8 million annually), not only from other parts of the country, but mainly from abroad. Therefore the system of public information and awareness is very important in this territory.

In the Giant Mountains the first National Park of the Czech Republic was established in 1963 covering an area of 36 300 hectares, extended later by the transition zone of 18 400 hectares. The Giant Mountains represent a border area with Poland, where the National Park was established in 1959 on an area of 5 560 hectares.

On the National Park territory with the country highest peak Sněžka (1 602 m above sea level) remarkable altitudinal zonation has been developed: submountain zone (400 – 800 m), where broad-leaved and mixed forests and cultivated meadows predominate, mountain zone (800 – 1200 m), with spruce forests and meadows rich in rare and protected plants, subalpine zone (1200 – 1450 m) with alpine meadows, peat-bogs and dwarf pine stands, alpine zone (1450 – 1602 m) with stone formations and tundra vegetation. Especially alpine and subalpine ecosystems are unique in central European conditions. More than 1250 species of vascular plants and almost 300 species of vertebrates were discovered in this territory, including endemic species. Due to rich natural and cultural heritage, the whole Giant Mountains range was included in 1992 in the UNESCO list of Biosphere Reserves, as bilateral Reserve with Poland, covering an area of 57 787 ha on the Czech side.

The unique environment of the Giant Mountains offers good opportunity for research, including systematic monitoring programme developed as response to air pollution damage since the beginning of the eighties of the twentieth century. Research results serve as a basis for management plans and decisions, adoption of conservation measures, but also for environmental education.

Public awareness and education is an important part of the National Park activities by which the special Department of Environmental Education and Public Relations is charged (Vrchlabí Administration Centre). A special Centre for Environmental Education was established at Rýchory – eastern part of the Giant Mountains. Activities of the Department is oriented mainly to children, youth and students of secondary schools, first of all from the region, in the form of free time activities, competitions and festivals (the Earth Day celebration became especially popular), in which participated e.g. in 2001 almost 3000 children and students. Some actions, such as exhibitions and summer holiday camps are organized for participants from different parts of the country or even from abroad. Moreover, the Department organizes language and other specialized courses for employees of the Large-scale Protected Areas of the Czech Republic, excursions, coordinates lectures of the National Park Administration, etc.(e.g. in 2000 - 1 269 excursions for 6 295

participants and 525 lectures for 14 301 participants). The ecological bulletin ANDROMEDA is distributed to schools of the region and to other centres of ecological education in the country. Information documents of the National Parks are distributed to local governments of the region.

Information Centres of the National Park have been established in the town of Vrchlabí as headquarters of the National Park and in the main tourist centres of the Park (Špindlerův Mlýn, Pec pod Sněžkou and Obří důl, Harrachov, Rokytnice nad Jizerou, Horní Maršov, Strážné). They offer basic information and documentation for the Park visitors.

Giant Mountains museums represent traditional centres of environmental and cultural education. The most important of them are located at the towns of Vrchlabí, Jilemnice and Paseky nad Jizerou. The Vrchlabí Giant Mountains Museum distinguishes by its permanent exposition "Stone and Life" composed in a modern, progressive way, demonstrating a unique mountain nature. Every year several special exhibitions are organized in the mentioned museums thematically connected with nature and traditional lifestyle of the Giant Mountains region. Annual number of visitors is in the Vrchlabí Museum and its three dependences about 40 000, in the Jilemnice Museum over 20 000, and in the Paseky Museum over 5 000.

Other type of information centres represent those initiated at local level. Two of them located at Pec pod Sněžkou and Horní Maršov called "Veselý výlet" (Happy Excursion). The centres offer information, publications, postcards and locally made souvenirs. A part of both centres is a gallery of pictures and photos inspired by the Giant Mountains landscape. The bulletin VESELÝ VÝLET is edited twice a year (summer and winter seasons). It publishes updated information from the region, recommends interesting places worth visit and offers services.

The non-governmental and non-profit organization SEVER - Centre for Environmental Education and Ethics organizes short- and long-term educational programmes, courses and workshops for children, students of secondary schools and universities, teachers and other educators. It offers also environmental education consultations and other services in this field. The programmes are combined with excursions to the National Park. The cooperation with schools from the region is especially well developed and programmes are organized either in the Centre or directly in the given school. The Centre is located at Horní Maršov (eastern part of the Giant Mountains). It edited the environmental education bulletin SISYFOS. The Centre cooperates with other NGOs. It is a member of the Brontosaurus Movement, Union of Environmental Education Centres Web ("Pavučina") and Green Circle (network of several environmental NGOs of the Czech Republic). In collaboration with education and environmental authorities of the Czech Republic and the partner organization Econtur Brehmen (supported by the Deutsche Bundesstiftung Umwelt – DBU) the SEVER is developing the "Pilot Project of Environmental Education in Northern Part of the Czech Republic".

Information and education activities are important tools for enhancement of public awareness on natural and cultural values of the region and through this for conservation of unique national heritage. This is why public awareness and education were included as important tasks into the State Nature Conservation and Landscape Protection Programme of the Czech Republic adopted by the Government in June 1998, and information, as well as education and public awareness were ranged among environmental policy instruments in the State Environmental Policy adopted by the Government of the Czech Republic in January 2001.

Main References and Web Sites

Periodicals of the National Park:
Krkonoše National Park Administration Yearbook (information on the National Park activities in corresponding year)

Krkonoše Magazine (12 numbers a year, articles on nature, culture and history of the Giant Mountains, for general public)

Opera Corcontica (Yearbook of scientific papers from the Giant Mountains, 2002 – Volume 38)

Prunella Newsletter (once a year, ornithological news on studies, research, monitoring)

Mlčoch S., Hošek J., Pelc F. Eds. (1998): State Nature Conservation and Landscape Protection Programme of the Czech Republic. Ministry of the Environment of the Czech Republic, Prague, 21 pp.

State Environmental Policy 2001. Ministry of the Environment of the Czech Republic, Prague, 60 pp.

www.env.cz
www.krnap.cz
www.ecn.cz
www.veselyvylet.cz

25
PRESSURES ON MOUNTAIN ENVIRONMENTS

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Keywords: Pressures and threats

Mountain regions are more likely to experience three or more of the six severe pressures illustrated than non-mountain regions ($p = 0.00$), but the proportion of the area affected is very similar (23-24%). The pressures considered were fire occurrence, seismic hazard, human conflict, future impacts of infrastructure, climate change simulations and suitability for rain-fed crops. Maps of these pressures were reclassified to display severe instances only. The number of severe instances was then counted for each spatial unit to produce the final map shown at the bottom of the poster.

This summary combines a mixture of predictive and observed data layers, so it must be considered a preliminary exercise. Ideally all layers would directly predict future threat (e.g. by substituting fire hazard for fire occurrence), so that like would be combined with like. Despite this scope for improvement, the map gives a unique indication of those areas experiencing multiple pressures.

Three of the six pressures affect a higher proportion of African mountains than other mountain regions. These are conflict, fire and suitability for rain-fed crops. Mountains in Eurasia and Australasia/South-East Asia experience a combination of three or more pressures over a larger percentage of land area than the other mountain regions.

In future analyses an objective will be not only to identify areas most likely to experience environmental change, but also to assess which will be most vulnerable to the changes that are projected to occur.

References

UNEP World Conservation Monitoring Centre. (2002). Mountain Watch. UNEP-WCMC, Cambridge, UK.

ILLUSTRATIONS

Figure 1.

Pressure indicators in mountain regions

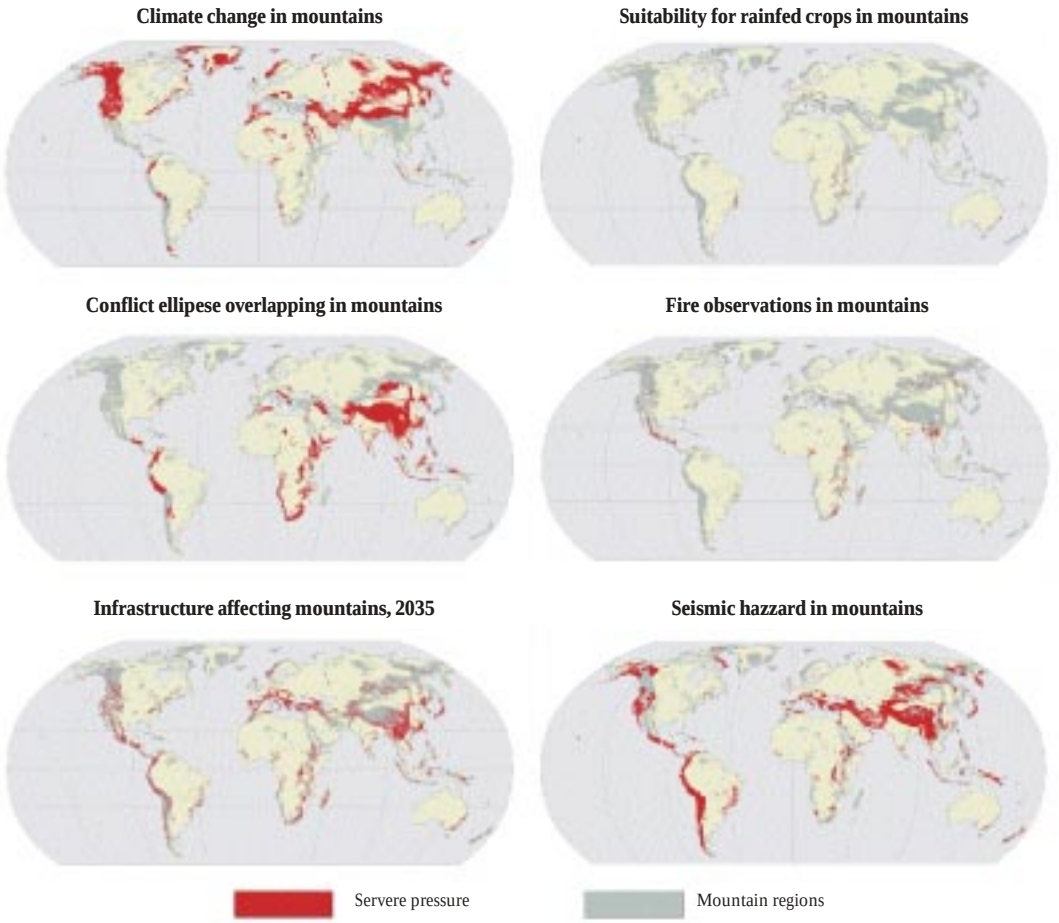
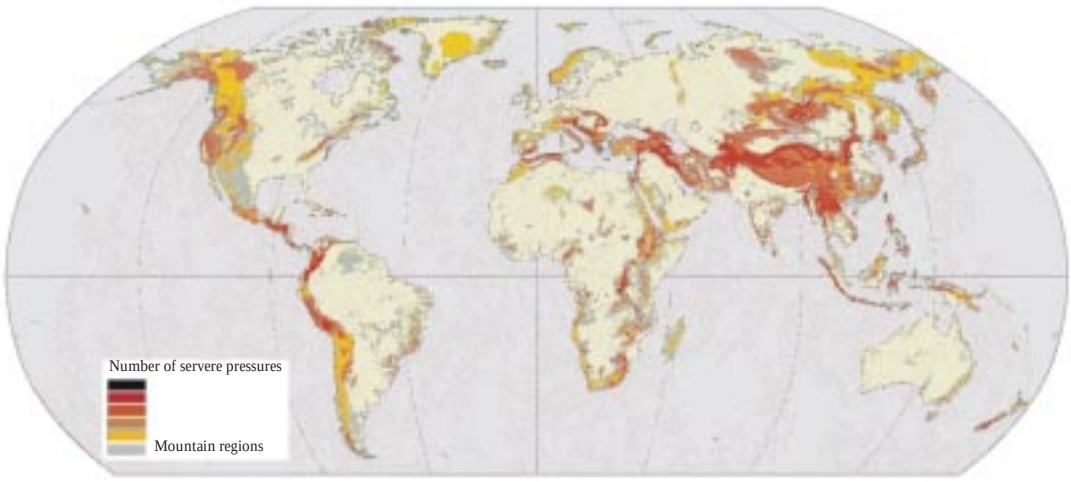


Figure 2.

Integrated assessment of six pressures in mountain regions



Source map (see refs in UNEP-WCMC (2002))	Definition of servere pressure
Agricutural suitability for rain-fed crops	All map units classed as "good" to "very suitable" for rain-fed crops
Nighttime fire: ATSR satellite observation, 1998-2000	All map units experiending fire in the 3 year period
Climate change anomalies 2040-69 means from five GCMs	All map units with a decrease in precipitation > 50 mmy^{-1} and/or increase in temperature > 25° C
Conflict with 50 km radius of "war" intensity	All map units induded in the radius of a conflict that led to at least 1000 battle-deaths per year
Global seismic hazard	All map units with a 10% chance of exceedance in 50 years of a peak ground acceleration of 10% g ("Destructive" quake on the Modified Mercalli scale)
Global scenario at 2035	All map units with an impact value of 1 (high impact)

26
PROMOTING DEVELOPMENT FOR SLUM COMMUNITIES LIVING IN THE MOUNTAINS AND HILLS OF SWAZILAND

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Keywords: Mbabane, tourism, Swaziland

The various communities and their ideas about the future development of the city of Mbabane need to be concerted. The vision for the future development of the city is that it should remain an administrative, commercial and residential area capable of attracting as well as accommodating tourists. The various groups were also unanimous on the issue of restricting the development of heavy industry in the city.

The topography of Mbabane is hilly and mountainous with steep slopes and largely impermeable hard rock with shallow soils; as a result about 40% of the land within the city boundaries cannot be developed easily.

Mountains are very important in Swaziland for providing different resources. If these resources can be developed, it can reduce the problem of community slums and informal housing in the kingdom of Swaziland.

However, government and non-government organisations are still planning the most economical and effective development of urban growing townships such as starting projects to reduce the rate of unemployment.

The mountains areas in Swaziland cover North-South of the country. These areas are rich of natural resources such as biodiversity, minerals, forests, water and others resources.

Many of the primary issues in sustainability-including biodiversity, tradition systems, and social change-are either directly or indirectly associated with the increase use of mountains as touristy attraction in Swaziland. While a well-managed tourism brings benefits, usually the bulk of economy go elsewhere, leaving mountain people with depleted resources. These tourists visiting the mountains have a great impact on Swazi culture and their way of living.

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STATUS, TRENDS AND CONSERVATION APPROACH FOR WHITEBARK PINE ECOSYSTEMS IN CANADIAN ROCKY MOUNTAIN NATIONAL PARKS

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Keywords: forests, status and trends of mountain biodiversity, mountain vegetation, protected areas, impacts of invasive alien species, Canada

Introduction

The Canada National Parks Act establishes the maintenance or restoration of ecological integrity as the first priority in the management of National Parks (Canadian Heritage 2000). Whitebark pine (*Pinus albicaulis*) is found in high elevation forests in the mountainous regions of western North America (Arno and Hoff 1989) (Figure 1). Whitebark is a keystone species shaping subalpine biodiversity in the Canadian Mountain National Parks but its ecological role is threatened. This paper outlines the ecology of the species, the threats to it and the conservation approach being pursued by Parks Canada.

Status

Whitebark pine is the only North American stone pine – a subsection of the pines whose cones remain closed at maturity and seeds are wingless. Whitebark seeds are an important food source for a number of animals including squirrels, bears, and in particular, the bird species Clark's nutcracker (*Nucifraga columbiana*). Clark's nutcrackers are thought to have co-evolved with the pine as its only effective seed dispersal agent. Forest openings created by fire are attractive to Clark's nutcracker as they provide increased opportunities for seed caching (Tomback and Linhart 1990). Un-retrieved, cached seeds appear to be the sole source for whitebark regeneration (Lanner 1996). Whitebark can dominate subalpine sites for several decades or more, depending on site characteristics. Whitebark also plays an important role in watershed protection by aiding soil stability and facilitating a more rapid return to forested landscapes following disturbances on southern exposures where harsh conditions may otherwise limit seed germination (Arno and Hoff 1989, Callaway 1998). Eventually, in the absence of disturbance, many stands that were initiated by whitebark pine become in-grown and then dominated by mature Engelmann spruce (*Picea englemannii* and subalpine fir (*Abies lasiocarpa*).

Trends

Whitebark pine is threatened by a number of anthropogenic factors. These include an introduced blister rust species (*Cronartium ribicola*), fire suppression and associated seral replacement by more shade tolerant tree species, and by rapid global climate change. Both fire suppression and global climate change pose significant challenges to maintaining whitebark ecosystems. However, the most immediate threat is widespread mortality due to white pine blister rust infection. Blister rust has become an epidemic on whitebark pine in parts of its range with 40-100% mortality and 50-100% of the remaining trees infected (Kendall 1996). Blister rust infection and mortality is more pronounced in the southern regions of the Canadian Rockies (Figure 2), but has serious ramifications for all of the Mountain National Parks.

Conservation Plan

In response to widespread infection and mortality in the southern (USA) portion of its distribution, Parks Canada initiated a study to determine the level of blister rust infection and associated mortality of whitebark pine in the Rocky Mountain National Parks (Stuart-Smith 1998). In response to the results of that study, Parks Canada initiated a prescribed burn program, and associated monitoring, to promote whitebark pine

regeneration through nutcracker seed caching. In 2002, Parks Canada completed a whitebark pine conservation plan for the Canadian Rocky Mountain National Parks (Wilson and Stuart-Smith 2002). The plan consists of the following steps to maintain whitebark pine ecosystems:

1. A detailed inventory of the species throughout the federally administered land base;
2. Continuing prescribed burn restoration efforts and associated monitoring;
3. Seed collection for gene conservation and selective breeding for rust-resistance;
4. Analysis of the geographic distribution of adaptive traits;
5. Develop partnerships with other interested agencies and organizations;
6. Explore existing data resources to generate hypotheses to determine relationships between the pine, its environment, and its stressors;
7. Examine potential provincial and federal Species at Risk listing for whitebark pine.

Conclusion

Whitebark pine is a critical element of subalpine, ecological integrity in the Canadian Mountain National Parks. The species is at risk throughout its range, primarily from an introduced pathogen. A conservation approach is now being implemented to respond to the identified threats.

References

Arno, S. F. and Hoff, R. J. (1989). Silvics of Whitebark pine (*Pinus albicaulis*). Intermountain Research Station. Ogden, UT 84401.

Callaway, R. M. (1998). Competition and facilitation on elevation gradients in subalpine forest of the northern Rocky Mountains, USA. Oikos. 82: 561-573.

Canadian Heritage (2000). Canada National Parks Act. Canada Gazette, Part III, Chapter 32. Queen's Printer for Canada. Ottawa, ON, Canada.

Kendall, K.C. (1996). Whitebark pine ecosystems, status and trends. In: Forest Health and the Ecosystem: proceedings of the Fourth Annual Alberta-BC Intermountain Forest Health Workshop, edited by R.C. Walker and R. Kubian, Parks Canada, Radium Hot Springs, BC, Canada.

Lanner, R. M. (1996). Made for each other. A symbiosis of birds and pines. Oxford University Press. New York, NY, USA.

Stuart-Smith, J. (1998). Conservation of whitebark pine in the Canadian Rockies: blister rust and population genetics. MSc. Thesis. University of Alberta. Edmonton, AB, Canada.

Tomback, D. F. and Linhart, Y. B. (1990). The evolution of bird-dispersed pines. Evolutionary Ecology. 4: 185-219.

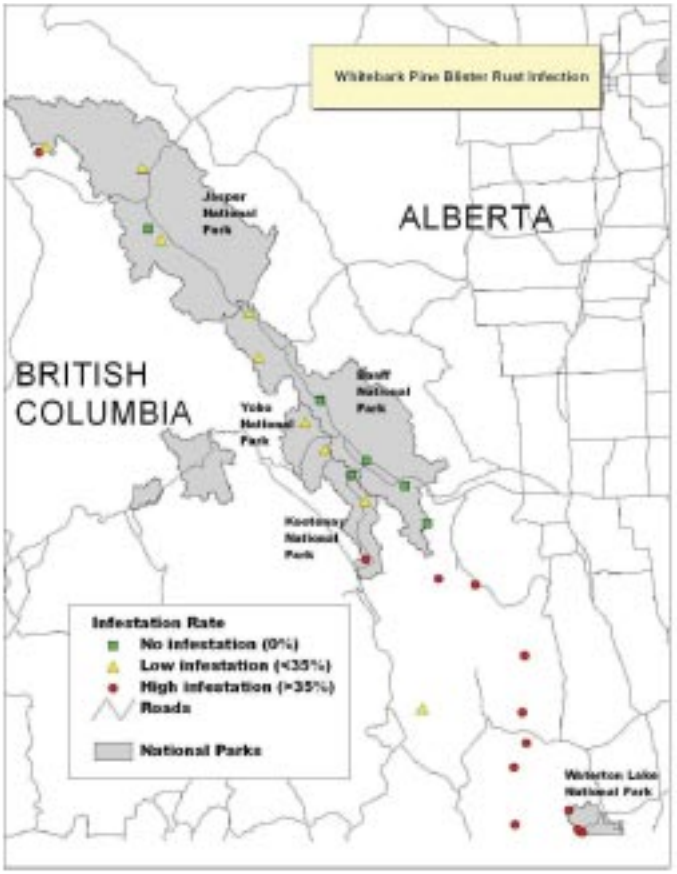
Wilson, B. C. and Stuart-Smith, G. J. (2000). Whitebark Pine Conservation for the Canadian Rocky Mountain National Parks. Cordilleran Ecological Research. Winlaw, BC, Canada.

Figure 1.

Outline of the native range of whitebark pine (adapted from Arno and Hoff 1989).

Figure 2.

Relative levels of Cronartium ribicola infection in the Canadian Mountain National Parks.



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TROPICAL MONTANE CLOUD FORESTS

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Keywords: Forests, goods and services, climate change

Tropical Montane Cloud Forest (TMCF) occurs on mountains where there is frequent cloud or mist. These evergreen forests are characterised by the presence of tree ferns and an abundance of mosses, orchids and other plants growing on every tree and branch. The vegetation intercepts moisture from the direct presence of clouds, and so adds water to the ecosystem over and above direct rainfall. This clean water is vital to the economies and well-being of local communities and cities in the lowlands, especially in the dry season. TMCFs are also of global importance because they contain exceptionally high levels of species that are endemic or restricted to local areas.

Mapping cloud forests

This map shows the distribution of forests between 1000 and 3500m, derived from UNEP-WCMC tropical forest data set and land cover data from the University of Maryland Global Land Cover Facility (Hansen *et al*. 2000). TMCFs occupy an altitudinal belt of about 500m where the clouds form, which varies from 1000 to 3500m in different mountain ranges. All TMCFs should therefore occur within the shaded area of this map.

Threats

Tropical montane cloud forests are increasingly becoming fragmented islands of montane forests surrounded by agricultural landscapes. UNEP-WCMC has compiled a database of TMCF sites. This records clearance for farmland by resource-poor farmers as the dominant threat to TMCFs around the world. In South America extensive cattle ranching is a major pressure on TMCFs. In Africa they are also being degraded by fires in the dry season and the hunting of game species. In some southeast Asian countries commercial logging is a particular pressure. Cloud forests are also uniquely threatened by global warming causing a lifting of the cloud base above the forest, which subsequently becomes dryer.

UNEP-WCMC is working with WWF, IUCN and the UNEP Regional Offices to build partnerships and strategies for cloud forest conservation.

Références

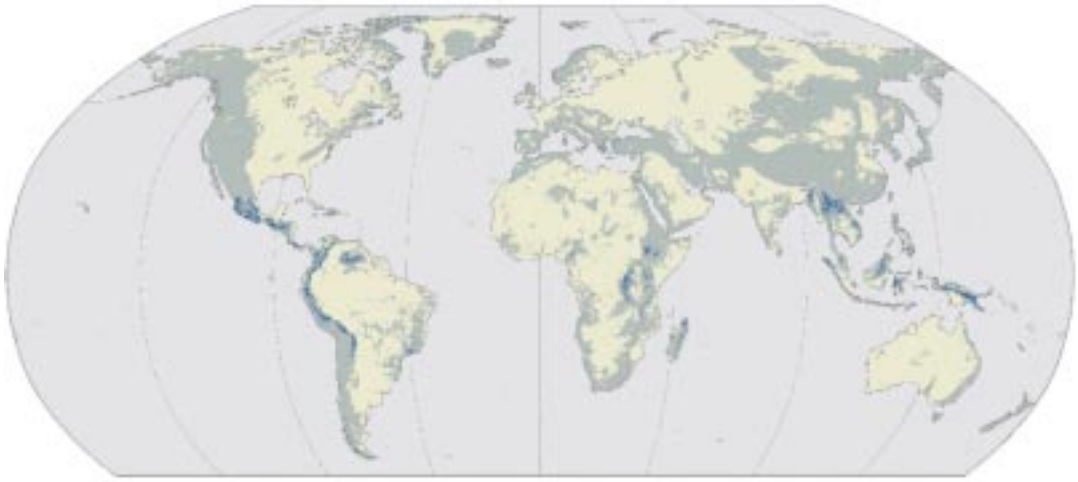
Hansen, M., DeFries, R., Townshend, J. R. G. and Sohlberg, R. (2000). "Global land cover classification at 1km resolution using a decision tree classifier", International Journal of Remote Sensing. 21: 1331-1365.

UNEP World Conservation Monitoring Centre. (2002) Mountain Watch. UNEP-WCMC, Cambridge, UK.

ILLUSTRATIONS

Figure 1.

Potential distribution of tropical montane cloud forest: tropical (& subtropical) moist mountain forests between 1000 and 3500m.



Marine and Coastal Biodiversity

1
COLLABORATIVE, GLOBAL ACTION TO CONSERVE TROPICAL MARINE BIODIVERSITY

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Keywords: protected areas, coral reefs, marine ecosystems

Conservation International, The Nature Conservancy, and the World Wildlife Fund pledge to work together – and to promote partnerships with a wide range of other global, regional, national, and local organizations – to protect tropical marine biodiversity around the world by helping create and sustain networks of well-managed marine protected areas (MPAs); by addressing threats to their biological integrity posed by unsustainable fishing, pollution, and other factors; and by building resilience in the face of large-scale, unmanageable threats such as coral bleaching, into MPA selection, design, and management.

Our vision

Our Vision is a future in which scientifically designed, functionally connected, effectively managed, and sustainably financed networks of marine protected areas succeed at conserving the representative biodiversity and ecological processes of the world's most biologically important tropical marine areas. Key components of effective management are that marine biodiversity loss is halted, current threats to ecosystem health and integrity no longer endanger biodiversity within these MPAs, and future threats are prevented or mitigated. Planning and action to create and sustain these networks should involve key stakeholders, respect and builds on environmentally sound community/traditional practices, and includes incentives for improving human livelihoods compatible with conservation goals.

Problem statement

All around the world, marine ecosystems are collapsing under the pressures of biological, chemical and physical impacts. Over-exploitation, pollution, conversion of coastal habitat and degredation of marine habitat are all serious and significant threats stemming from human activities. Futhermore they are being exacerbated by chronic long-term threats such as climate change. Coral reefs are a particular concern. They represent one of the greatest storehouses of biodiversity on Earth, and provide food and income to sustain hundreds of millions of people, yet are being destroyed at an unprecedented rate and scale.

Collaborative Global Action for Conservation

Marine protected areas—ranging from community-designated reserves to large national parks—are considered one of the best and most effective tools for conserving tropical marine biodiversity and maximising the productivity of these ecosystems. However, present levels of protection (less than 1% of ocean and coastal habitat) are grossly insufficient to safeguard tropical marine biodiveristy and prevent immanent extinctions.

Addressing the global crisis in the tropical ocean requires both a concerted global effort to expand the area under protection and sustainable management, and addressing the range of threats to marine biodiversity. Protected areas, especially scientifically designed, strategically placed MPAs that form functionally linked networks, provide a solid foundation for ambitious, large-scale conservation programs, and help to focus threat reduction, restoration, and mitigation efforts. MPAs also provide a testing ground for new and innovative management approaches and sustainable financing options.

Conservation International, The Nature Conservancy, and the World Wildlife Fund believe that by focusing on a number of critical goals, the collective influence of our international networks and convening power of our organizations can mobilize the momentum required to succeed at a truly global scale and create the necessary foundation to protect tropical marine biodiversity.

Ten-Year Conservation Goals

Working jointly and individually – and operating through a broad network of global, regional, national, and local partners – Conservation International, The Nature Conservancy, and the World Wildlife Fund seek to achieve the following goals over the next ten years:

- Conservation activities in at least ten marine ecoregions around the globe are framed within large-scale priority setting and strategic conservation planning frameworks.

- At least 100 additional new or existing high priority tropical marine MPAs achieve effective management and are successful at eliminating current threats, stabilizing and restoring ecosystem integrity, and mitigating future threats. These sites regularly meet their management costs from a portfolio of reliable long-term revenue sources and innovative management approaches.

- At least ten functionally connected MPA networks are in place in the world's most biologically important tropical marine areas. These networks are designed using leading-edge marine science, meet high standards of management effectiveness and financial sustainability, and show measurable progress in maintaining large-scale patterns of biodiversity and abating current and future threats. The biological and economic benefits of these networks are demonstrated to a wide range of stakeholders through effective monitoring programs.

- Lessons learned from implementing activities in the MPA sites and MPA networks are well documented and widely accessible to partners and stakeholders. Education and outreach efforts ensure complementary action by other organizations around the world, and governments, managers, NGOs, and donor agencies incorporate lessons learned and adopt the new approaches being advocated.

2
THE ENDEAVOUR HYDROTHERMAL VENTS MARINE PROTECTED AREA

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Keywords: Conservation, Marine Protected Areas, Hydrothermal Vents, Canada

Background

Plant life is impossible in the total darkness of the deep sea and most deep-sea food chains are nourished by organic debris that sediments down from surface waters where phytoplankton carry out photosynthesis. Only a very small fraction (1% or less) of this surface productivity reaches the deep ocean floor. As a result, nutritional resources and animal life are very scarce. The 1977 discovery of luxuriant oases of giant tubeworms, clams and mussels clustering around hydrothermal vents >2000m deep came as a complete surprise to biologists who scrambled to identify the food source for this unusual ecosystem. Vent faunal biomass, measured as kg tissue/m^2, can be 500 to 1000 times that of the surrounding deep sea, and rivals values in the most productive marine ecosystems such as shellfish cultures. Biological productivity at hydrothermal vents is sustained not by photosynthetic products arriving from the sunlit surface ocean, but rather by the chemosynthesis of organic matter by vent microorganisms, using energy from chemical oxidations to produce organic matter from CO_2 and mineral nutrients. Hydrogen sulphide and other reducing substances present in hydrothermal fluids provide the 'fuel' for organic matter synthesis. Since hydrothermal fluids are formed by reaction of seawater with hot rock, researchers quickly realized that vent ecosystems were ultimately powered by heat from the earth's mantle. This was a startling conceptual challenge to the long held view that all of our planet's ecosystems require sunlight and photosynthesis to create new biomass and nourish animal food chains.

Another surprise to biologists was the novel nature of the vent organisms, most previously unknown to science and many exhibiting unusual adaptations to the severe, potentially toxic nature of the hydrothermal fluids. High animal density and the presence of unusual species are now known to be common characteristics of deep-sea hydrothermal vents all over the globe, with the composition of the fauna varying between sites and regions. More than 100 vent fields have been documented along the 60,000km global mid-ocean ridge system. Species conservation and environmental stewardship are becoming issues of particular concern to hydrothermal vent scientists. Hydrothermal faunal communities occupy very small areas of the seafloor and many sites contain animal species found nowhere else. As vent sites become the focus of intensive research activity, ecotourism, mineral exploration and deep-sea mining, oversight organisations will need to develop mitigative measures to avoid significant loss of habitat or extinction of populations.

The Endeavour Hydrothermal Vents

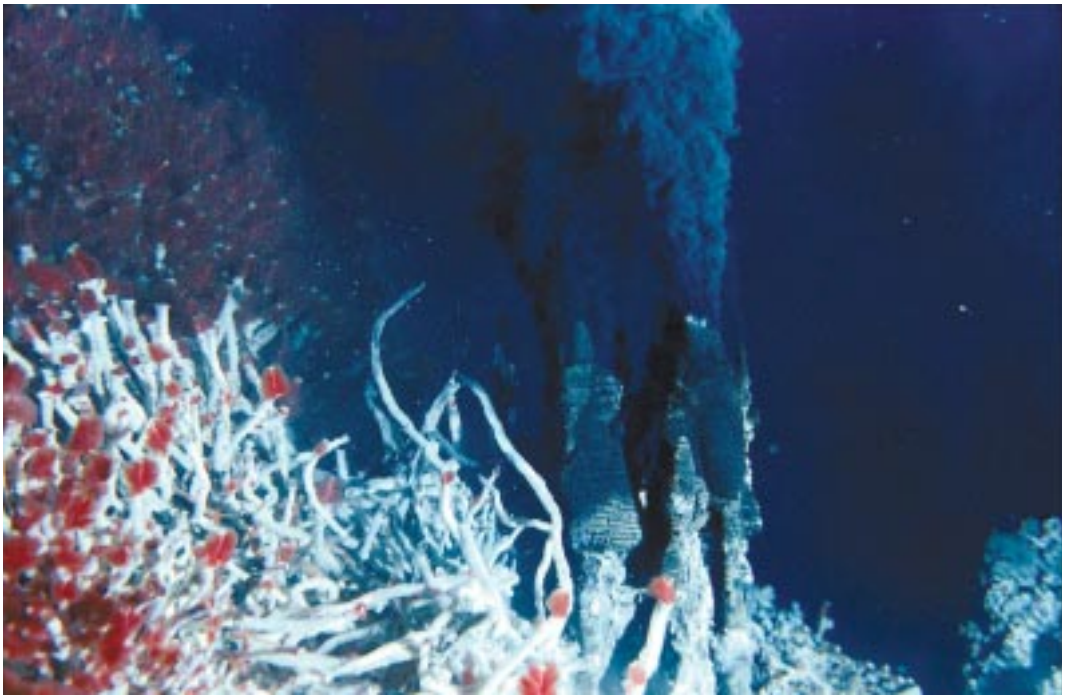
Canada has become the first country to accord measures of protection to deep-sea hydrothermal vent fields and their associated organisms. Canada's 1997 Oceans Act contains provisions for the creation of Marine Protected Areas (MPA's) as a management tool, within Canada's 200 mile Exclusive Economic Zone. One of the first candidate locations identified for the creation of an offshore MPA was the Endeavour Hydrothermal Vents, which are found in the northeast Pacific Ocean at 2200m depth, 250km southwest of Vancouver Island. Since their discovery in 1982, the Endeavour Hydrothermal Vents have been a focus of research by Canadian and international scientists. The 4 x 6 nautical mile (82 km^2) Endeavour MPA encompasses 4 vent fields that include features such as large hot black smoker chimneys and surrounding lower temperature vents. The fields span a wide range of hydrothermal venting conditions characterized by different water temperatures and salt content, mineral chimney morphology and animal abundance. Temperatures associated with the black smokers are typically in excess of 300˚C. Formation of the large, polymetallic chimneys takes place when dissolved minerals and metal ions carried upward by the hydrothermal fluids precipitate on contact with

cold seawater. The flanks of the chimneys and the surrounding seawater support an abundant fauna that forms an unusual mosaic community whose composition is constantly changing in response to shifting temperature and chemical conditions. The Endeavour Hydrothermal Vents are home to at least 12 species found nowhere else.

The Endeavour MPA has been created to set the area aside for scientific research. Research activities are monitored by a Management Committee to mitigate use conflicts and environmental disturbance. Included in the present management plan are provisions such as zoning of sampling and 'observation only' areas, to ensure the pristine nature of the area and permit long-term observations of natural change and response to natural disturbances.

Figure 1.

Summit of a black smoker chimney complex at the Endeavour Hydrothermal Vents Marine Protected Area. Red gills and white tubes of metre-long giant tubeworms are visible in left foreground. Photo V. Tunnicliffe.



3
ESTABLISHING THE BASELINE AND IDENTIFYING THE MPA "GAP" – ASSESSING THE CURRENT STATE OF MPA COVERAGE

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Keywords: Marine Protected Areas

The agreement on oceans at the World Summit on Sustainable Development in September 2002 made a global commitment to establishing networks of representative marine protected areas (MPAs) by 2012. To reach this goal it will be necessary to establish a baseline of current MPAs and track further MPA establishment. The most complete, global list of marine protected areas, the UNEP – World Conservation Monitoring Center database (IUCN, 1998), depends on nationally generated data sets. As such, it is liable to give an inflated picture of the number of MPAs around the world, since both paper parks, and sites with no conservation intent, are included in the data set.

In order to get a more accurate picture of dedicated and effective MPA designations at national, regional, and ultimately global scales, WWF has developed a set of criteria to screen all existing designated parks and establish benchmarks against which to measure progress in meeting the 2012 goal.

The criteria qualifying under "conservation intent" to be included in our baseline include:
1. Be established with an aim of achieving conservation; damaging use is prohibited
2. Be spatially explicit
3. Be of long term or permanent duration
4. Have a commitment and ability to provide proper management

Thus far, we have found that in North America (Canada, USA, Mexico) less than 10% of sites in the UNEP-WCMC MPA database (IUCN, 1998), or approximately 8,169,970Ha (81,699 sq. Km), met our conservation criteria. We are currently assessing Africa, Europe, Southeast Asia and Australia.

References:

IUCN (1998). 1997 *United Nations List of Protected Areas.* Prepared by UNEP-WCMC and WCPA. IUCN, Gland, Switzerland and Cambridge, UK. 1xii + 412pp. ISBN 283170426X

Figure 1.


WWF
PRELIMINARY
MPAs in North America that meet the
WWF Criteria for Protection
0
2500
5000
Kilometres
Sites in Canada (2,344,220 Ha, Approx. 0.78% of EEZ)
Sites in the USA (2,090,750Ha, Approx 0.25% of EEZ)
Sites in Mexico (3,735,000 Ha, Approx 1.25% of EEZ)

4
ETAT DES CONNAISSANCES SUR LA BIODIVERSITE MARINE (ESPECES) DU MAROC[1]

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Keywords: Marine ecosystems, Morocco

Les côtes marocaines en raison de leur situation dans des zones d'Uppwelling comptent parmi les plus poissonneuses du Maroc ; de plus, leur position entre la Méditerranée et l'Atlantique et à la croisée de masses d'eaux d'origines différentes en ont fait l'un des pays les plus riches, sur les plans écosystémique et spécifique, dans la région lusitanienne.

Structure de la Biodiversité spécifique du Maroc

De l'étude nationale sur la biodiversité, il se dégage que la diversité biologique marine se montre très riche et diversifiée (7825 espèces, dont 7136 formes animales et 689 espèces végétales), et il y a lieu de penser que ce nombre devrait être bien plus important dans la mesure où les côtes marocaines, malgré le grand nombre de campagnes scientifiques dont elles étaient sujettes, bon nombre de groupes systématiques n'ont jamais été étudiés ou n'ont fait l'objet que d'études peu nombreuses et très limitées dans le temps et dans l'espace.

Dans tous les cas, si on ne prend en considération que certains groupes connus et étudiés au Maroc, la faune par exemple, celle-ci représenterait, à l'état actuel des connaissances, près de 5.44% du total des espèces recensées à l'échelle de la planète et dépasserait toute celle estimée dans la Méditerranée y compris la mer noire, de 0.22%. La faune marine du Maroc dépasserait également de 31,72% toute la faune effectivement stockée dans la base de données méditerranéenne jusqu'en.

La faune marine du Maroc montre une structure très comparable à celle de la faune mondiale et méditerranéenne, avec la prédominance des trois mêmes groupes zoologiques (Arthropodes, mollusques puis les vertébrés) qui comptent, ensemble, 65.85% du total de toutes les espèces recensées jusqu'à présent au Maroc; pourcentage très proche de celui calculé à l'échelle planétaire. Quant aux végétaux marins, ceux ci comptant près de 690 espèces au total, ils sont essentiellement dominés par les algues Rhodophycées (303 espèces), puis Phæophycées (99 taxa), puis Chlorophycées (87 espèces) et, enfin, les Cyanophycées (12 formes différentes). Quant aux phanérogames marines, elles n'y sont représentées que par 4 espèces dont une très probablement éteinte de nos côtes. Outre ces macrophytes benthiques, les côtes marocaines abritent quelques 200 espèces d'algues phytoplanctoniques recensées principalement sur la façade atlantique.

Biodiversité marine d'intérêt socio-économique du Maroc

De toutes les ressources biologiques naturelles du Maroc ayant un intérêt ou une répercussion socio-économique, celles en provenance du milieu marin restent les plus diversifiées (878 espèces).

Les espèces de la faune marine du Maroc, pouvant avoir des répercussions aussi bien positives que négatives sur le plan socio-économique, comptent 724 formes différentes et représentent un peu plus de 10% du total des espèces. Cette faune est très largement dominée par les poissons qui constituent l'essentiel des prises. Ils sont suivis des cœlentérés, tous des coraux, mais dont seul le corail rouge est actuellement exploité (ou plutôt surexploité).

[1] Travail réalisé dans le cadre du projet SPANB-Maroc

Parmi les 154 espèces végétales pouvant avoir un intérêt économique ou commercial, une seule algue (*Gelidium sesquipedale*) est exploitée alors que l'utilisation d'autres algues, très abondantes pourrait être envisagée.

Biodiversité marine menacée du Maroc

271 formes animales ont été placées dans cette catégorie d'espèces, ce qui constitue 3.75% du total des espèces. Elles sont dominées par les 108 coraux qui représentent 40% du total des espèces menacées, puis des poissons avec 85 espèces (31.48%), des crustacés (23 espèces, soit 8.51%), les mammifères marins (21 espèces, correspondant à 7.77%), puis des mollusques (20 espèces, 7.40%), des tortues marines (6 espèces; 2.22%), des spongiaires (5 espèces; 1.84%) et, enfin, les agnathes (2 espèces, 0.74%). Parmi les espèces animales marines les plus menacées du Maroc, il y a lieu de citer le phoque moine de la Méditerranée (*Monachus monachus*) l'une des 12 espèces les plus menacées à l'échelle planétaire.

Pour la flore marine, le nombre d'espèces réellement menacées est relativement réduit, limité essentiellement à des espèces soit exploitées dont *Gelidium sesquipedale* soit à des herbiers décimés par la dégradation du milieu et la pollution.

Biodiversité marine réglementée du Maroc

Les ressources marines biologiques du Maroc soumises à une réglementation nationale ou internationale sont relativement peu nombreuses. 262 espèces peuvent être placées dans cette catégorie, soit 3.67% du total des espèces. Elles sont réparties sur les cœlentérés (40.45%), les poissons (32.44%), les mammifères marins (8%), les crustacés (7.63%), les mollusques (6.48%), les tortues marines (2.29%), les spongiaires (1.90%) et, enfin, les échinodermes et les agnathes (moins de 1%).

Biodiversité marine endémique du Maroc

Le Maroc recèle aujourd'hui quelques 237 espèces marines endémiques, ce qui constitue près de 6% du total de toutes les endémiques du pays (4110). Avec un indice d'endémisme de 3.31%, le Maroc est situé parmi les pays ayant un pourcentage d'endémisme normal; mais on pense que ce taux d'endémisme marin devrait, en principe, être plus élevé pour deux raisons principales: - les côtes marocaines, encore inexplorées par endroits révéleraient très certainement de nombreuses autres espèces nouvelles pour la science; - la surface réelle prospectée, considérablement plus faible que celle utilisée pour le calcul de cet indice, permettrait la correction de ce pourcentage et, par conséquent, situer le Maroc dans la région des pays à fort taux d'endémisme.

Biodiversité marine domestiquée du Maroc

Les espèces marines réellement domestiquées au Maroc comptent 66 espèces différentes, soit 0.94% de toutes les espèces marines recensées à l'échelle nationale. La structure générale est largement dominée par les poissons (44 espèces, 75.6%), suivis des mollusques (10 espèces, 15%) puis les crustacés (5 espèces, 7%), puis les mammifères, les tortues, les échinodermes et les rotifères. La majorité de ces espèces étaient domestiquées pour des fins d'aquariophilie et très peu l'était pour des buts aquacoles.

Références :

Département de l'environnement (1998) : Etude Nationale sur la Biodiversité Faune Marine. Min. Env./PNUE : 101 p

Riadi H. (1998) : Etude Nationale sur la Bidiversité. Algues marines. Min. Env./PNUE : 98 p

5
FIRST REGIONAL ASSESSMENT OF CARIBBEAN CORAL REEF HEALTH

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Keywords: Coral reef, rapid assessment, regional database, management, conservation, Caribbean

Introduction

Clearly coral reefs of the Caribbean are in decline. What is not clear is the spatial extent and severity of the declines. To produce answers to these concerns, the Atlantic and Gulf Rapid Reef Assessment (AGRRA) Program was designed to assess the health of coral reefs throughout the region by examining communities of reef-building corals, fishes, and algae. It is the first ever initiative to examine the regional health of coral reefs using trained experts rather than volunteers. AGRRA is focused on three objectives:

- Complete the regional assessment of the health of coral reefs throughout the Western Atlantic and compile results in a searchable database.
- Establish a practical scale of comparative reef condition.
- Use training, publications, and workshops to transfer results to a wider audience including 1) the general public 2) resource managers 3) government officials 4) policy makers 5) tourist operators 6) students.

Guiding Principles

The AGRRA surveys are based on three guiding principles:

- Multiple indicators are required to evaluate the interrelated communities of corals, algae, and fishes.
- Assessments must be done rapidly so that many reefs can be surveyed.
- The surveys are designed to provide multi-scale comparisons (e.g. adjacent reef; reefs of a country; reefs within a region) of reef health so that a single assessment can be used to determine where a reef falls within the scales of Caribbean reefs.

Field Procedures

Benthos:
Corals, algae, and grazing sea urchins (*Diadema sp*). Our teams of four to six trained divers evaluate reef health in about an hour by assessing several key indicators of coral reef condition:

- Corals by species and sizes
- Percent partial mortality of each specimen subdivided into recent (<6 months) and old (>6 months)
- Incidence and classification of coral diseases
- Relative abundance of principal algal communities –crustose and fleshy Abundance of grazing sea urchins (*Diadema sp.*)

Fish Surveys. Two distinct methods are used to quantify fish diversity and abundance:

- Divers swim a belt transect and record number of exploited species, abundance, and sizes.
- Divers make a roving diver census of all species of fishes following the method of REEF *(http://www.reef.org/)*.

All recorded data are transferred to the AGRRA database (Microsoft Access). A complete description of the AGRRA methodology Version 3.1 is available at our web site *(http://www.coral.noaa.gov/agra/method/methodology.htm)*.

Preliminary Results

1. Over 500 reef sites have been assessed in 15 different countries during which around 40,000 coral colonies were examined. This information is the first comprehensive regional compilation of spatial biodiversity of coral and fish species. In addition, the data assembled is an essential baseline with which to evaluate changes by repeating the assessments.

2. An example of how the results can be used to establish a classification of reef health is shown in Figure 2 for a limited number of reef areas. When our regional assessment is complete, it will be possible to make multi-scale comparisons of reef health for all sites, areas, or countries.

3. Nearly 100 scientists, reef park managers and graduate students have been trained in the AGRRA methods through courses and participation in surveys. Some countries have adopted the AGRRA method as the standard for monitoring.

4. Efforts are underway to make the AGRRA database available on the World Wide Web.

Figure 1.

Map of western Atlantic showing AGRRA regional division boundaries and site locations for surveys reported between 1998-2002. Numbered sites correspond to reef health classification using the Bray Curtis similarity index in Figure 2.

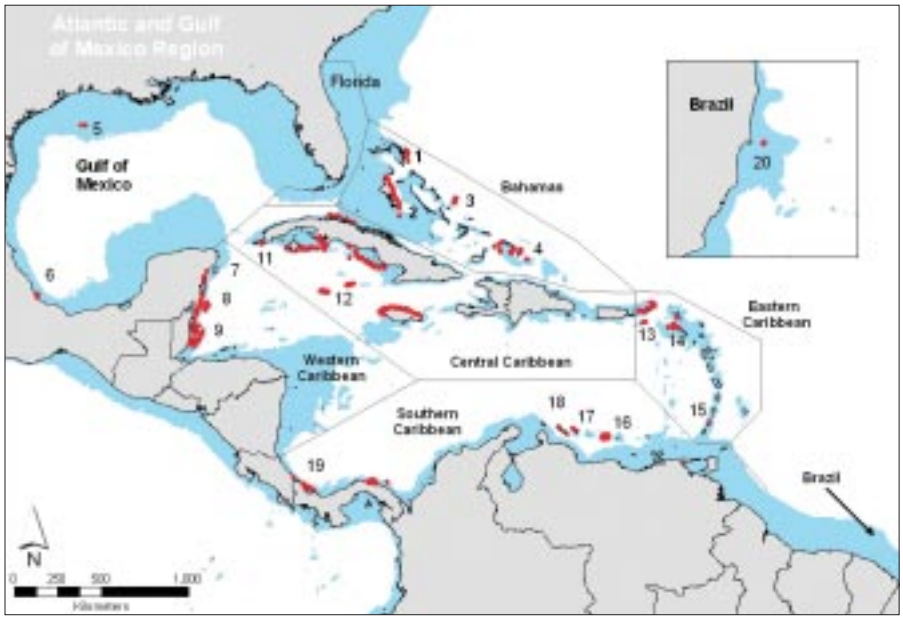
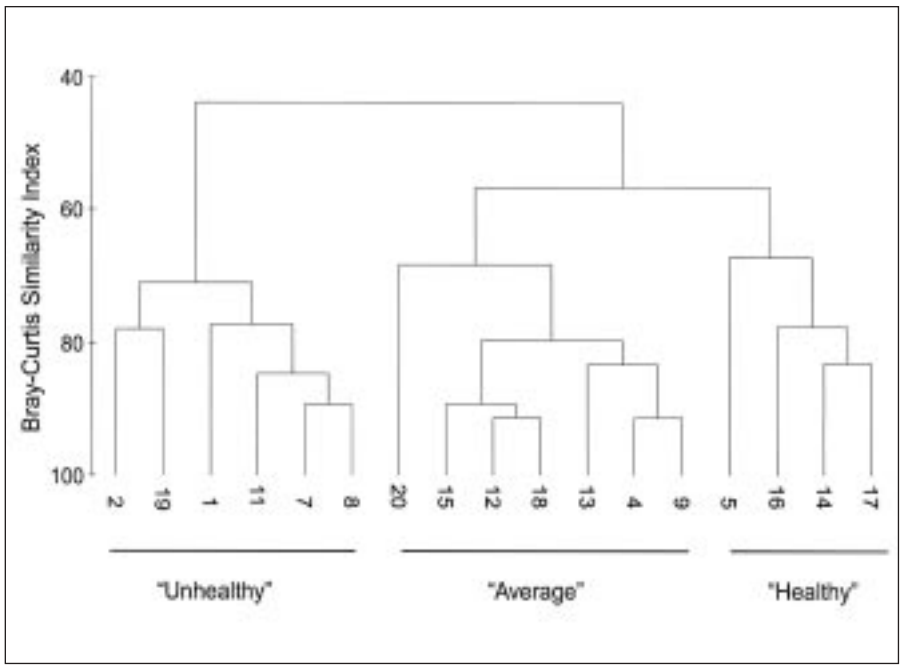


Figure 2.

Preliminary regional reef health classification using Bray Curtis similarity diagram. Diagram based on 14 AGRRA indices (live coral cover, large coral density, small coral density, *Montastraea annularis* complex diameter, recent mortality, old partial mortality, total mortality (including standing dead), coral disease incidence, macroalgal index, relative abundance of crustose coralline algae, *Diadema* density, herbivore fish abundance, carnivore fish abundance).



6
GEF CORAL REEF TARGETED RESEARCH AND CAPACITY BUILDING – addressing critical knowledge gaps to improve management

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Keywords: coral reefs, vulnerability, resilience, targeted research, capacity building, cost-effective management

Introduction

A major initiative has been launched by the World Bank and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, with support from the Global Environment Facility, to support coral reef resource managers with the best available scientific advice on coral reefs response to human disturbances and climate change.

The program will be addressing a range of components of CBD's **Specific Workplan on Coral Bleaching** (COP VI/3), and CBD's developing workplan on physical degradation and destruction of coral reefs (SBSTTA 6, recommendation VI/2).

Project goals

Through targeted research the initiative seeks to address the gaps in our knowledge of factors determining vulnerability and resilience of coral reef ecosystems to a range of stressors, and the application of this knowledge to management. Coral reef managers continue to struggle between the need for protection and providing for the needs of many direct and indirect users of coral reefs. This often means that complex tradeoffs are necessary, and frequently these decisions are made without access to sound scientific advice: "Hard decisions require hard science, and successful long-term management without it is an illusion" (Citation: Knowlton, N. 1998), Hard Decisions and Hard Science: Research Needs for Coral Reef Management).

The GEF Targeted Research and Capacity Building Program is assembling more than 60 experienced scientists to answer critical questions concerning coral reef vulnerability to human stresses and the impacts of climate change. The program aims to:

- Address the gaps in scientific knowledge that prevent informed decision-making for coral reef management;

- Create the investigative framework and build human resource capacity to address these gaps.

This is a collaborative program between developed and developing country scientists to examine the issues on a global scale. It also aims to build capacity within coral reef countries to better manage reefs by furthering our understanding of those factors conferring resilience or increasing vulnerability of reefs to major stress, and addressing the risks to reef sustainability.

Project structure

The program will be implemented by networks of researchers, and will be guided by a Synthesis Panel and 6 thematic coral reef working groups:

Synthesis Panel:
Nancy Knowlton, Scripps Institute of Oceanography, USA; Robert Watson and John Dixon of The World Bank; Angel Alcala, Silliman University, Philippines; and the chairs of the 6 working groups' described below.

Coral Bleaching and Local Ecological Responses, Chair: Ove Hoegh-Guldberg, University of Queensland, Australia. **Goal**: to develop molecular, cellular, physiological and community indicators for coral bleaching under a range of variables, and examine potential mechanisms of coral reefs for adaptation and acclimatization to environmental change. IOC/UNESCO convened the first meeting of the Coral Bleaching working group in April, 2001, with the mandate to develop biological indicators and tools to predict environmental stress on coral reefs and examine specific physiological mechanisms leading to coral bleaching, addressing recommendations of the Convention on Biological Diversity. With support from the World Bank/GEF to develop a broader Targeted Research framework in support of management and conservation of Coral Reefs, the group expanded its mandate to also consider local ecological factors (details on www.ioc.unesco.org/coralbleaching).

Coral Diseases, Chair: Drew Harvell, Cornell University, Ithaca, NY, USA. **Goal:** to examine, prioritize and target investigations that are critical to the understanding of coral diseases, and how this information can assist managers in minimizing disease frequency and transmission;

Large-Scale Ecological Processes, Recruitment and Connectivity, Chair: Peter Sale, University of Windsor, Canada. **Goal:** To examine the role that larval transport, recruitment, post-recruitment survival, and connectivity play in networking coral reef environments, particularly as they relate to the siting and management of marine protected areas;

Coral Restoration and Remediation, Chair Loke Ming Chou, University of Singapore. **Goal:** to examine the state of remediation techniques and efficacy of potential applications, with considerations on protocols to design and implement restoration strategies; baseline data for developing effective criteria; the efficacy and feasibility of restoration and remediation techniques, and prospects for enhancing natural recovery;

Remote Sensing, Chair: Peter Mumby, University of Exeter, UK. **Goal:** to develop systems for holistic monitoring of the physical environment and stress on coral reefs; develop tools to measure the status of reef ecosystems at various ecological, spatial and temporal scales; an integrate above to provide a comprehensive perspective of how global, regional and local processes affect the health of coral reef ecosystems;

Modelling and Decision Support, Chair: John McManus, University of Miami, USA. **Goal:** to develop a coordinated information base that can improve the accuracy and reliability of forecasting and predictive modelling, and to develop modelling tools to handle data on aspects such as community dynamics, oceanography, climate, as well as socio-economic data on fisheries, tourism, and coastal development.

Project developments

Each of the working groups has systematically identified what is known and unknown, and has begun ranking research priorities to benefit management. The six working groups will integrate their efforts and new findings, and will build new research capacities between developed and developing countries by integrating expertise and skills. Each group's reports, new findings and outputs will be available online.

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Reference

Knowlton, N. (1998), Hard Decisions and Hard Science: Research Needs for Coral Reef Management. In: Coral Reefs: Challenges and Opportunities for Sustainable Management. Proceedings of an associated event of the Fifth Annual World Bank Conference on Environmentally and Socially Sustainable Development. October 9-11, 1997

7
GLOBAL INTERNATIONAL WATERS ASSESSMENT

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Keywords: habitat modification, freshwater shortage, assessment, living resources

Introduction

The Global International Waters Assessment (GIWA) is a project led by the United Nations Environmental Programme (UNEP) with the aim of developing a comprehensive, strategic, framework for the identification of priorities for remedial and mitigatory actions in international waters. The Global Environment Facility (GEF) and its partners will use the results of the assessment as an effective means of developing well targeted, practical proposals for incremental funding. In the case of international waters, there is no global assessment comparable with those on climate change, biodiversity and stratospheric ozone. Consequently, it has often proven difficult to prioritize projects related to international waters, particularly given the insufficient understanding of the nature and root causes of environmental problems in this area. The GIWA assessment encompasses the ecological status of trans-boundary freshwater basins and their associated coastal and ocean systems, as well as analyses on the causes of environmental problems and potential policy responses. GIWA focuses on five major concerns:

- Freshwater shortage
- Pollution
- Habitat and community modification
- Unsustainable exploitations of fisheries and other living resources
- Global change

The assessment is conducted in 66 sub-regions across the world by teams of local experts. The main determining factor to define the sub-regional borders was the integrity of each sub-region in terms of encompassing the major causes and effects of environmental problems associated with each trans-boundary water area, whether river basin, groundwater, lake or sea.

Methodology

The GIWA methodology has four components:

- Scaling
- Scoping
- Causal chain analysis
- Policy option analysis

Scaling in conducted in order to: validate sub-regional boundaries, identify the main geographical, socio-economic and physical features, and to identify international water systems within the sub-region.

Scoping generates: an assessment of environmental and socio-economic impacts under present conditions, the likely impacts under future conditions, and ranking of priorities for further analysis. The types of impacts to be investigated cover the impacts that can be associated to the five major concerns. The five major concerns are divided into 23 environmental issues, as shown in figure 1. The impact of each environmental issue and concern is to be assessed on a four point scale, where:

- 0 = no known impact
- 1 = slight impact
- 2 = moderate impact
- 3 = severe impact

The methodology provides definitions for each environmental issue and guidelines as to when impacts should have a particular score.
The assessment of the likely environmental and socio-economic impacts under future conditions involves:

- Construction of a most likely scenario relating to demographic, economic, technological and other relevant changes which may influence the aquatic environment within the sub-region by 2020
- Assessment of the most likely changes in environmental and socio-economic impacts likely to result within the sub-region by 2020

Based on the above analysis, the task teams rank the five major concerns according to the severity of environmental and socio-economic impacts (both current and expected impacts are considered). Only the prioritized concern is subjected to causal chain analysis and the construction of policy options.

Causal Chain Analysis traces the cause-effect pathways from the socio-economic and environmental impacts back to its root causes. Its purpose in GIWA is to identify the most important causes of selected problems in international waters in order to target them by appropriate policy measures for remediation or mitigation.

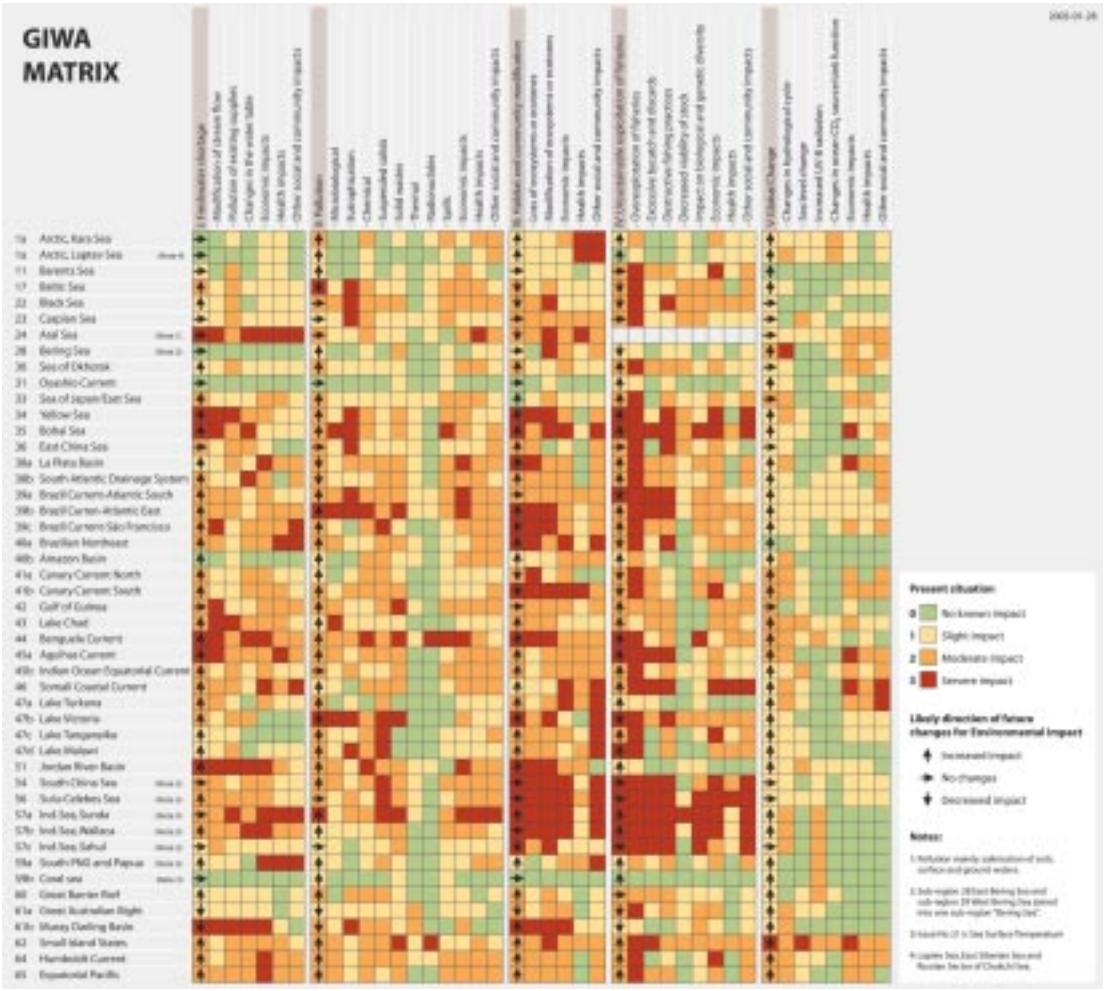
Policy options are different courses of action (not always mutually exclusive) or ways of intervention to solve or mitigate the problems. The core tasks of the GIWA policy options analysis are to i) list potential policy instruments ii) evaluate the performance of the most promising instruments with regard to their effectiveness, fairness, efficiency and practical considerations iii) to realistically project the outcomes of the recommended options. The best estimations of both costs (including undesirable side-effects) and benefits of the recommended policy options are considered. The risks and obstacles that might cause the proposal to fail to generate the desired benefits as well as their estimated probabilities is also included.

Current stage of the GIWA project

The GIWA project began in 1999 and is projected to be completed in 2004. Currently, most of the sub-regions have finalized the scaling and scoping part of the assessment and are moving into causal chain and policy option analysis. The assessment of current environmental impacts, as shown in figure 1, clearly indicates that “Unsustainable exploitation of fisheries” and “Habitat and community modification” are considered as the most stressing concerns i.e. they have been assessed as severe in more sub-regions than any other concerns.

Figure 1.

The table illustrates the present situation in terms of how the GIWA experts assess the areas of concern and the likely direction of future changes for the environmental impacts.



8
HABITAT DESTRUCTION IN THE WORLD'S WATERS

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Keywords: habitat destruction, eutrophication, socio-economic impacts

Results from the GIWA assessment on Habitat and Community Modification

Habitat and community modification is one of the concerns assessed within the ongoing GIWA project (for detailed description of the project see dedicated poster). The environmental impact of the concern has been assessed as severe in 16 sub-regions out of 47 at this stage of the project (figure 1). Within the assessment, Habitat and community modification has been compared with other urgent water related issues i.e. Freshwater Shortage, Pollution, Overexploitation of Fisheries and Global Change. When ranking the five environmental issues, including socio-economic and future concerns, about half of the regions have ranked Habitat and Community Modification among their two top priorities. In other regions the issue is perceived as secondary in relation to other more stressing regional issues, although Habitat and Community Modification may be prevalent. The socio-economic impacts of Habitat Modification are generally not rated as severe as the environmental impact, possibly as a consequence of the intricacy in estimating the true value of the services provided. The major threats to aquatic habitats can be summarized in the following;

- In Europe and Central Asia, eutrophication and overfishing in lakes, estuaries and semi-enclosed seas have altered the ecosystem balance and resulted in habitat destruction and changes in biodiversity.
- In South America the habitats most at risk are the ones situated along the Atlantic coast in the vicinity of large metropolitan areas. Heavy industrialization, tourism developments and domestic sewage are major contributors to the deteriorating condition of habitats.
- In Africa, habitat destruction hotspots are scattered over the continent. The Lake Victoria ecosystem is in a precarious situation as a result of many contributing factors including eutrophication, invasive species and overexploitation. In Southern Africa and in the northwestern part of the continent, rivers and wetlands have been severely impacted by dam constructions and development.
- In Southeast Asia mangrove forests are the most threatened habitats mainly due to extensive aquaculture practices.
- Coral reefs in the Pacific and Indian Ocean are deteriorating as a result of destructive fishing practices and large-scale coral bleaching events caused by increased sea surface temperatures.

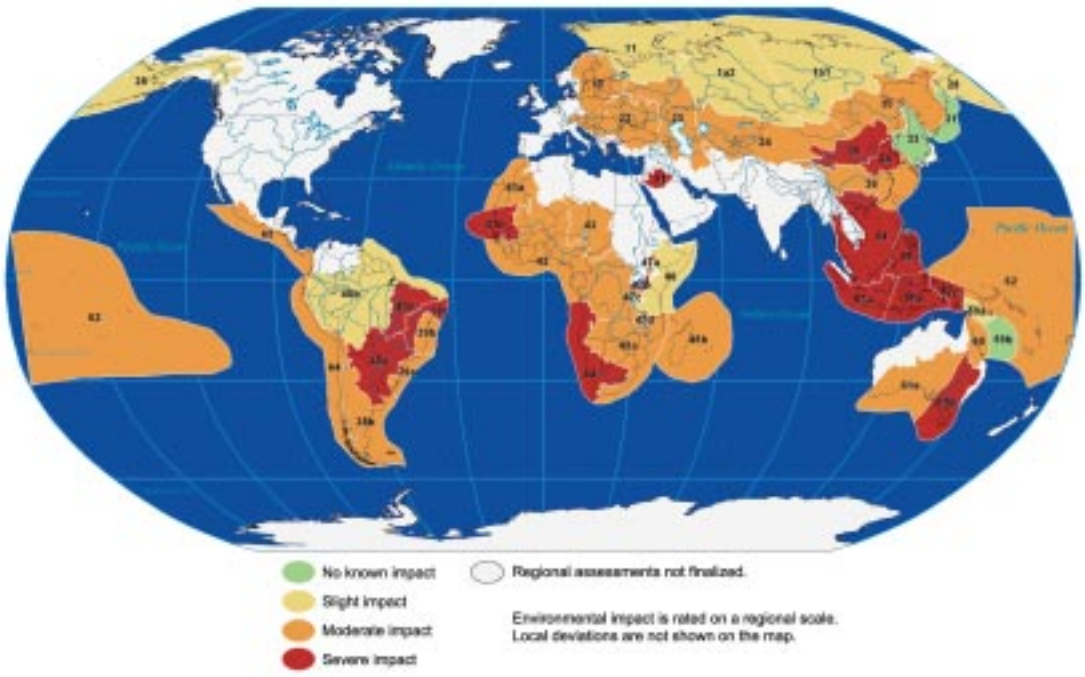
The GIWA assessment is currently moving into the completion of Causal chain and Policy option analysis, where the root causes and different actions to solve or mitigate the problems are analyzed.

Figure 1.

The map illustrates the present situation in terms of how the GIWA experts assess Habitat and Community Modification in the world's waters.

HABITAT AND COMMUNITY MODIFICATION

Interim results of the GIWA project.



9
INCORPORATING CBD OBJECTIVES INTO IMCAM INITIATIVES

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Keywords: Marine and Coastal Management

The CBD has recognised Integrated Marine and Coastal Area Management (IMCAM) as the most effective tool for its implementation with respect to the conservation and sustainable use of marine and coastal biodiversity. In 2000, the CBD Secretariat identified and analysed several existing sets of international (global) guidelines on integrated coastal zone/area management. The results of this preliminary analysis indicated that the existing guidelines do not make adequate specific reference to the biological diversity of the resources being managed. The 5th meeting of the CBD Conference of Parties (CoP-5, 2000), hence endorsed the conduct of further work on IMCAM guidelines to fully meet the Convention's objectives.

In pursuance of this, the Coastal Zone Management Centre (CZMC), The Netherlands initiated a project aim at integrating CBD objectives into IMCAM programmes. In the first phase of this project, the CZMC conducted an analysis of numerous IMCAM documents and three case studies on IMCAM projects by the CZMC in 2001 (CZMC, 2002). This analysis was based on a set of criteria, inferred from the objectives and provisions of the Convention on Biological Diversity and Decisions by the CBD Conferences of Parties. The findings of this analysis were summarised and discussed at a side event "Towards better incorporation of CBD elements in IMCAM projects" at CBD-CoP-6 in The Hague, April 2002.

The above analysis identified several specific topics that required further guidance in order to promote conservation and sustainable use of marine biodiversity through IMCAM. Further discussion and consultation on these issues amongst a wide group of ICZM practitioners and specialists was facilitated through an internet based discussion during October-November, 2002, with the aim of obtaining consensus on the most urgent issues.

Follow up:

During 2003, the CZMC in cooperation with the CBD and several partners (Wetlands International, Ministry of Land, Nature and Fisheries, The Netheralnds, UNEP Global Programme of Action, EUCC - The Coastal Union will produce additional guidance on the following five topics:

- Economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity
- Elaboration and operationalisation of the Ecosystem Approach
- Restoration and rehabilitation of degraded ecosystems and promotion of recovery of threatened species
- Support to local populations to develop and implement remedial action in degraded areas
- Development of indicators to enable monitoring of the implementation of the performance of CBD objectives

The main outcome of this project will be a document providing comprehensive guidance to ensure the integration of CBD objectives within IMCAM programmes. This document will be comprehensive and concise, referring to existing guidance where available and expanding on above topics in which there is limited guidance. The development of this guidance will be collaborative and participatory and it is expected that the process of developing guidance will lead to increased recognition and awareness of the need to incorporate elements of the CBD in IMCAM initiatives.

The final document will be presented at the COP 7 in 2004 for adoption. Progress will be reported at upcoming SBSTTA meetings.

10
IOC/UNESCO STUDY GROUP ON BENTHIC INDICATORS
- development of health indicators for coastal benthos communities

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Keywords: health of coastal benthos, global database, environmental indicators

Study group members: Jeff Hyland, Chair (US); Ioannis Karakassis (Grece); Paolo Magni (Italy); Alexei Petrov (Ukraine); James Shine (US) and Richard Warwick (UK).

[Details on: http://www.ioc.unesco.org/benthicindicators]

Introduction

Numerous research programmes on marine benthos conducted throughout the world have produced substantial datasets containing synoptic information on the abundance and distribution of the biota, environmental conditions and contaminates levels.

By combining them into a global data set and subjecting it to critical analyses that seek to determine relationships between the benthos and environmental conditions, specific environmental variables may be identified that can serve as simple, yet robust indicators of high versus low impacts of anthropogenic and/or natural sources of stress (e.g., due to organic over-enrichment or sediment contamination) on a regional and global basis, to be used in environmental monitoring programs in different parts of the world.

Objectives

In late 1999, The *Intergovernmental Oceanographic Commission (IOC)* of the *United Nations Educational, Scientific and Cultural Organization (UNESCO)* established the Benthic Indicator Study Group with the following objectives:

A) To collate and synthesize data on marine benthos and environmental conditions of selected coastal areas and to investigate patterns in the distribution and abundance of biota in relation to environmental characteristics.
B) To develop recommendations for a subset of specific indicators that are sensitive and reliable in their ability to detect environmental stress of benthic communities, and in addition, are easy to use and broadly applicable in different parts of the world.
C) To demonstrate the effectiveness of these indicators through their application in test data sets from selected coastal regions of the world;
D) To promote the use of these indicators to the broad user community through disseminating results in reports, publications, symposia, web sites, or other effective forums.

Outputs

The expected outputs are:

A) A series of indicators such as geo-chemical markers, which reflects biological conditions, that is easy to use and broadly applicable in detecting stress of benthic communities.

B) A website containing: 1. A database with data on marine benthos and environmental conditions from selected coastal areas of the world; 2. Guidelines and recommendations on the use of indicators in monitoring programs; 3. Guidelines on performing statistical analyses of specific monitoring data; 4. Reference material and standards for comparing and interpreting results.
C) The presentation of results at major international conferences and workshops, in technical reports and the publication of results in scientific and popular journals.

Early findings

Global database and statistical analyses identifies health indicator of benthic fauna communities

In a series of research workshops synoptic data on the structure of macroinfaunal communities and a series of environmental variables such as salinity, total organic carbon (TOC) concentration in sediments, nutrient status, anoxya, heavy metals and more has been obtained from a total of 948 stations representing seven different coastal regions of the world.

Study Sites: A) Northern Black sea along Crimean and Caucasian coasts; B) Eastern Mediterranean Sea along the coast of Crete; C) North Sea, near Ekofisk oil rig, UK; D) Firth of Clyde and Liverpool Bay, UK; E) Tidal estuary of the Seto Inland Sea, Japan; F) Boston Harbor and Massachusetts Bay, U.S.A.; G) Estuaries along Southeastern cost, Cape Henry, Virginia to St. Lucie Inlet, Florida, U.S.A.

Total organic carbon (TOC) indicates the health of benthic communities

Statistical analyses across these various datasets have identified robust relationships between the sediment concentration of total organic carbon (TOC) and the biological state of the benthos communities, which are being developed into a useful indicator of ecosystem health.
A conceptual model (based on Pearson and Rosenberg 1978) showing a generalized pattern of response of benthic fauna in relation to TOC content of sediment and other potential co-varying environmental stressors in sediments is shown in figure 1.

Three levels of low, medium or high concentrations of TOC respectively correspond closely to changes in species diversity of the benthos across the different geographic regions.
Results suggests that risks of pollution-induced reductions in diversity should be relatively low at TOC concentrations below about 8 mg/g, high at concentrations in excess of about 36 mg/g, and intermediate at concentrations in-between. Predictive ability within these ranges, based on results of re-sampling simulation, was shown to be high.

Such general patterns of response to stress should be applicable over broad coastal areas receiving organic wastes and other pollutants associated with human activities.

However, these indicators are intended to be used as general guidelines for assessing the likelihood of bioeffect occurrences and should not be regarded as absolute criteria free of uncertainty.

Implications for global monitoring

The group attempts to provide a general framework for evaluating risks of adverse environmental conditions leading to reductions in benthic species diversity within different ranges of TOC.

The ultimate purpose is to improve the capability to assess and predict changes in the quality of coastal ecosystems through the development of simple reliable indicators that are broadly applicable. These indicators are intended to be used as general guidelines for assessing the likelihood of a bioeffect occurrence and should not be regarded as absolute criteria free of uncertainty.

Future activities

The study group has submitted a scientific paper discussing these findings and their applicability in coastal environmental assessments. In the near future additional datasets will be used to validate the model, and future studies will as an example focus on species-specific trends in distributions along TOC-gradients. Through a set of research- and training workshops focussing on the use of statistical methods to analyse trends in TOC-species indices relationships, as described in the presented study, more data will be integrated in the database, thereby increasing the global applicability of the model.

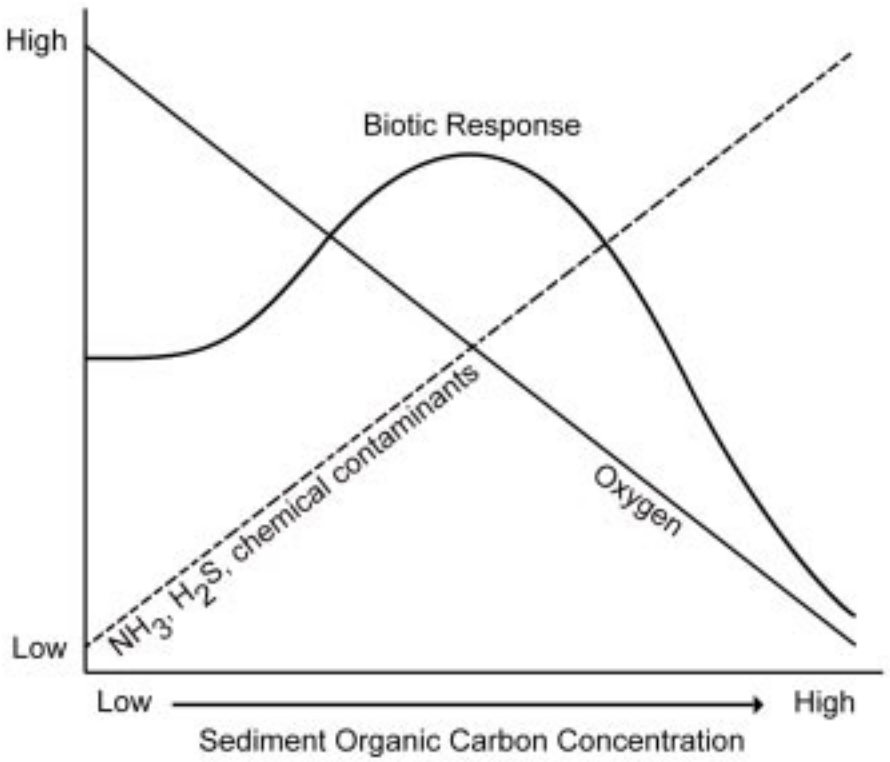
Further information: *http://www.ioc.unesco.org/benthicindicators*

Literature

Pearson, T.H., and R. Rosenberg. 1978. Macrobenthic succession in relation to organic enrichment and pollution of the marine environment. *Oceanogr. Mar. Biol. Ann. Rev*., 16: 229-311.

Figure 1.

Conceptual model showing a generalized pattern of response of benthic fauna in relation to TOC content of sediment and other potential co-varying environmental stressors in sediments.



11
STRATEGIE MAROCAINE RELATIVE A LA CONSERVATION ET L'UTILISATION DURABLE DE LA BIODIVERSITE MARINE[1]

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Keywords: Marine ecosystems, Action plan, conservation, Morocco

L'importance stratégique de la biodiversité marine et des ressources halieutiques pour le Maroc, l'insuffisance des données scientifiques récentes et fiables pour une meilleure gestion de cette biodiversité, l'inadéquation des textes législatifs actuels régissant cette biodiversité ainsi que l'engagement international du Maroc en matière de conservation et d'utilisation durable du patrimoine biologique mondial, etc. ont incité le Maroc à élaborer une stratégie (6 priorités et orientations) et un plan d'action (128 actions) nationaux pour la conservation et l'utilisation rationnelle et durable de son patrimoine biologique. Cette stratégie repose sur les priorités suivantes :

La gestion rationnelle des ressources biologiques marines du Maroc

C'est un objectif qui englobe 24 actions réparties sur 4 orientations favorisant l'approche écosystémique, le renforcement des capacités pour la conservation ex situ, l'intégration de l'utilisation de la ressource dans le processus de la conservation et la préservation de la variabilité génétique de ces ressources.

L'amélioration des connaissances en matière de biodiversité marine

C'est une priorité stratégique programmée sur 63 actions en 3 orientations principales concernant essentiellement la formation de scientifiques et de techniciens qualifiés caractérisée par un manque cruel ainsi que la gestion de l'information scientifique très dispersée et mal organisée.

Le développement de l'aquaculture, en réponse aux recommandations de Jakarta et, aussi, en tant qu'alternative pour diminuer la pression sur un grand nombre d'espèces, surtout dans un pays disposant d'un riche potentiel aquacole et, en même, temps l'un des plus grands exportateurs de ressources marines. Cet objectif est articulé autour de 17 actions concernant l'aquaculture de production, celle de soutien ou de repeuplement ainsi que l'aquaculture préventive.

La sensibilisation et l'éducation de divers utilisateurs de la mer, des décideurs et des générations futures. Cette priorité déclinée en 6 actions concerne le renforcement des structures de sensibilisation existantes mais aussi l'élaboration de programmes d'éducations nouveaux visant l'amélioration des approches aussi bien pour l'heure actuelle que pour les générations futures.

Le renforcement des cadres législatif et institutionnel avec 7 actions visant principalement l'amélioration de la protection des espèces peu ou pas couvertes par des textes législatifs, mais aussi l'harmonisation entre les textes nationaux et l'engagement international du pays.

Le renforcement de la coopération dans un but du renforcement des capacités nationales en matière de conservation et d'utilisation durable et rationnelle de la biodiversité marine du pays.

La stratégie et le plan d'action nationaux pour la conservation et l'utilisation durable de la biodiversité marocaine comportent également un important programme relatif au suivi et la surveillance de l'évolution de cette biodiversité basé sur des indicateurs identifiés pour l'ensemble des composantes de la biodiversité marocaine et adoptant le système « Etat-Pression-Réponse ».

[1] Travail réalisé dans le cadre du projet SPANB-Maroc

Les indicateurs relatifs à la **Biodiversité marine** comportent 122 indicateurs :

- **Indicateurs de l'évolution de la Diversité :** 10 indicateurs (Etat-Pression) ;
- **Indicateurs de l'évolution des paramètres abiotiques :** 14 indicateurs (Etat-Pression) ;
- **Indicateurs socio-économiques :** 11 indicateurs (Etat-Pression) ;
- **Indicateurs de Réponse de la Biodiversité marine :** 14 indicateurs (Réponse) ;
- **Indicateurs des espèces vulnérables (espèces menacées, rares, etc.) :** 38 indicateurs;
- **Indicateurs des mesures d'accompagnement :** 28 indicateurs
    - **Indicateurs de la sensibilisation/Education :** 12 indicateurs
    - **Indicateurs de la Recherche-Formation :** 8 indicateurs
    - **Indicateurs de la législation :** 6 indicateurs
    - **Indicateurs de la coopération :** 2 indicateurs
- **Autres Indicateurs environementaux :** 16 indicateurs

Références :

Département de l'environnement (1998) : Etude Nationale sur la Biodiversité Faune Marine. Min. Env./PNUE : 101 p

Riadi H. (1998) : Etude Nationale sur la Bidiversité. Algues marines. Min. Env./PNUE : 98 p

Département de l'environnement 2001 : Biodiversité Marine et côtière . Stratégie et Plan d'action pour la conservation et l'utilisation durable de la biodiversité marocaine. Min. Env./PNUE : 44 p.

Département de l'environnement 2001 : Biodiversité marocaine – Indicateurs de surveillance.. Min. Env./PNUE : 80 p.

12
UNDERSTANDING CORAL BLEACHING ACROSS FOUR OCEANS

- addressing CBD's Specific Workplan on Coral Bleaching

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Keywords: coral bleaching, targeted research, capacity building, mitigating responses

[The CBD Specific Workplan on Coral Bleaching is available from http://www.biodiv.org]

Introduction

Coral bleaching is rapidly developing as a major problem for the health of coral reefs worldwide. Unfortunately, the level of understanding of this phenomenon is limited. Developing a good understanding of the phenomenon is important if management practices are to be effective in minimising the detrimental impacts of coral bleaching as projected to occur over the next 50 years.

In response to this situation an expert group, the *IOC/UNESCO Working Group on Coral Bleaching,* has been established to 1) integrate, synthesize and develop global research on coral bleaching and related impacts of climate change on coral ecosystems; 2) generate tools and techniques to detect early stress responses and longer-term impacts of climate change with a wide applicability in both developed and developing nations; and 3) strengthen the capacity for research and management of coral bleaching impacts in developing countries affected by coral bleaching, through the transfer of expertise and technologies. The effort has become an important implementer of **CBD's Specific Workplan on Coral Bleaching** (COP 6 VI/3, 2002).

Background

Coral reefs play a key role for the functioning of tropical coastal ecosystems and for the large coastal populations that depend on reef resources for their daily livelihoods. Unfortunately, coral reefs are now experiencing unparalleled levels of human related stress. Furthermore, recent evidence suggests that coral reefs also appear to be very sensitive to environmental changes like climate change related temperature stress (Hoegh-Guldberg 1999). Coral bleaching and mortality have steadily increased over the past 20 years. Coral bleaching occurs when the critical symbionts of corals become stressed and the symbiosis breaks down. Mass coral bleaching (global episodes) has not been reported prior to 1979. In 1998, the world experienced the largest and most widespread example of mass bleaching with an estimated 16% of the world's living corals were eliminated in a single warming event (Wilkinson 2000).

Our current understanding of the potential impacts of global climate change is still relatively limited. As a global society, we have a minimal understanding of the mechanisms, ecological outcomes and economic ramifications. Improving this understanding is critical if we are to understand the changes that have occurred in the past and if we are to accurately project how the health of our coastal oceans will change as the earth experiences one of the most rapid periods of climate change in recent history. The latter is important if humans are to adapt to or mitigate the impacts of these changes over the next 50 to 100 years. Our understanding will also be critical in assessing the pros and cons of different strategies as regards energy use and the adoption of new forms of energy.

Expert group on coral bleaching and local ecological responses

The IOC/UNESCO Working Group on Coral Bleaching and Local Ecological Responses was established in fall 2000 by the *Intergovernmental Oceanographic Commission (IOC)* of the *United Nations Educational, Scientific and Cultural Organization (UNESCO)* with the mandate to fill critical knowledge gaps relating to 1) tolerance limits and potential mechanisms of corals for adaptation/acclimatization to global environmental change; 2) long-term responses of coral reefs to large-scale changes in environmental variables and 3) development of possible molecular, cellular, physiological or community indicator tools that are reliable in their ability to detect environmental stress responses.

Membership and corporative research

The Bleaching Working Group includes scientists from developing as well as developed countries bringing together expertise in different fields of coral physiology and ecology. The members are: Barbara Brown (UK); John Bythell (UK); Bill Fitt (USA); Ruth Gates (USA); Ove Hoegh-Guldberg, Chairperson (Australia); Roberto Iglesias-Prieto (Mexico); Ron Johnstone (Australia) Michael Lesser (USA); Yossi Loya (Israel); Nyawira Muthiga (Kenya); David Obura (Kenya); Rob van Woesik (USA); Helen T. Yap (Philippines). Associated with the group is a long list of young researchers and students at participating research institutions.

The IOC/UNESCO Bleaching Working Group has joined forces with five additional targeted working groups within the framework of a developing *GEF/World Bank Targeted Research program on Coral Reef Sustainability and Capacity Building* (see separate SBSTTA 8 abstract, CBD Technical Series).

Implementing CBD's Specific Workplan on Coral Bleaching

The CBD Specific Workplan on Coral Bleaching was developed under the programme of work on marine and coastal biological diversity in consultation with an international liaison group of experts. It was recommended for implementation by SBSTTA 6 (Recommendation VI/2, Annex 2, March 2001) and adopted by COP 6 (Decision VI/3, April 2002).

The overall goal of this plan is to: "*Support efforts to gather and assimilate information on, build capacity to mitigate the effects of, and to promote policy development and implementation strategies to address the impacts of coral bleaching and related mortality on coral-reef ecosystems and the human communities which depend upon coral reef services, including through financial and technical assistance.*"

The IOC/UNESCO Coral Bleaching Working Group has become an important implementer of the Workplan, addressing specific items in the areas of *information gathering; capacity building and mitigating responses*, as follows:

I. CBD Bleaching workplan: Information gathering

Critical questions

From its first meeting in April 2001 the group has engaged in research discussions and collaborative experiments addressing key questions regarding the future status of reefs under predicted climate change. The group has discussed different aspects of molecular and cellular responses to heat stress and other stressors disrupting the algal-coral symbiotic relationship leading to bleaching, the subsequent ecological impacts, and the potential for developing indicators and tools to assess changes and predict longer-term impacts of coral bleaching.

An overarching theme to be investigated is the issue of adaptation/acclimatization to increased sea surface temperature and the ability of corals to recover from bleaching; and the possible new state of coral reefs at increasing frequency of mass bleaching events, as summarised in the following broader questions:

Are coral reefs resilient in the face of projected climate change over the next 100 years?

How is the primary factor temperature affected by other secondary factors?

Why are some corals more immune than others?

How fast will change occur within coral reefs' ecosystems?

Can coral reefs recover and if so, how fast?

What factors influence the ability of reefs to recover?

Is a phase shift permanent?

What will the final state of the ecosystem be like if coral abundance decreases dramatically?

To address these and related questions a set of specific work hypotheses have been developed addressing fundamental physiological mechanisms leading to bleaching and longer-term ecological impacts of thermal stress, which will be tested through joint physiological experiments, ecological studies, reviews and discussions.

Main research themes

The project activities span from investigations at the molecular to ecological level and will generate tools and techniques applicable to a wide range of problems facing both developed and developing nations. The specific components within the major project for the next five years are as follows:

1. To develop a more complete understanding of the molecular to cellular mechanisms underpinning coral bleaching and mortality of reef-building corals.
2. To establish and test bioindicators of climate impacts and reef health and to develop appropriate bioindicator technologies at molecular, physiological and ecological scales.
3. To pursue a greater understanding of the ecological mechanisms and outcomes of climate impacts on coral reefs.
4. To provide the basis for firmer estimates of the direction and rate of ecological changes to coral reef ecosystems under progressive climate change. Inherent in this last objective is to integrate the knowledge gained to create a sturdy knowledge basis for developing strategies for human societies to adapt to or mitigate climate driven changes.

Within these major objectives, there are specific questions that will be undertaken around five principle research areas: (A) Mechanisms of thermal stress; (B) Bioindicators of coral stress; (C) Coral susceptibility, tolerance and associated factors of thermal stress; (D) Ecological consequences of reduced coral abundance; and (E) Projections of future change.

II. CBD Bleaching workplan: Mitigating responses

Indicator tools

A major output of the experimental program will be a series of indicator tools such as:

Molecular markers that will rapidly and easily distinguish heat stress from other types of stresses (e.g. sedimentation, metal contamination, nutrient stress) on coral reefs.

Cellular markers that will enable users to accurately anticipate and monitor the advent of coral bleaching or recovery.

Genetic markers that will enable insight into the tolerance and resilience of communities of reef-building corals.

Ecological markers that will enable users to monitor impacts of coral bleaching and to project how the changes are likely to impact on local ecosystem function.

Predictive models and scenario building

A more complete model of the mechanisms that trigger mass coral bleaching will be developed that will enable better projections of the potential impact of climate change on coral reefs, and enable better prediction of the potential impacts on those human communities relying upon them as sustainable resources.

Scenario planning will be used to develop an in-depth understanding of the changes that are likely to occur on reefs as reefs warm, starting with the four key IPCC scenarios (B1, B2, A1 and A2 scenarios) and developing a series scenarios based on biological responses in the context of economic and sociological scenarios. This project component will integrate the information derived from the other programs and will develop a series of tools by which managers can assess the impact of the changes they (or the society that they live in) are making to ameliorate the negative impacts of climate change.

Rapid response capability

Standard Operating Procedures and protocols will be developed and applied at all the field sites to collect and investigate coherent information on bleaching and its impacts on reefs, allowing comparisons at regional and global scales. Ultimately the network, the new tools and the standard procedures will provide a rapid response capability to document coral bleaching and mortality in developing countries and remote areas, as well as an infrastructure to follow longer-term effects.

III. CBD Bleaching workplan: Capacity building

Collaborative research through global network

The GEF/World Bank Coral Reef Targeted Research project will engage researchers and students from developing and developed countries in collaborative experiments, seminars, training workshops and discussions.

Teams will engage in series of regional research workshops at selected pilot sites, bringing together all associated scientists and students in a global network. The activities will include lab experiments and fieldwork spanning molecular, cellular to ecological research, as well as seminars and discussions. Grants will be provided to local researchers and students for longer-term studies at selected sites.

Training-through-research and grants for developing country scientists to visit foreign laboratories and to attend seminars and training courses will spread new knowledge and techniques and provide career opportunities for young researchers in coral physiology, taxonomy, ecology and related disciplines.

By implementing the activities at developing country institutions the program will strengthen national research capacities with new expertise, technologies and management skills. Field sites are being established with universities and research laboratories at four representative ocean areas covering sites in Mexican Caribbean, East Africa, Philippines and Southern Great Barrier Reef.

To maximise cross-fertilisation, mutual exchanges and cost sharing, the activities will be coordinated closely among the six GEF Coral Reef Targeted Research working groups, covering 1. Coral Diseases, 2. Connectivity, 3. Remote Sensing, 4. Modelling & decision Support; and 5. Remediation and Restoration. The total number of scientist in this global network will be well over 100, with wide representation of institutions and research communities.

Dissemination of new knowledge

Syntheses of new findings and results will be presented in scientific papers, reviews, technical guidelines and disseminated via seminars and training workshops. New knowledge generated through this effort will be integrated and continuously made available from the working group's website: *http://www.ioc.unesco.org/coralbleaching*.

Pilot research workshops

During 2002 two field workshops were held to test the concept of collaborative research, investing specific work-hypotheses and pilot future work. Both workshops included joint thermal simulation experiments, ecological surveys and scientific seminars given by attending scientists and students.

The first workshop took place from 25 February to18 March 2002 at Heron Island Research Station, Southern Great Barrier Reef, hosted by the Centre of Marine Studies, University of Queensland, Australia. It involved 32 scientists and 18 postgraduate students. The hypotheses tested ranged through a series that was developed during the April 2001 discussions. The coincidence of a major bleaching event across the Great Barrier Reef taking place during the workshop led to some unusual opportunities for the targeted working group to pursue questions associated with a "natural" bleaching event. Among the highlights of this successful workshop were a major audit of symbiotic *dinoflagellate* strains, the discovery of new coral diseases for the GBR region, new insights into the role of cell suicide and apoptosis in bleaching and the important role of clonal variability in coral stress tolerance.

The second step in testing the concept of targeted research took place from 9 to 22 September 2002 in Puerto Morelos, Mexican Caribbean, hosted by Universidad Nacional Autónoma de México. The workshop was attended by 25 local and international students and scientist. It led to the development of draft ecological survey protocols comprehensive discussions identified the critical chain of mechanisms leading to bleaching, the longer term ecological impacts and implications for society.

Near-future efforts will focus on finalising review papers, further refine and consolidate the concept of targeted research and initiate the development of specific tools and biomarkers, which will provide new insight in the complex area of coral bleaching and climate change.

Further information

The IOC/WB Coral Bleaching Group is online: *http://www.ioc.unesco.org/coralbleaching* with information on contacts, workshop reports, seminar proceedings, workplans, publications and information sheets on recent progress and future activities.

The CBD Specific workplan on coral Bleaching is available online from at CBD's website: *http://www.biodiv.org/recommendations/*.

For additional information please contact IOC/UNESCO at *o.vestergaard@unesco.org* or *u.unluata@unesco.org*, or Working Group chairman Professor Ove Hoegh-Guldberg at *oveh@uq.edu.au*.

References

Hoegh-Guldberg, O. (1999) "Coral bleaching, Climate Change and the future of the world's Coral Reefs.'à" *Review, Marine and Freshwater Research*. 50:839-866.

Wilkinson, C. (2000) The Status of the Worlds Coral Reef 2002 (IOC/UNESCO-UNEP-IUCN- World Bank)

Inland Waters Biodiversity

1
DEVELOPMENT OF WETLANDS PRODUCTS USING EARTH OBSERVATION DATA

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Keywords: Earth observation satellites; GIS, wetlands

In 2001, a Canadian team led by Atlantis Scientific Inc. was awarded a competitive contract by the European Space Agency (ESA). This contract was part of a set of initiatives collectively known as TESEO (Treaty Enforcement Services using Earth Observation).

The major objective of the project was to study new methodologies that incorporate current and future Earth Observation satellites. The project required the development of prototype information products that could be used to improve wetlands management practises as defined in the Ramsar Convention on Wetlands (1971). Aspects of the Convention cover a wide variety of habitat types, including rivers and lakes, coastal lagoons, mangroves, peatlands, and coral reefs.

The extent to which wetlands have been converted has only recently been understood, in part through the application of Earth Observation (EO) data. Legal requirements are now such that wetland conversions are in some cases reversed after legal action. This has become common in Europe, the United States, and in Canada. Change detection is therefore of fundamental importance. In spite of important progress made in recent decades, wetlands continue to be among the world's most threatened ecosystems, owing mainly to ongoing drainage, conversion, pollution, climate change, and over-exploitation of their resources.

Performing an efficient inventory of the Ramsar sites and providing an efficient monitoring of their ecological character represent some of the main provisions of the Ramsar Convention. Earth Observation technology can play a key role in many of the major issues facing wetlands today. The introduction of wetlands monitoring techniques will provide a mechanism to evaluate the effects of:

- Illegal land use conversion
- Illegal Drainage
- Land-based pollution
- Coastal marine pollution
- Erosion
- Reduction in bio-diversity
- Introduction of non-native species
- Reduction of water in-flow (from irrigation)
- Impact of human activities in surrounding area
- Changes in salinity of runoff
- Changes in water temperature

Initially, it was uncertain whether it would be possible to meet the needs of the wetland managers. In particular, the spatial and spectral precision required to correct for sensor position/attitude and atmospheric effects was of considerable concern. The need to integrate EO data from a variety of sources with differing resolutions, and imaging geometry also represented a significant challenge.

This project required a three-phase effort. The initial phase consisted of an analysis of the requirements of individual wetlands managers in the context of the Ramsar Convention, including exploratory studies to explore the potential of the latest EO sensors and technology. The second phase involved the analysis of a set of potential products and services that could be provided using EO technology. The final phase included the selection, development and refinement of a few prototype information products for further development.

This paper will describe the EO information products resulting from the project. These included:

- Dynamic monitoring of water cover (open water and inundated vegetation);
- Current land use;
- Current land cover;
- Land cover change, from which changes in land use can be inferred;
- A case study that provides a model for communication with wetlands managers.

These products have been produced using standard GIS (Geographic Information Systems) formats. They can be combined and used to derive numerous additional secondary and tertiary products.

2
EXEMPLE DE STRATEGIE DE GESTION INTEGREE DES FORETS DE MANGROVES DE LA BAIE DE SANGAREYA : IMPLICATION DES COMMUNAUTÉS LOCALES

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Keywords: Mangrove, Baie de Sangaréya, Guinea

Introduction

Les mangroves de la Baie de Sangareya couvrent environ 52 400 hectares de périmètre forestier. Les demandes sans cesse croissantes en bois-énergie et en terres de riziculture ont entraîné une augmentation de pression humaine sur ce milieu naturel et sa dégradation.

Surexploitation des forêts de palétuvier, le déficit de régénération des formations boisées, la stérilisation des sols, la baisse de productivité des rizières, les modes d'appropriation et l'utilisation anarchique de la ressource, la paupérisation chronique et la qualité de vie misérable des populations riveraines, sont autant de problèmes auxquels il fallait faire face en vue d'apporter des solutions appropriées.

Le plan d'aménagement à mettre en oeuvre s'inscrit dans le programme général de lutte contre le processus de dégradation des ressources de la diversité biologique. Il vise à promouvoir des modes adéquats d'utilisation du milieu afin de renverser les tendances actuelles et de retrouver l'équilibre naturel de l'écosystème mangrove.

La résolution des problèmes environnementaux qui assaillent ce milieu passe par l'optimisation des systèmes productifs qui s'inscrit dans un cadre participatif négocié sur l'ensemble des capacités physiques de l'écosystème et des capacités techniques, financières et organisationnelles de tous les acteurs du développement, principalement les communautés locales qui y résident.

En 1989, la Guinée avait bénéficié d'une aide de la Commission des Communautés Européennes (C.C.E) pour la conduite d'une étude de son littoral en vue de l'élaboration du Schéma Directeur d'Aménagement de la Mangrove (S.D.A.M).

Ce schéma directeur a proposé des lignes directrices et les grandes orientations d'aménagement de la mangrove guinéenne. La mise en application fut concrétisée en 1992 par le démarrage effectif du projet pilote de gestion des Mangroves de la Baie de Sangaréya dont la première phase de 1992-1993 avait abouti à la production d'un plan d'aménagement visant à promouvoir les modes adéquats d'utilisation du milieu pour renverser les tendances actuelles et restaurer l'équilibre naturel de l'écosystème de mangrove.

Connaissance du milieu –études

La première étape a consisté à l'acquisition des connaissances appropriées du milieu sur lequel l'on s'est proposé d'intervenir.

A cet effet diverses études sectorielles ont été réalisées notamment celles portant sur le milieu physique.

Deux photo-interprétations

l'une forestière et l'autre d'aptitude des sols ont été effectuées. La première a présenté les massifs forestiers sous une forme stratifiée et a permis une visualisation de la proportion et la distribution de chacune des strates. La seconde a permis de présenter la configuration du terrain en faisant apparaître ses caractéristiques géomorphologiques et hydrographiques. La cartographie des peuplements forestiers a défini un classement de ceux-ci selon leur aptitude apparente à l'exploitation du bois et l'importance de leur rôle écologique.

Un inventaire forestier

une estimation quantitative des peuplements identifiés et classés a été réalisée. Les conditions qui régissent à la fois la physionomie et l'état d santé des peuplements sont avant tout d'ordre écologique. L'hydrographie, la dynamique des courants et l'hydro-sédimentation jouent un rôle prépondérant dans la nature même des peuplements, leurs caractéristiques volumétriques et leur répartition.

Une étude pédologique

limitée à l'examen d'une carte des sols à petite échelle de secteur accompagnée d'une description des profils effectués a permis d'identifier et d'apprécier les différentes catégories de sols dominants de la zone d'étude et d'en évaluer les aptitudes à la riziculture.

Une étude sur l'aquaculture et la rizipisciculture

Elle a permis d'identifier les contraintes et les déterminants biologiques physico-chimiques et socio-économiques du secteur de l'aquaculture afin d'évaluer les différentes stratégies d'aménagement envisageables à l'échelle de petites unités de production paysannes.

Une enquête socio-économique

Réalisée à partir d'un échantillon représentatif des habitants de la zone a rendu possible la définition des principales caractéristiques des populations, de même qu'une analyse des diverses activités économiques auxquelles elles s'adonnent. La zone d'activités compte 23 480 habitants répartis entre 51 villages et la Commune urbaine de Dubréka. En mangrove, on dénombre seulement 6 villages mais on compte 35 campements occupés sur une base saisonnière.

Des études thématiques et des enquêtes

Elles ont été réalisées à partir d'un échantillon représentatif des habitants de la zone qui a rendu possible la définition des principales caractéristiques des communautés locales dans le but d'analyser l'impact des activités humaines sur le périmètre d'intervention.

La pression sur la ressource ligneuse causée par l'extraction du sel est singulièrement plus marquée que celle due à la riziculture.

L'opération d'extraction du sel

Elle correspond à une superficie annuelle moyenne de déboisement de 55 ha comparativement aux 22 ha pour l'extension de la riziculture.

Les grandes activités économiques en mangrove

Elles génèrent des revenus annuels de l'ordre de 755 millions de francs guinéens pour les populations locales alors que le chiffre d'affaires de ces activités représente quelque 1 980 GNF. Ces activités constituent également une importante source d'emploi ;

Une enquête sur la gestion du foncier et des ressources (carte de la zone d'études 1 : 200 000)

Elle a contribué à améliorer la perception sur les modes d'accès à la propriété et l'utilisation de la ressource tant au niveau des habitants de la mangrove et de l'arrière mangrove qu'à celui des " étrangers ".

Une étude sur la création de groupements de producteurs villageois

Elle a permis de préciser les modalités existantes en matière de création de tels groupements et de faire une synthèse de l'état actuel des groupements et associations à l'intérieur du secteur d'intervention.

La Guinée reconnaît la constitution des groupements d'intérêt économique.

Les conditions requises à leur création sont peu contraignantes. Il a été aussi réalisé par l'approche participative et de concertation, à titre de sensibilisation, d'encouragement ou de démonstration, des actions pilotes de modeste ampleur mais soigneusement ciblées, susceptibles d'être appropriées et reproduites par la population.

Problématique de la zone

Les études menées ont conduit à l'identification des facteurs qui contribuent à la dégradation du milieu de même que ceux limitant le développement.

Les problèmes environnementaux majeurs de la zone d'intervention sont reliés principalement aux effets des modes inadéquats d'utilisation du milieu par les populations, bien que certains d'entre eux relèvent de phénomènes purement naturels. Ces causes répertoriées s'articulent autour de trois groupes cibles :

a. les causes naturelles ;
b. les pressions humaines sur le milieu ;
c. les contraintes socio-économiques.

Les causes naturelles :

Les deux problèmes pédologiques majeurs affectant les sols de mangrove sont le risque de salinisation et le potentiel d'acidification

La tendance au déficit pluviométrique vient de plus compliquer la situation. Les précipitations enregistrées au cours de la période 1996-1992 a accusé un certain déficit de 510 mm par rapport à la normale observée au cours des 25 années précédentes :

- Les ravageurs, tels certains passereaux granivores se nourrissant du riz et surtout les crabes qui détruisent les jeunes plants de riz , endommagent aussi les diguettes.

- L'érosion , il se produit au niveau de certains sites de front de mer ce phénomène est accentué par le déboisement de la lisière boisée causée par la forte pression agricole ou la forte demande de bois de feu.

Les pressions humaines :

- Le droit coutumier d'accès aux terres est cause d'un défrichement excessif.
- La coupe de bois se fait sans aucun contrôle. On assiste à une surexploitation du Rhizophora sur l'ensemble du territoire forestier productif. Les prélèvements de bois ne correspondent pas aux potentialités de secteurs de coupe.
- le bois est libre d'accès partout en mangrove. L'organisation de la coupe du bois est telle que les populations locales tirent un faible revenu de la filière commerciale de bois sur Conakry.
- les techniques actuelles de coupe de bois ne sont pas pratiquées selon la règle de l'art.
- les défrichements de la mangrove sont abusifs.

- le fumage du poisson consomme une quantité abusive de bois de mangrove.
- l'extraction du sel.
- la surpêche et l'exploitation irrationnelle des ressources halieutiques;
- les contraintes socio-économiques. Les enquêtes ont révélé une paupérisation chronique des populations résidentes :
- Le désenclavement pose un grand problème au niveau des villageois. Plusieurs pistes reliant les villages d'arrière-mangrove à la route nationale sont inaccessibles.
- Même si la zone bénéficie d'un niveau appréciable de précipitations, l'approvisionnement en eau potable de la population du secteur d'intervention se pose avec acuité. (tableau des données de la monographie de dubréka).
- Les difficultés d'accès aux soins de santé primaires et aux médicaments essentiels constituent une des difficultés majeures des populations locales.
- On constate que certaines ressources associées à la mangrove ne sont pas valorisées. Tel le cas de l'apiculture qui n'est pas pratiquée à l'intérieur des mangroves de la Baie de Sangaréya. Cette activité peut aussi être une source appréciable de revenus des paysans.
- Les activités touristiques liées aux ressources du littoral de la mangrove et les paysages sont inexistants.
- Les difficultés de conservation de la production vivrière entraînent chaque année de lourdes pertes au niveau des produits agricoles.
- Le manque d'organisation dynamique des producteurs ruraux est l'une des faiblesses du système d'organisation et de connaissance en gestion. (Tableau des données de base sur la population)

Les orientations stratégiques

Les grandes orientations se résument :

- la mise à profit des potentialités de l'écosystème de mangrove tout en maintenant des activités traditionnelles rurales à un niveau compatible avec les potentiels offerts ;
- une exploitation et une gestion rationnelle des ressources forestières au bénéfice des populations locales avec un réseau forestier aux vocations multiples de production et protection ;
- la promotion de modes adéquats d'utilisation du milieu par une prise en compte des besoins actuels et futurs de développement et par une mobilisation des ressources peu valorisées.

Plan d'aménagement

Activités préalables à l'aménagement

Trois démarches constituent les préliminaires à la mise en œuvre du plan d'aménagement :

- de l'organisation des acteurs du développement en groupement ;
- de l'élaboration du plan de gestion par terroir ou par unité d'aménagement affecté en mangroves
- des programmes d'animation/sensibilisation des populations par la méthode d'approche GRAAP (Groupe de réflexion sur l'approche en auto-promotion paysanne) qui amène les populations à observer leur situation par rapport à leur environnement, à réfléchir sur les causes et les conséquences des problèmes rencontrés et agir pour y remédier.

Les interventions d'aménagements

Les interventions sont ordonnancées et regroupées sur les objectifs du plan d'aménagement. Elles sont complétées par des mesures d'accompagnement.

Objectif 1. Contribuer à la satisfaction des besoins en bois de feu de la capitale et des principales agglomérations du littoral

Un zonage et la délimitation des périmètres forestiers ont été faits dont la gestion et l'aménagement sont confiés aux communautés locales.

- affectation des unités d'aménagement à des groupements d'intérêt économique villageois et la détermination du quota de vente de bois ;
- organisation de la coupe et du transport des bois par l'implantation d'un réseau de dix ports à bois en mangrove et le maintien de douze ports en arrière mangrove ;
- la mise au point d'un système de coupon de transport dont le principe est que la quantité de leur émission corresponde aux quotas fixés par unité d'aménagement ;
- la formation au métier de bûcheron-sylvicuteur de la mangrove dans l'optique que l'équilibre offre offre/demande ;
- le contrôle de l'exploitation et la perception des taxes à la fois en mangrove et dans les ports à bois en arrière mangrove ;
- la reconstitution du capital forestier par des reboisements sur les sites présentant des conditions appropriées.

Objectif 2. Promouvoir des modes adéquats d'utilisation des terroirs villageois en zone de mangrove

Les terroirs villageois en mangrove sont constitués par les périmètres défrichés pour la riziculture ou pour l'extraction du sel. Les actions à mener avec le concours des groupements sont :

- l'intensification de la riziculture par l'introduction et la diffusion des variétés améliorées de riz, l'amélioration des techniques de conduite des pépinières, la gestion communautaire des défrichements rizicoles pour la mise en place des forêts communautaires en mangrove au alentours des périmètres rizicoles existantes.
- la réhabilitation des terres rizicultivables
- l'introduction de technologie de substitution à la méthode traditionnelle d'extraction du sel.

Objectif 3. Assurer le maintien des grands équilibres de l'écosystème de mangrove en concentrant les efforts de protection sur les espaces devant jouer un rôle prioritaire de conservation

- par la mise en défend des secteurs sensibles à l'érosion et des sites d'intérêt biologique ;
- par l'identification et la protection des sites frayères.

Objectif 4. Développer l'ensemble des ressources de la diversité biologique associées à l'écosystème mangrove

- mise en place d'un programme d'activités d'inventaire des ressources de la diversité biologique du site ;
- par l'introduction de l'apiculture ;
- par l'aménagement des sites d'observation de l'avifaune et des parcours touristiques (écotourisme).

Amélioration des conditions de vie des populations communautaires vivant dans la mangrove, construction de puits améliorés et de citernes ;

- ouverture d'infirmeries villageoises ;
- construction de magasin d'entreposage de sel et autres produits de la mangrove ;
- assistance à des groupements maraîchers.

Actions complémentaires

- en perspective la construction d'un centre mangrove ;
- études sur la régénération en mangrove et le comportement des essences en station ;
- extension des actions sur d'autres massifs de mangroves sur le littoral guinéens ;
- développement de partenariat avec les autres institutions intéressées. (Illustration des actions)

Conclusion

Le processus de gestion intégrée mis en œuvre dans la Baie de Sangaréya ne peut porter fruit que lorsque les populations bénéficiaires des ressources prendraient effectivement en main la responsabilité de gestion de leurs ressources. A travers la sensibilisation et la participation, une prise de conscience sur les dangers de l'épuisement des ressources et des conséquences qui pourraient en découler est perceptible au sein de la population. La tâche est rendue difficile par la paupérisation chronique de ces habitants et le taux d'analphabétisme élevé. Un aspect encourageant de l'aménagement se retrouve au niveau de l'acception de technologies nouvelles susceptibles de réduire la pression sur les ressources par les populations (fumage du poisson, production de sel solaire, intensification de la riziculture).

Références Bibliographiques

1. ABF (Fiches technique), 1986. Enquêtes de consommation de combustibles ligneux en milieu domestique ;

2. Agbogba, C, 1986. La mangrove de Toubacouta (Sine-Saloum-Sénégal). Caractéristiques Méthodologie-résultats ;

3. Bah, Y, 1991. Esquisse de manographie de Dubréka ;

4. Benssalah, D. 1988. Manuel on mapping and Inventory of Mangroves, Rome ;

5. Brethois, L. 1963. La sédimentation en période de crue dans le fleuve Konkouré. R. Guinée

6. Brethois, L. et Le Calvez,Y. 1959. Etude dynamique de la sédimentation dans la Baie de Sangaréya, Rep. Guinée ;

7. Bertrand, F. 1959. Pêcheurs migrants sur les côtes de Guinée du 18ème siècle à nos jours ;

8. Boyé, M. Les palétuviers du littoral de la Guiyane française. Ressources et problèmes d'exploitation ;

9. Cassagne,B. et al. 1993. Projet de gestion des Ressources naturelles. Volet : Appui filière bois "énergie de Conakry ;

10. Wibe, A. et Van Der Kamp, J. 1991. La désignation des sites Ramsar dans les zones humides côtières ;

11. P.A.F.T, 1988. politique forestière et plan d'action. Annexe 1,2,3,4,5 ;

12. Moreau, N. 1990. Identification et dynamique des paysages de mangroves en Guinée à l'aide du satellite Spot11 ;

13. Lootvoet, B, et d'autres1989. Notes sur l'organisation économique et sociale de la pêche artisanale, du fumage et de la commercialisation du poisson dans la ville de Conakry ;

14. Diemont, W ;H et Pons, 1986. Conservation et gestion des mangroves de Guinée ;

15. CEE, 1993. Plan d'Aménagement forestier des mangroves de la Baie de sangareya, Document No 13/93, Novembre 1993.

3
INTRODUCTION AND SPREAD OF ALIEN AQUATIC SPECIES IN THE GREAT LAKES–ST. LAWRENCE RIVER ECOSYSTEM

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Keywords : alien species, aquatic ecosystem, St. Lawrence River, Canada

The introduction of and invasion of new territory by alien species threatens the integrity of aquatic ecosystems in all parts of the world (Sala et al. 2000). With regard to biodiversity, introduced species occasionally become the dominant life-forms in an ecosystem and can lead to homogenization of the biota (Rahel 2000). The Great Lakes–St. Lawrence River system is the largest drainage basin in Canada and represents a gateway for the trade of goods across North America. For the Great Lakes only, Mills et al. (1993) listed 139 species introduced up to 1991, but very little was known about alien species in the St. Lawrence River. This paper presents an overview of the current status of alien aquatic species in the St. Lawrence River ecosystem and evaluates the importance of downstream relative to upstream transfer of alien species between the St. Lawrence River and the Great Lakes.

Data collection

The list of alien species introduced and established in the St. Lawrence River and in the Great Lakes in the past 200 years was obtained through an extensive search of various documents, including scientific papers, books, technical reports, computerized databases, museum and herbarium collections and Web sites. Information compiled on each species included the scientific and common names of the species, the date and site of introduction into the Great Lakes–St. Lawrence River drainage basin, the geographic origin of the species, and the identified vector of introduction (de Lafontaine et al. 2002).

Results

A total of 163 alien aquatic species have been introduced in the entire Great Lakes–St. Lawrence River drainage basin (Table 1). So far, 160 have been reported from the Great Lakes only and 87 have been introduced into the St. Lawrence River and its tributaries. Only 3 alien species currently found in the St. Lawrence River drainage basin have not yet been reported in the Great Lakes : the spinycheek crayfish (*Orconectes limosus*), the cutthroat trout (*Oncorhynchus clarki*), and the tench (*Tinca tinca*). The spinycheek crayfish was presumably introduced in the late 1960s and now dominates the crayfish assemblage in the lower St. Lawrence River. The presence of cutthroat trout resulted from fish stocking that took place in the 1940s and the tench had escaped from fish farming ponds in 1991, following its unauthorized import from Europe in 1986. Although the number of introduced species in the Great Lakes is twice that for the St. Lawrence River, the relative proportion of the various taxonomic groups differs between the 2 systems. There are between 2.1 and 2.6 times more invertebrate, algal and fish species, but only 1.3 times more vascular plant species in the Great Lakes (Table 1).

The numbers of species introduced in the Great Lakes gradually increased after 1820, levelling off at about 20 to 25 species every 2 decades since 1921. In contrast, the number of alien species introductions in the St. Lawrence River have increased almost exponentially since 1820 (Figure 1). Introductions in the river peaked during the last 20-year period (1980–2000), with a total of 21 new species recorded as observed in the Great Lakes. Overall, 65 (83%) of the 78 species with known dates of introduction were reported in the Great Lakes before being found in the St. Lawrence River. This suggests that species introduction in the river was mainly due to downstream transfer. The proportion of species first observed in the Great Lakes and later reported in the St. Lawrence River has decreased with time (Figure 2). Nearly all species that were introduced >100 years ago have been transferred in the river. Only 10% to 35% of the species introduced during the past 40 years had been reported in the river by 2000. The pattern is relatively independent of taxonomic groups. Conversely,

13 species (12 vascular plants and 1 alga) were discovered in the St. Lawrence River before being observed in the Great Lakes, suggesting some upstream transfer of species between the river and the lakes. For these species, the river might have been the first site of introduction in the entire drainage basin or even in North America.

Discussion

The count of 163 alien species in the entire Great Lakes–St. Lawrence River drainage basin is considered a conservative estimate, as the list is certainly not complete. In fresh waters, taxonomic difficulties are particularly important for planktonic organisms, bryozoans, benthic worms, parasites, fungi, and other pathogens and may impede the capacity to detect new species within these numerically abundant groups. The rate of species introductions in the 2 regions was approximately one per year since 1980. The lack of similar indexes for other aquatic systems precludes any comparison, but intuitively this value would exceed by far the rate of species expansion due to natural causes and should therefore be considered indicative of a serious problem. Given that 62 species introduced into the Great Lakes have not yet been reported in the river, it is expected that the number of alien species reported in the St. Lawrence River will continue to increase in the near future. More than half of the species that were introduced into the Great Lakes have been reported in the St. Lawrence River to date. In comparison, the Hudson River has more alien species (n = 113) than the St. Lawrence River but shares a lower percentage of species with the Great Lakes (48 [34%] of 139) (Mills et al. 1996). Because of its geographic position at the end of the drainage basin, the St. Lawrence River is highly exposed and vulnerable to downstream transfer and invasion by alien species from upstream sources, which in turn results in similarity of introduced species between the 2 regions. In recent years much emphasis has been dedicated to the introduction of species, but much less attention has been given to their subsequent transfer. The present analysis of the Great Lakes–St. Lawrence River basin reveals that these 2 aspects of the problem are equally important in the spread of alien aquatic species. We have noted however that information on the distribution and relative abundance of the vast majority of alien species was very scanty. The lack of adequate monitoring programs for freshwater biodiversity in Canada is largely responsible for this situation. Such information is a prerequisite to assessing the relative importance, and the eventual impact, of alien species on Canadian aquatic ecosystems.

References

de Lafontaine, Y., and Costan, G. (2002) « Introduction and transfer of alien aquatic species in the Great Lakes- St. Lawrence river drainage basin », in *Alien invaders in Canada's waters, wetlands and forests*, Natural Resources Canada, Canadian Forest Service, Ottawa, ON.

Mills, E.L., Leach, J.H., Carlton, J.T., and Secor, C.L. (1993). « Exotic species in the Great Lakes: a history of biotic crises and anthropogenic introductions ». *J. Great Lakes Res.* 19:1–54.

Mills, E.L., Strayer, D.L., Scheuerell, M.D., and Carlton, J.T. (1996). « Exotic species in the Hudson River basin: a history of invasions and introductions ». *Estuaries* 19(4):814–823.

Rahel, F.J. (2000). « Homogenization of fish faunas across the United States ». *Science* 288:854–856.

Sala, O.E., Chapin, F.S. III, Armesto, J.J., Berlow, E., Bloomfield, J., Dirzo, R., Huber-Sannwald, E., Huenneke, L., Jackson, R.B., Kinsig, A., Leemans, R., Lodge, D.M., Mooney, H.A., Oesterheld, M., Poff, N.L., Sykes, M.T., Walker, B.H., Walker, M., and Wall, D.H. (2000). Biodiversity scenarios for the year 2010. *Science* 287:1770–1774.

Table 1.

Number of alien species introduced in the Great Lakes and the St. Lawrence River

Taxonomic group	Number of alien species			
	Entire drainage basin	St. Lawrence River	Great Lakes	Ratio GL/SLR
Algae	25	12	25	2.08
Vascular plants	60	44	60	1.36
Invertebrates	45	19	44	2.31
Fishes	33	12	31	2.58
Total	163	87	160	1.84

Figure 1.

Temporal succession of species introductions in the St. Lawrence River and the Great Lakes, sorted by taxonomic groups.

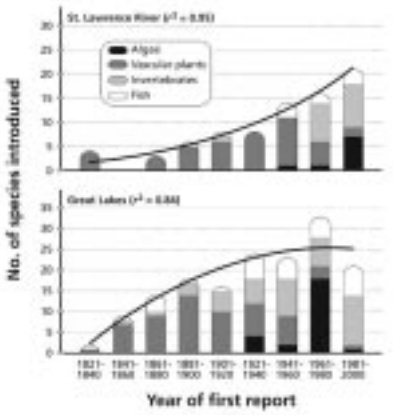
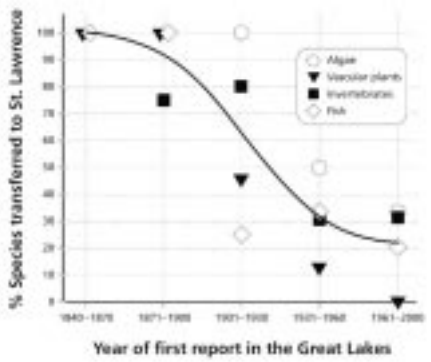


Figure 2.

Proportion of species transferred from the Great Lakes into the St. Lawrence River as a function of year of first report in the Great Lakes.



4
KNOWING, MAPPING AND UNDERSTANDING ST. LAWRENCE BIODIVERSITY

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Keywords: atlas, biodiversity, conservation, species at risk, St. Lawrence River, Canada

Environment Canada and the Québec Department of the Environment, partners in the St Lawrence Vision 2000 Action Plan, set out to prepare a compendium of knowledge of the flora and fauna of the St Lawrence and to identify potential conservation sites. The resulting Portrait is an Internet site that presents the current knowledge base of the river's ecological and biological diversity *(http://lavoieverte.qc.ec.gc.ca/faune/biodiv/index.html)*.

The *Portrait* provides information on over 5,000 species of flora and fauna. On the website, you will find a detailed ecological analysis of the richness, rarity and vulnerability of several broad groups of plant and animal species. Furthermore, you will find a list of species for each of the 700 survey units and a distribution map for 2,500 species recorded along the St Lawrence., in atlas form, along with a detailed conservation plan. The plan encompasses the most unique and heterogeneous landscapes of the St Lawrence, some of which have no protection at present. The *Portrait* provides an overview of the sites that are currently protected by public agencies and private-sector organisations and identifies new sites of interest for conserving biodiversity and protecting species at risk.

This paper exposes the content of this extensive compendium on the biodiversity of the St. Lawrence. For conciseness, it presents some of the analyses conducted on birds to illustrate a few of the analytical approaches that were used. Then, the information on species richness and concentration areas for priority species of vascular plants, breeding birds and herpetofauna will serve to identify the terrestrial sites of significance for biodiversity. Finally, a similar approach having been applied to the aquatic environnement, we will conclude with a conservation plan that identifies the terrestrial and aquatic ecosystems, and the geographic sites where the most important elements of St. Lawrence biodiversity are concentrated.

5
MONITORING THE STATE OF THE ST. LAWRENCE

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Keywords: St.Lawrence river; toxic contamination, alien species, Canada

In order to assess and report on the state and the evolution of the St. Lawrence River, Estuary and Gulf, federal (Environment Canada, Fisheries and Oceans Canada) and provincial (Quebec Ministry of the Environment, Quebec Wildlife and Parks Society) governmental agencies are now joining their expertise within a large-scale and long-term monitoring program. A series of state indicators derived from 21 ongoing monitoring activities are developed. These activities fall into three basic components of the ecosystem: water (quantity and quality), sediment (quality), and biological resources (diversity and condition). Population uses are taken into account when specific quality guidelines have been defined. Several variables related to toxics and physico-chemical characteristics are used to describe the quality of the different components. Water level and discharge are monitored through an extensive hydrometric network. Biological resources are described at the habitat, community and species levels.

Data show that through the 1980s and 1990s, sediment quality has improved and toxic contamination has decreased in the St. Lawrence River. Water quality in the freshwater section of the system is sensitive to anthropogenic inputs, whereas climatic and meteorological processes control the physical and chemical characteristics of marine water masses. Fish consumption is now encouraged but recreational uses (bathing) are still impaired. PCB and mercury levels in freshwater fishes and marine biota have also decreased. Gannet populations show a constant increase after years of decline in the '60s and '70s due to a heavy burden of DDT residues in their eggs. However, other problems (introduction and invasion of exotic species, habitat fragmentation and losses, low water levels, erosion, changing land use, etc.) are still causes for concern. Efforts are invested to complement the indicators suite developed at the head of the basin in the North American Great Lakes. New partners from government and non government organizations are expected to join this newly formed program and help fill in information gaps previously identified.

6
USE OF PARASITOLOGY AS A TOOL TO STUDY ENVIRONMENTAL STRESS AND BIODIVERSITY AT THE ST. LAWRENCE CENTRE

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Keywords: biodiversity, pollution, environmental stress, parasites, Canada

The St. Lawrence Centre

The St. Lawrence Centre is engaged in studying the effects of human activities on the health and integrity of the St. Lawrence River ecosystem. Present initiatives include multidisciplinary programs examining impacts of urban effluents and of fluctuating water levels on the river's flora, fauna and habitats, in addition to projects on introduced species. Expertise includes plant and animal ecology, ecotoxicology, chemistry and parasitology. Herein, the parasitological component of the research is discussed in more detail.

Parasites as indicators

Parasites can be useful indicators of environmental stress and biodiversity. The very nature of parasitism makes it a suitable and appropriate indicator of environmental stress, food web structure and biodiversity. Many parasites possess complex life cycles, dependent on the presence of various intermediate hosts and predator-prey relationships to complete their life cycles. Thus, the occurrence of a parasite in a host organism not only reflects the presence of other organisms that participate in the parasite's life cycle, rendering them useful biodiversity indicators, but also trophic pathways in which the host participates both up and down the food chain. Thus, parasites reflect the host's role in the food web. Any alterations of the food web as a result of environmental perturbations will be manifested in the parasite fauna of fish or other organisms and parasites of these organisms may be used as a tool to compare food web structure among habitats or ecosystems. Thus, parasites may be employed as indicators of both species diversity and ecosystem diversity, two of the three hierarchical levels of variation used by the United Nations in its definition of biodiversity.

Examples of environmental stress: case histories

Environmental perturbations and parasite biodiversity

Parasite communities of eels (*Anguilla rostrata*) in Nova Scotia responded to acid conditions in rivers. In an experimental system where one of a pair of acidified rivers within a watershed was limed to restore pH, parasite species richness was greater in eels from the limed river compared to those from the acidified river. Results of a survey of 28 sites in Nova Scotia encompassing a pH gradient increasing from southwest to northeast support those obtained by experimental manipulation. Parasite diversity decreased with increasing acidity. These results demonstrate that parasite species composition and diversity in eels are sensitive to acidity, and support the hypothesis that parasite communities are good indicators of environmental stress and biodiversity, because they reflect the presence of many different types of organisms based on the variety of complex life cycles displayed by the different parasite taxa.

Myxozoan parasite communities in spottail shiners (*Notropis hudsonius*) increased in prevalence of infection and in diversity in the St. Lawrence River downstream from the island of Montreal compared to upstream. These parasites use oligochaetes as alternate hosts, and it is suggested that organic enrichment of the sediments downstream from urban effluents resulted in an increase in oligochaete populations, with a subsequent increase in myxozoan parasitism in fish.

Parasitism and stress: fish and frogs

Parasites may interact with anthropogenic stressors, further impacting the health of aquatic organisms. Lipid peroxidase is indicative of cellular damage and oxydative stress. Levels of lipid peroxidase in livers of yellow perch (*Perca flavescens*) were low from a reference site in the St. Lawrence River, regardless of the presence of the parasitic nematode *Raphidascaris acus*. In uninfected fish from a polluted site in the river, levels of lipid peroxidase increased by 50%. In fish from the same contaminated site that were infected with the parasite, levels of lipid peroxidase increased by over 80%, suggesting that detrimental effects of parasitic infections are exacerbated under polluted conditions or that parasites enhance the toxic effects of pollutants.

A study involving the exposure of leopard frogs (*Rana pipiens*) to pesticides demonstrated that certain aspects of the frogs' immune systems were compromised. Furthermore, nematode lungworms (*Rhabdias ranae*) migrated to the lungs faster and matured and reproduced earlier in frogs that were exposed to higher concentrations of pesticides. Such alterations in parasite life history characteristics that enhance parasite transmission may lead to an increase in parasite virulence. Thus, interactions between anthropogenic contaminants and parasitism may play a role in declines in amphibians that have been observed in several parts of the world.

An international biodiversity initiative for inland and coastal waters

Sticklebacks are among the most widely distributed fishes in the northern hemisphere. They are euryhaline, occurring in marine coastal areas, brackish waters and fresh waters. They also are tolerant of adverse conditions, and can be found in both perturbed and undisturbed habitats. Moreover, by spanning the freshwater-saltwater continuum, they provide a unique host-parasite model with which to evaluate ecological conditions and biodiversity in aquatic habitats of varying quality.

The *Survey of Stickleback Parasites* is a core project of the International Biodiversity Observation Year (IBOY), an initiative of DIVERSITAS. To date, there over 40 participants from 16 countries including Canada, Czech Republic, Denmark, England, Finland, Germany, Iceland, Iran, Japan, Lithuania, Norway, Russia, Scotland, Turkey, Ukraine, and United States. The project is volunteer-based and does not receive any major funding. The project has been endorsed by the International Council for the Exploration of the Seas (ICES) Working Group on Pathology and Diseases of Marine Organisms, the Biodiversity Science Board of Canada, the Biological Survey of Canada, and the Biodiversity Committee of the Canadian Society of Zoologists.

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UTILIZATION OF AQUATIC BIODIVERSITY IN MOUNTAINOUS RICE-BASED ECOSYSTEMS OF CHINA AND VIET NAM

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Background

Aquatic resources from rice fields and other aquatic habitats often constitute a large share of the animal protein intake of poor households, particularly in SE Asia. Unfortunately, although this dietary contribution is self-evident for those working in the field, the role of aquatic resources in food security of rural households is poorly documented because of the complexity of seasonally and spatially variable resources, habitat diversity and farmers' activities. However, evidence is needed by policy makers for formulating more pro-poor policies or to make resource allocation decisions. Greater emphasis on advocacy is therefore required to raise awareness of the role of aquatic resources for food security and poverty alleviation of the rural poor. Organizations in the field of sustainable development need to work further to integrate and mainstream agricultural biodiversity in their policies, programmes and activities in order to develop action plans on the conservation and sustainable utilization of agricultural biodiversity, especially at agro-ecosystems level.

To support the above objectives, the Inland Water Resources and Aquaculture Service of the FAO Fisheries Department initiated a regional activity on the availability and use of aquatic organisms in rice-based farming. The following particularly highlights initial results obtained from the mountainous areas in China and Viet Nam.

Making aquatic biodiversity visible

The objectives of two case studies in Xishuangbanna, Yunnan Province, China, and Hoa Binh and Lai Chau provinces, Viet Nam, were to collect and document information on the living aquatic resources availability and use pattern of rice farmers. Specific attention was paid to apply participatory methods and techniques to learn about the traditional knowledge of farmers.

Aquatic species were largely collected by the farmers themselves using their own tools and techniques. Farmers identified the species in local language and the names were recorded. Smaller species were preserved and bigger species were photographed for reference purposes. All species were listed in databases providing local and scientific names, information on the sampling, special observations for collection and/or use, and, as far as possible, information on consumption and marketing (see Table 1).

A first analysis of the findings shows that the ricefield ecosystems despite the geographically fairly localized study areas have a rich aquatic biodiversity with 95 and 74 aquatic species (vertebrates and invertebrates) in China and Viet Nam, respectively. This diversity is extensively used by the local people. The most important group are the fishes. A total of 60 and 42 different fish species were found in the China and Viet Nam study, respectively, most of which are consumed fresh. Surpluses are usually preserved in various traditional ways by salting, fermenting, sun drying or smoking and are kept for the dry season or marketed locally.

Fish, fresh or processed, are usually part of every meal and are the primary source of protein and essential fatty acids which are of key importance in brain development particularly for the visual sense. Both the Chinese and the Vietnamese study stressed the importance of fish and other aquatic organisms from rice-based systems as part of the daily diet, in China particular for the rice farming Dai minority in

Xishuangbanna. The consumption level of aquatic organisms has probably remained constant, but in the Chinese study it was estimated that nowadays one fifth to one third of the consumption are derived from capture in rice-based farming, a decade ago the capture supplied half of the needed fish in the diet.

In addition many species of crustaceans, molluscs, amphibians, insects, reptiles, and aquatic plants were recorded in these studies all of which are either used directly or processed for human consumption, as animal feeds or bait, or have medicinal value.

Threats to the Aquatic Biodiversity

The availability of aquatic resources is declining. Farmers in Xishuangbanna claimed that fish are becoming less and less abundant, and that the amount of aquatic organisms collected in one day nowadays is equivalent to what was collected a decade ago in one hour. Similarly, the Vietnamese study points out that fish catches have greatly reduced both in terms of quantity and diversity, especially in the last decade. Human population increase and the consequent increased fishing pressure on aquatic resources is certainly important, but a number of management reasons are claimed to be chiefly responsible for this decline: pesticide use, destruction of fish breeding grounds, and illegal fishing tools such as electro-fishing or chemical poisoning. Development and capacity building efforts for example through integrated pest management and production (including aquatic resources) training as part of Farmer Field Schools need to address these threats but efforts are also needed at the policy level to ensure change.

Documentation and dissemination of results

The initial goal of these studies, i.e. to document the availability and use of aquatic organisms in rice-based farming and to raise awareness of all stakeholders about the aquatic biodiversity in rice fields, has partially been achieved through the participatory process that was followed in the studies. However, further activities are planned in the form of documentation, presentation and workshops to make a larger audience, particularly agricultural policy makers, aware of the results. So far, one publication has been produced based on a Cambodian case study in flooded rice which was the first to be completed in this series[1] - the electronic version accessible via the Internet[2] - and presentations and distribution of the publication have been made at various international fora. A regional workshop[3] which brought together the collaborators from the four Asian countries highlighted the need for increased information exchange and longer-term studies focussing *inter alia* on the quantitative contribution and nutritional aspects of the aquatic biodiversity to the diet of rice farming families.

Outlook

The Chinese and Vietnamese studies now require further analysis and follow-up since they could only cover limited areas and time spans. They should be expanded to other countries in the region. Findings are furthermore expected to serve as important background information for similar activities in other regions such as West Africa or Latin America. An informal Asian Aquatic Biodiversity Group has been created to facilitate information exchange. The collected data are expected to provide a good basis for further insights not only into aquatic biodiversity but also into alien species, endangered species, food security, gender and sustainable resource use aspects as well as possibilities for post-harvest value adding. Furthermore, it is expected that the findings will be an important basis for collaborative programmes with other organizations, in particular for a recently initiated joint activity between FAO, DFID, VSO, and NACA entitled Support to Regional Aquatic Resource Management (STREAM).

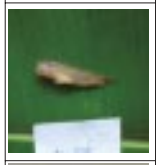
[1] Balzer, T., Balzer, P. and S. Pon. Traditional use and availability of aquatic biodiversity in rice-based ecosystems. I. Kampong Thom Province, Kingdom of Cambodia. Edited by M. Halwart & D. Bartley (FAO) and H. Guttman (Guest editor, MRC). CD ROM. FAO, Rome, Italy. ISBN 92-5-104820-7.

[2] Available at www.ecoport.org, click on eNarrative, then eArticle, enter ID 131.

[3] FAO/NACA 2003. Traditional use and availability of aquatic biodiversity in rice-based ecosystems. Report of a Workshop held in Xishuangbanna, Yunnan, P.R. China, 21-23 October 2002. FAO, Rome.

Table 1.

Example of a database documentation of fish species collected in rice-based ecosystems (Viet Nam)

	Vietnamese Name	Local Name	English name	Scientific name	Family	Fishing gear/method	Preference*	Availability*	Aquatic Resource
	Ca Chep	Pa Nay	Common carp	Cyprinus carpio	Cyprinidae	cast net, lift net, scoop net, long handled net	high	high	pond, rice field
	Ca Troi mrigan		Mrigal	Cirrhinus mrigala	Cyprinidae	cast net, lift net	high	high	pond, rice field
	Ca Ro phi		tilapia	Oreochromis sp.	Cichlidae	cast net, lift net, hook	middle	high	pond, rice field
	Ca bong 1	Pa Bu (Pa Bun) 1	Goby	Eleotris sp.	Eleotridae	scoop net, cylindrical trap, (cast net, hook, long handled net)	high	high	streams, less in rice field
	Ca bong trang (1) Ca bong da	Pa Bu (Pa Bun) 2	Goby	Rhinogobius sp.	Gobiidae	scoop net, cylindrical trap, (cast net, hook, long handled net)	high	high	rice field, ditch, stream
	Ca bong trang (2) Ca bong doi	Pa Bu (Pa Bun) 3	Goby	Mugilogolius sp.	Gobiidae	scoop net, cylindrical trap, (cast net, hook, long handled net)	high	high	rice field, ditch, stream

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The Convention on Biological Diversity (CBD), negotiated under the auspices of the United Nations Environment Programme (UNEP), was adopted in 1992 and entered into force in 1993. Its aims are the conservation of biological diversity, the sustainable use of biological resources, and the fair and equitable sharing of benefits arising from the use of genetic resources. One of the major challenges facing the Convention on Biological Diversity is the communication of research results in a way that provides the policy makers, their advisors, the scientific community and other stakeholders with helpful insights.

Major factors leading to biodiversity loss are habitat loss and degradation, invasive alien species, overuse of resources and pollution. Due to the complexity of these factors, various approaches and strategies are being used to reduce biodiversity loss. All, however, require the best available scientific information that allows the development and implementation of sound management strategies.

The goal of the CBD Technical Publications Series is to contribute to the dissemination of up-to-date and accurate information on selected topics that are important for the conservation of biological diversity, the sustainable use of its components and the equitable sharing of its benefits. A large and growing body of evidence has clearly established the need to disseminate synthesis publications relevant to CBD objectives and selected reports presented at CBD meetings.

The Technical Publications Series is intended to:

- Foster scientific and technical cooperation;
- Improve communication between the Convention and the scientific community;
- Increase awareness of current biodiversity-related problems and concerns; and
- Facilitate widespread and effective use of the growing body of scientific and technical information on conserving and using biological diversity.

The CBD Technical Publications Series comes at a time when the international community through the Conference of the Parties to the Convention has committed itself to achieving tangible results in all aspects of the sustainable management of biological diversity for social and economic purposes. We therefore believe that this series will be useful to the broader scientific community and those concerned with biodiversity management.