Case Studies Illustrating the Socio-Economic Benefits of Ecological Networks

Ministry of Agriculture, Nature and Food Quality

Convention on Biological Diversity

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Foreword

Protected areas that remain as isolated units almost always face serious viability problems over the long term. Ecological coherence and resilience must be strengthened in order to achieve biodiversity conservation and sustainable development. The development of national and regional ecological networks and corridors was endorsed by the World Summit on Sustainable Development as necessary to achieve the 2010 biodiversity target. Goal 1.2 of the CBD programme of work on protected areas specifically calls for integrating protected areas into broader land- and seascapes and sectors to maintain the structural and functional viability of ecosystems.

Ecological networks provide an operational model for conserving biological diversity while allowing for sustainable use of natural resources. The connection of ecosystems and populations of species that are threatened by habitat fragmentation facilitates genetic exchange between different populations and thus increases the chances of survival of threatened species.

Many ecological networks have been developed around the world, and considerable research has been carried out, particularly in recent years, in assessing their effectiveness in conserving biodiversity. The CBD Secretariat compiled information on ecological networks and their contribution to the conservation and the sustainable use of biological diversity and sustainable development in Technical Series 23. That review contains detailed information and case studies on the development and implementation of ecological networks in each of the five UN regions. However, to date, relatively little research has focused on the socio-economic benefits which ecological networks accrue.

This brochure provides a broad examination of the benefits of ecological networks, including how the concept is applied in the conservation and sustainable use of biodiversity, the achievement of the 2010 biodiversity target, and how these networks can contribute to poverty alleviation and address climate change issues. The case studies presented reflect experiences in Europe, Asia, Australia, North America and Latin America.

The compelling evidence presented in the document illustrates the socio-economic benefits that ecological networks provide so that we may better understand their role in both conserving biological diversity and in supporting human wellbeing. I express my deepest gratitude to the Government of the Netherlands for generously providing the financial resources for producing this brochure.

Ahmed Djoghlaf
Executive Secretary
Convention on Biological Diversity

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For further information, please contact:
Secretariat of the Convention on Biological Diversity
World Trade Centre
413 St. Jacques Street, Suite 800
Montreal, Quebec, Canada H2Y 1N9
Phone: 1(514) 288 2220
Fax: 1 (514) 288 6588
E-mail: secretariat@cbd.int
Website: http://www.cbd.int

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THE SOCIO-ECONOMIC BENEFITS OF ECOLOGICAL NETWORKS

Introduction

Over the past 15 years we have seen a paradigm shift in perspectives on biodiversity conservation, particularly in the interrelationship between biodiversity conservation and other land uses. This is reflected in the increasing number of programmes that aim to maintain ecosystem functions in combination with the sustainable use of the landscape.

Today, over 250 programmes worldwide have adopted this approach to conservation and sustainability. A wide range of names are used to describe the broad approach, such as Biosphere Reserve, Territorial System of Ecological Stability, Reserve Network, Bioregional Planning, Ecoregion-Based Conservation, Biological Corridor, the Ecosystem Approach and Connectivity Conservation, although the term "ecological network" is often used internationally as a generic description.

While each of these programme types has its own broad approach, the differences between them represent to a large extent variations in scope or working method rather than any essential divergences in the basic management philosophy. At the heart of all these approaches lies a core vision that integrates biodiversity conservation with economic development within a broad landscape management framework. A number of common elements can be discerned in the way in which this goal is achieved, namely:

- a focus on conserving biodiversity at the landscape, ecosystem or regional scale;
- an emphasis on maintaining or strengthening ecological coherence, primarily through providing for connectivity;
- ensuring that critical areas are buffered from the effects of potentially damaging external activities
- restoring where appropriate degraded ecosystems; and
- promoting the sustainable use of natural resources in areas of importance to biodiversity conservation in such a way that they are economically and socially viable and also ecologically sustainable.

The programmes also share a common understanding of how the model should be applied on the ground, namely through the allocation of specific functions to different areas depending on their ecological value and their natural-resource potential. These functions are reflected in a coherent system of areal components:

- core areas, where the conservation of biodiversity takes primary importance;
- corridors, which maintain vital ecological or environmental linkages between the core areas;
- buffer zones, which protect the network from potentially damaging external influences; and
- sustainable-use areas, where opportunities are exploited within the landscape mozaic for the sustainable use of natural resources.

Considerable research has been carried out in recent years in assessing the effectiveness of ecological networks in conserving biodiversity. However, relatively little attention has been focused on the extent to which ecological networks achieve their socio-economic goals. Nonetheless, through the application of the ecological network model in a wide range of circumstances, considerable experience has now been gained in securing socio-economic objectives through these programmes. Disseminating this experience throughout the biodiversity-conservation and sustainable-development communities is clearly overdue.

The ways in which ecological networks contribute to achieving these objectives are illustrated through a selection of eight case studies that reflect experience in five regions: Europe, Asia, Australia, North America and Latin America. The examples highlight experience in contrasting socio-economic environments—from poor to rich, at different scales and across various economic sectors and cultures.

For the purposes of this brochure, the socio-economic dimension of ecological networks encompasses four elements, namely:

- the conservation and sustainable use of biological diversity;
- meeting the 2010 biodiversity target;
- reducing poverty; and
- adaptation to climate change.

establish and maintain the environmental conditions that are necessary to secure the long-term conservation of biodiversity

SUSTAINABILITY

The Conservation and Sustainable Use of Biological Diversity

One of the main characteristics of ecological network programmes is that they aim to establish and maintain the environmental conditions that are necessary to secure the long-term conservation of biodiversity rather than limiting measures to the *in-situ* protection of valuable sites or threatened species populations. This involves, in the main, safeguarding assemblages of habitat large enough and of sufficient quality to support species populations, providing where necessary opportunities for movement between these reserves, buffering the network from potentially damaging human activities and promoting sustainable forms of land-use in the contiguous landscapes.

Indeed, the integration of biodiversity conservation and sustainable use is one of the defining features of ecological networks. Thus, the programmes promote an array of land-use functions which can range from strictly protected areas (equivalent to IUCN's Category Ia Strict Nature Reserve or Category Ib Wilderness Area) through to multiple-use areas in which the landscape has an important productive role. In fact, the pioneering national ecological network programmes that were originally developed 20–30 years ago in Central Europe, such as the Estonian Green Network and the Czech and Slovakian Territorial Systems of Ecological Stability, were based on an approach that would now be called sustainable development and involved detailed elaboration at the local level through the comprehensive planning systems in those countries.

Most government-driven ecological network programmes use the spatial-planning system and a range of other instruments, such as financial incentives, to promote the sustainable use of biodiversity. For example, in Europe support for extensive forms of traditional farming is a commonly used instrument, as is the purchase of land by public bodies in order to ensure that appropriate forms of management are applied, which can include sustainable uses such as forestry and recreation. A diverse range of other instruments are also applied by the programmes. These include legal protection, land reform, the establishment of community forests, buying up logging concessions, compensating livestock losses, organizing smallholders into producer associations, forest certification, conducting awareness-raising campaigns and education programmes, offering training courses, strengthening institutional capacity, and negotiating voluntary agreements, environmental service payments and conservation easements with land owners.

The NGOs that operate at a continental or international scale have developed more-or-less standard methodologies that encompass sustainable use. For example, the Wildlands Network in North America has developed a common approach to preparing plans that includes sustainable use through distinguishing between four kinds of compatible-use lands: low-use lands, moderate-use lands, transportation lands and private lands.

As the case studies demonstrate – and many other examples such as the Atlantic Forest Central Corridor (Brazil) and the Tri-Dom programme (Cameroon, Gabon and Congo)—the variety of complementary land uses that are being promoted is extremely wide. These include the sustainable harvesting of non-timber forest products and the cultivation of organic cocoa (the Mesoamerican Biological Corridor), ecotourism and developing sustainable forestry in indigenous territories (the Vilcabamba–Amboró Conservation Corridor), the establishment of tree nurseries (the Terai Arc Landscape) and the promotion of sandalwood growing, dry-country forestry and bush foods (the Gondwana Link).

Meeting the 2010 Biodiversity Target

Since 2001, when the governments of the EU member states first commited their countries to halt the loss of biodiversity by 2010, the target (or the similar objective of a significant reduction in the current rate of loss of biodiversity) has been adopted by many international, national and sub-national political bodies. Indeed, given the far-reaching implications of the commitment, the 2010 target is probably the most far-reaching international agreement made in any field in recent years.

The political significance of the 2010 target is the breadth of the commitments made to date. The original agreement dates from June 2001 when the EU Heads of State and Government committed themselves to halt the loss of biodiversity by 2010, an objective that was reaffirmed in March 2005. In April 2002 the Parties to the Convention on Biological Diversity adopted a Strategic Plan that includes the target of achieving by 2010 a significant reduction in the current rate of biodiversity loss. In September 2002 the UN World Summit on Sustainable Development endorsed the achievement by 2010 of a significant reduction in the current rate of loss of biodiversity. Finally, in May 2003 at the Fifth Environment for Europe Ministerial Conference, over 50 Eurasian states reiterated the objective to halt the loss of biodiversity at all levels by 2010.

It is clear, given the rate at which biodiversity is being lost on all continents and the imminence of the 2010 deadline, that these commitments infer a substantial upgrading of conservation measures, a stronger focus on sustainability across a wide range of policy sectors and a marked improvement in the effectiveness with which actions are implemented on the ground. Meeting the 2010 target will therefore require not only additional conservation measures but also structural changes in how natural resources are exploited.

However, despite the global confirmations of the EU's original commitment, it is clear that the main inertia for action can be found in Europe. In terms of policy development the 2010 target has been incorporated into various European instruments, such as the European Commission's 2006 Communication *Halting the Loss of Biodiversity by 2010—And Beyond*, the European Environment Agency's SEBI 2010 indicators and the Pan-European Biological and Landscape Diversity Strategy's 2010 targets that were agreed at the Kiev ministerial meeting in 2003. Many European countries, inspired by the 2004 Malahide Conference, have also taken more focused measures and about 750 businesses, NGOs, research institutes and other civil society organizations are cooperating with declarations of specific commitments to conservation action through the Countdown 2010 initiative.

In that perspective, the management model that underlies ecological networks has much to offer: it not only aims to conserve specific sites and species populations, it has the goal of ensuring the maintenance of ecosystem functions and promoting the sustainable use of natural resources. In other words, it aims to establish and maintain the conditions that are necessary for the long-term conservation of biodiversity and to do so at the landscape, the ecosystem or even the ecoregional scale. The 2010 target is therefore intrinsic to the model.

Indeed, as the European case studies show, improving the connectivity of protected-area networks is now regarded as a key means of reducing biodiversity loss. At the same time, however, it must be concluded that achieving the 2010 target within a few years is beyond the capability of most of the current programmes, if only because of the extent of the measures that need to be taken, by the recent commencement of most initiatives and the time that will be necesary for the programmes to achieve substantive results on the ground. Ecological networks, if they secure their goals, will certainly make an important contribution to achieving the 2010 target. In most cases, however, given the magnitude and the timescales of the implementation measures, this will only be achieved some years after 2010.

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sustainable use of the landscape in combination with the maintenance of ecosystem functions creates the long-term conditions that are necessary for the reduction of poverty

Poverty Reduction

One of the most interesting aspects of ecological networks is that the programmes are being implemented in an exceptionally wide range of socio-economic circumstances, from advanced industrialized countries to some of the poorest regions in Africa, Asia and Latin America. The argument for applying these programmes in developing countries is that the sustainable use of the landscape in combination with the maintenance of ecosystem functions creates the long-term conditions that are necessary for the reduction of poverty through building sustainable livelihoods. Indeed, several major donors are supporting the realization of ecological networks in poorer regions as part of their development-aid programmes. These donors include the World Bank, UNDP, USAID, the Inter-American Development Bank and national ministries and agencies in countries such as Germany, the Netherlands and Japan.

The case studies illustrate various ways in which ecological networks are serving to help reduce poverty. For example, the Vilcabamba-Amboró Conservation Corridor is supporting low-impact economic enterprises, sustainable hunting practices and the development of ecotourism, and the Terai Arc Landscape has organized education courses for local livestock herders and provided subsidies to local communities for the construction of livestock pens, improved fuel-efficient cooking stoves and biogas plants. Similar initiatives are being taken in other programmes, such as the Kazungula Heartlands Project in Botswana, Namibia, Zambia and Zimbabwe.

Despite these successes, ecological network programmes in poor regions are facing major implementation challenges. These stem mainly from high population densities in many areas and the resulting pressures on natural resources, the underdeveloped institutional structures, the difficulty in establishing professional process-management frameworks for the necessarily complex implementation programmes, securing the support of local communities and balancing the need for short-term urgent development measures with investments in achieving long-term sustainability objectives.

Adaptation to Climate Change

In recent years it has become clear that climate change is becoming a serious threat to global biodiversity. The IPCC's recent *Fourth Assessment Report* highlights a wide range of impacts, including species extinctions, reductions in area of some ecosystems and biome shifts. Moreover, the report concludes that beyond 2050 climate change will probably be the major driver for biodiversity loss.

According to the IPCC, the biodiversity that is most at risk includes Mediterranean-climate ecosystems, desert biodiversity, coral reefs, the sea-ice biome, mountain ecosystems and high-latitude ecosystems such as boreal forests. For example, at the southern ecotone of boreal forests and Arctic tundra ecosystems with continental grasslands, a contraction of boreal forest is projected due to increased impacts of drought, insects and fires, together with a lower rate of sapling survival. Tropical ecosystems are expected to change, particularly in the Amazon where climate models show strong-to-moderate reductions in precipitation, with the result that evergreen tropical forests are likely to transition into rain-green forests or grasslands.

These findings have far-reaching implications for biodiversity conservation. For example, mobile species such as polar bears and migratory animals, particularly those dependent on tundra, wetlands, lakes, tropical forests and savannas, are likely to be severely affected by climate change impacts within and across biomes. As the IPCC report emphasizes, an important obstacle for adapting to climate change is that the ability of many species populations to migrate in response to a changing environment is seriously hindered by the high level of habitat fragmentation and the intensive use of natural resources in many regions. Moreover, most protected areas are islands of biodiversity which cannot simply move their boundaries to follow shifting species populations and ecosystems. Most reptile and amphibian species populations, for example, would tend to expand their ranges in response to climate change. However, according to the IPCC, if habitat fragmentation prevents these species from dispersing, their ranges are likely to decline.

These threats infer the need for a new relationship between many protected areas and their surrounding landscapes and local communities. The priority must be to strengthen the resilience of ecosystems to environmental change. Because many protected areas are already limited in size in relation to the ecosystems that they aim to conserve and are therefore vulnerable to climate change, biodiversity conservation will need to focus increasingly on the wider landscape. Two priority measures are to improve the ecological quality of multiple-use areas and to reduce the degree of ecological fragmentation and thereby increase the permeability of the landscape for species populations. Examples of this approach are illustrated in the case studies, where the Gondwana Link in southwestern Australia is restoring the ecological connectivity of a critical vector for species in the face of projected climate change, and where the conservation strategy for grizzly bear populations in the Yellowstone-to-Yukon ecoregion is aiming to build a matrix of core areas and corridors that allow for projected climate change.

beyond 2050 climate change will probably be the major driver for biodiversity loss

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CASE STUDIES

Eight case studies that reflect experience in five regions: Europe, Asia, Australia, North America and Latin America.

The Conservation and Sustainable Use of Biodiversity

CASE STUDY

THE MESOAMERICAN BIOLOGICAL CORRIDOR

The Conservation and Sustainable Use of Biodiversity Across Central America

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Mesoamerica covers one half per cent of the world's land surface but is home to about 7% of the planet's terrestrial biodiversity. This biological wealth is the result not only of Mesoamerica's particular environmental characteristics but also of its strategic position as a land bridge connecting the biotas of the two American continents. About 30 ecoregions have been identified, ranging from lowland rainforests through pine savannas, dry forests, high mountain forests and mangroves to grasslands and coastal ecosystems.

Given this unusually rich biodiversity and the growing threats posed by economic development, the US-based Wildlife Conservation Society and the Caribbean Conservation Corporation launched an initiative in 1994 known as *Paseo Pantera* (Path of the Jaguar) that proposed linking existing protected areas along the Caribbean coast with corridors. In 1997 the programme, now known as the Mesoamerican Biological Corridor, was formally endorsed by the region's eight heads of state as a framework for protecting biodiversity and maintaining ecosystem services, while at the same time improving the lives of Central Americans through sustainable development.

The Mesoamerican Biological Corridor distinguishes four kinds of zones: core areas, buffer zones, corridors and multiple-use areas. At the regional level these elements were delineated on an indicative map that covered over a quarter of the region's territory. The basis of the Corridor's core areas are the region's 368 protected areas, 18 of which are larger than 100,000 hectares. Together they protect nearly 11% of Mesoamerica's land area. Within this area can also be found 26 indigenous groups and all the major Maya sites, such as Tikal, Chichén Itza and Copán.

The international Corridor programme ended in 2005, but at the national level work is underway to translate the strategic plan into implementation programmes. Much of this work is promoting sustainable development through projects in the buffer zones, corridors and multiple-use areas that encourage land users to test and adopt management practices that are both biodiversity-friendly and economically viable. Examples include the use of community concessions for harvesting non-timber forest products such as xate, wildberries and allspice in the Maya Forest, which stretches from Mexico through Yucatan to Belize. Other projects are promoting layered-cropping farming and combinations of timber trees and shade coffee while at the same time organizing smallholders into producer associations that are capable of competing on the world market.

Costa Rica is a good example of the range of actions being undertaken by one Mesoamerican

country. With support from the World Bank and the German development bank KfW, the Costa Rican government is financing management measures by private land owners whose land is located in corridors. The 1500-strong Small Farmers' Association of Talamanca now produces 20% of the world's organic cocoa. Costa Rica is also benefiting from the Small Grants Programme of the United Nations Development Programme to fund local Natural Resources Vigilance Committees (COVIRENAS), farmers' cooperatives and local conservation and development associations in establishing local ecotourism enterprises. Indeed, tourism is now the most important foreign exchange earner, with ecotourism having developed into the biggest sector.

In 1996 the Costa Rican government developed a programme to offer environmental service payments to private landowners who own land in forest areas. Funded through a fuel tax—currently 3.5%—and from voluntary contracts with private hydroelectric producers, these payments compensate the owners for the ecosystem services that their lands provide. The annual rate for conserving forest is about $42 per hectare, for reforestation the rate averages $107 per hectare a year and for forest management about $65 a year is paid. The payments undoubtedly provide some incentive against logging forest and using the land for raising cattle. However, an evaluation of their effect could not determine the precise impact of the payments. For example, the deforestation rate in the period 1997–2000 was not significantly lower in areas that received payments. An explanation of this apparent anomaly is that the payment system did not operate as effectively as intended with the result that the number of landowners signing up for the payments declined during the period. Experience to date has enabled important lessons to be learned which can be used to refine the environmental service payments system to operate more effectively in the future.

The Mesoamerican Biological Corridor is clearly one of the most ambitious initiatives of its kind. It provides a wealth of experience, not only in seizing the right moment to bring together a wide range of stakeholders by offering a broad-based vision of development and conservation, but also in identifying the most difficult practical issues that arise in implementing ecological networks and formulating ways of meeting these challenges. However, many problems remain to be resolved. Some stakeholders and policy-makers remain to be convinced of the programme's benefits and are wary of its likely impact on their interests. Also, many projects are implemented in relative isolation. An evaluation by the World Resources Institute that was published in 2001 was broadly positive, but identified eight key issues that the programme needs to address if it is to achieve its objectives, namely:

- reconciling stakeholder interests;
- fostering democratic governance and enabling civil society participation;
- catalyzing information for participatory decision-making;
- clarifying the function of land-use categories;
- addressing property rights and land-tenure issues;
- capturing benefits from ecosystem goods and services;
- harmonizing institutional and legal frameworks and promoting intersectoral cooperation; and
- setting investment and management priorities.

The report nevertheless concluded that the initiative had built a strong foundation through actively soliciting the support of a wide range of stakeholders and actors. Its involvement of local groups – farmers, indigenous peoples, municipalities and local companies—offers the main key to the initiative's success.


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In 1996 the Costa Rican government developed a programme to offer environmental service payments to private landowners who own land in forest areas.

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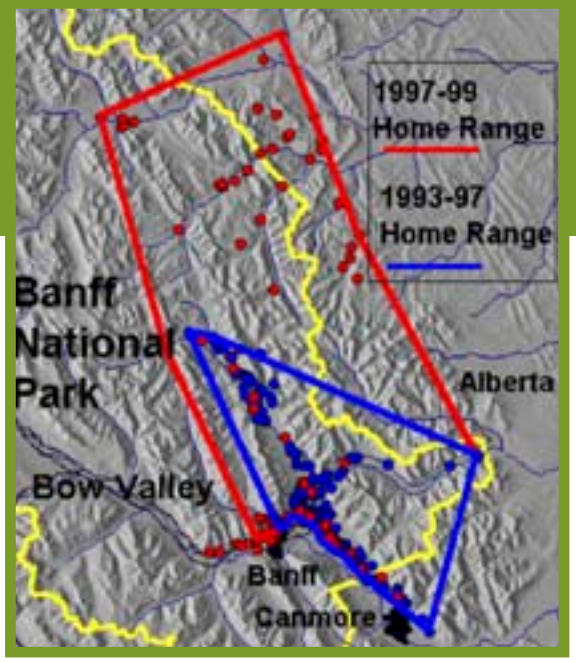
CASE STUDY

THE CASCADE CORRIDOR

Reconciling Land Use and Biodiversity Conservation in the Rocky Mountains



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The Rocky Mountains are North America's last remaining intact mountain ecoregion. Although the Rockies retain their full complement of native species, local extinctions and endangered species are causing serious and increasing concern. This is particularly the case for the region's large carnivores: pumas, grizzly bears, wolverines and wolves. Mainly as a result of habitat destruction and hunting, potentially viable populations of these animals are now found only in the small number of protected areas in the region's northern stretches.

The wolf is a good example of the special needs of these large carnivores. Wolves require access to exceptionally large tracts of habitat. Because none of the existing national parks is large enough to support a viable population of wolves, the long-term survival of the populations depends on the ability of wolf packs to move freely between the islands of habitat that remain.

In the central Canadian Rockies, the rugged nature of the terrain forces wolves to confine their movements to low-lying valley bottoms. Rivers and passes therefore function as natural corridors. This can clearly be seen in the Bow River Valley in Alberta's Banff National Park, a linkage that offers the highest-quality habitat for wolves in the central Canadian Rockies and permits the movement of wolf packs between Canada and the US. The valley was recolonized by wolves during the 1980s, but increasing urban development severely disrupted the opportunities for movement through the valley. This forced wolf packs to adopt circuitous, energy-intensive and less suitable alternative routes and to abandon some high-quality habitats.

The Cascade Corridor, one of three routes around the town of Banff that are available to wolves, offers the greatest potential for movement. The corridor lies about one kilometre to the north of the town, is about six kilometres long and varies in width from 350 to 1,500 metres. Vegetation cover is about 50% open forest, 30% closed forest and 20% open meadow.

The corridor is especially important to wolves during the winter months when their prey—mainly elk and mule deer—move down to lower elevations and the Cascade wolf pack roams across the lower Bow River Valley. Wolves made little use of the route before 1997 because of the moderate-to-high level of human intrusion in the corridor, which included a hotel, a ski access road, a buffalo paddock, barns, horse corrals, an airport and a military training facility.

Because of the regional importance of the corridor in facilitating the movement of wolves, Parks

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Because of the regional importance of the corridor in facilitating the movement of wolves, Parks Canada … agreed to take action to reduce the intensity of human activities.

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Canada—the management authority of the national park—agreed to take action to reduce the intensity of human activities. As a result, the buffalo paddock and several barns and horse corrals were removed in 1997 and the airstrip was closed to all air traffic except emergency landings. Two years later the training camp was also removed. These actions also reduced associated recreational activities and vehicle use in the corridor.

A programme to monitor wolf movements in the Bow River Valley had been underway for several years and had already provided extensive tracking data through the use of radio collars, with additional data being provided from analyses of snow tracks and kills of the wolf's prey species. Reducing human activities in the Cascade Corridor offered an excellent opportunity to determine the effect of the restoration actions on the wolves' movement patterns. The results were striking.

Using the overall intensity of wolf movements within the Bow River Valley as a baseline, relative movement through the Cascade Corridor increased sevenfold in the period 1997–1999 compared with the period 1993–1997, an increase far greater than had been hypothesized. Moreover, not only was the intensity of movement through the Cascade Corridor far greater, the improved connectivity seemed to allow the Cascade wolf pack to expand its range: the home range of the pack increased in extent to include four more valleys, expanding in area from 607 to 1,847 square kilometres.

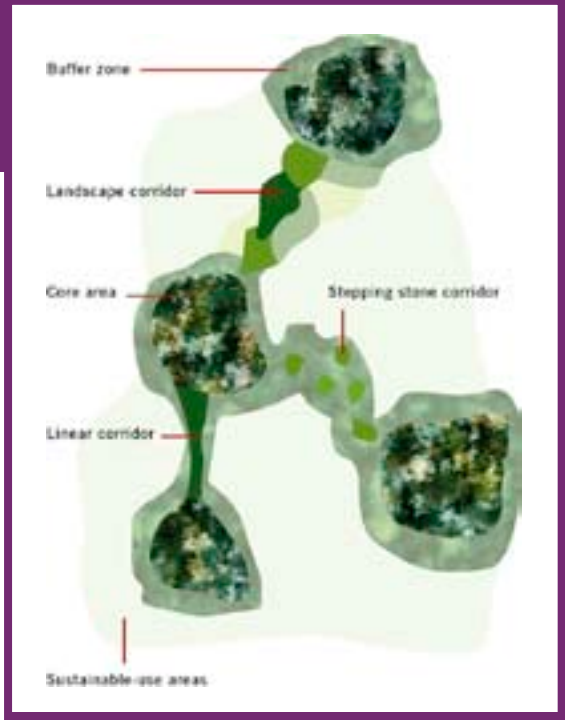
Analysis of the results indicated that wolves were not negatively affected by roads and human but were negatively affected by high human use, such as residential, commercial and industrial areas. However, wolves did use areas less than 500 metres from human disturbance where these provided ample cover, were relatively flat and enjoyed a high prey abundance.

Since the monitoring programme only extended over a relatively short period, it was possible that other incidental factors – such as variations in snowfall and the abundance and location of prey – could have been partly or wholly responsible for the increased movement of the wolves. Analysis of these factors, however, showed that the recorded variations during the monitoring period did not explain the observed changes in use of the corridor. The results confirmed that the restoration of the Cascade Corridor recreated a linkage that is crucially important for wolf packs in the region.

CASE STUDY

THE PAN-EUROPEAN ECOLOGICAL NETWORK

Conserving Biodiversity from the Atlantic Ocean to the Bering Sea



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To an important extent, Europe's landscapes have been shaped by man. Over thousands of years human activities have slowly transformed the continent, increasing Europe's visual diversity and encouraging in many cases even greater natural diversity. Indeed, until the nineteenth century the diversity of habitat types and the number of animal and plant species across Europe had generally been increasing.

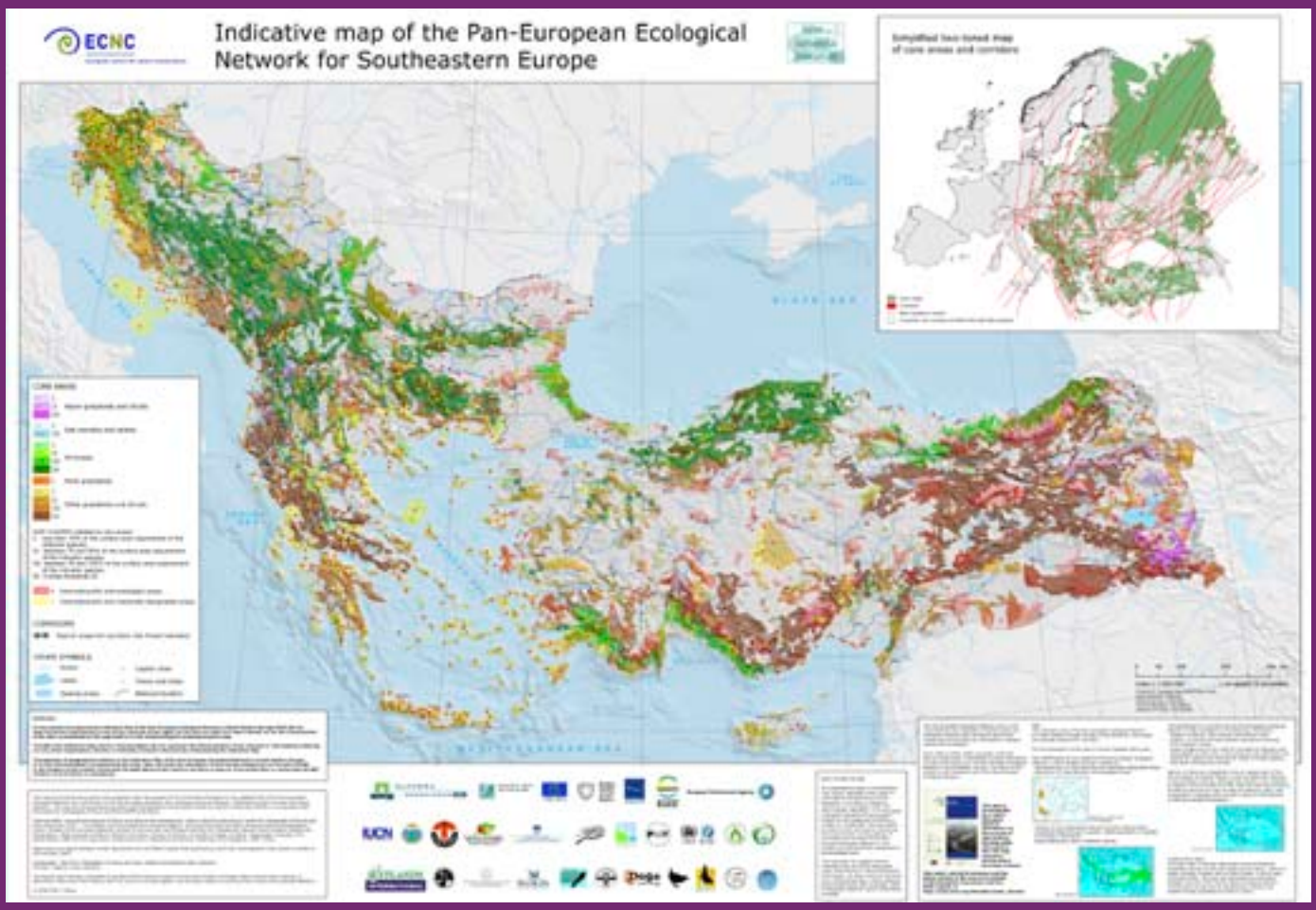
In recent decades, however, human impacts on the environment have become so severe that this trend has been reversed. Deforestation, agriculture, wetland drainage, the modification of coasts and rivers, mining, road construction and urbanisation are threatening to destroy much of Europe's natural heritage: the diversity of natural and semi-natural habitats is falling rapidly and many of the animal and plant populations that depend on these habitats for their survival are declining both in total numbers and in their geographical range. We are seeing a wide range of habitats and species populations becoming increasingly fragmented into isolated "islands" which are too small to be ecologically viable in the long term, especially with the growing environmental pressures from human activities.

Meeting this challenge is complicated by the fact that Europe, more so than any other continent, is a patchwork of relatively small countries. As a consequence, ecosystems and the processes that disrupt their functioning often extend across national boundaries. Isolated measures taken within a local, regional or national context will therefore in many cases be inadequate to deal with the problems.

Working within an international framework provides the opportunity to take more effective measures by facilitating the development of a common approach to the conservation of Europe's biodiversity and by helping to promote coordinated action.

It was for these reasons that in 1995 over 50 Eurasian countries endorsed the Pan-European Biological and Landscape Diversity Strategy. The central element of the strategy was the establishment of the Pan-European Ecological Network with four main aims:

- the conservation of the characteristic ecosystems and the natural habitats and landscapes of European importance across their traditional ranges;
- the sustainable use of semi-natural habitats and cultural landscapes of European importance;
- the maintenance of viable populations of species of European importance across their traditional ranges; and



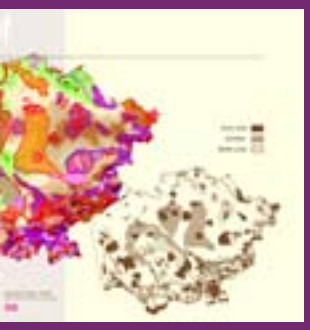
- the maintenance of the environmental processes on which these ecosystems, habitats, species and landscapes depend.

These objectives are to be achieved through the establishment of an ecological network that is being built up from three functionally complementary components: core areas that provide the optimum achievable quantity and quality of environmental space, corridors to ensure appropriate interconnectivity between the core areas, and buffer zones to protect the core areas and corridors from potentially damaging external influences.

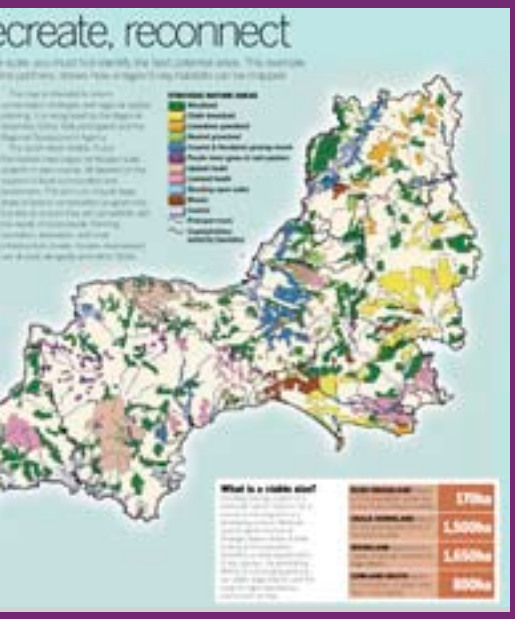
The contribution of the Pan-European Ecological Network to halting the loss of biodiversity by 2010 was highlighted in the Kiev Resolution on Biodiversity that was adopted in 2003 by the Fifth "Environment for Europe" Ministerial Conference. The resolution reinforced the objective to halt the loss of biodiversity by 2010 and included a commitment by governments in the pan-European region to achieving two specific targets:

- By 2006, the Pan-European Ecological Network will be identified and reflected on coherent indicative European maps as a European contribution towards a global ecological network.
- By 2008, all core areas of the Pan-European Ecological Network will be adequately conserved and the Pan-European Ecological Network will give guidance to all major national, regional and international land-use and planning policies and to the relevant economic and financial sectors.

For the implementation of the first target, a high-level cooperation has been established between the Council of Europe, the European Centre for Nature Conservation, the European Environment Agency and the Committee of Experts for the Pan-European Ecological Network. Indicative maps have been prepared for Central and Eastern Europe and Southeastern Europe, and a map for Western Europe is in preparation. These maps indicate core areas of pan-European importance and broad areas within which associated corridors or stepping stones could be located. It should also be noted that ecological network programmes are be-



ecological network programmes are being developed at different levels and by a variety of organizations, both government and non-government



ing developed at different levels and by a variety of organizations, both government and non-government. Currently about 20 countries have national ecological network programmes, including some non-governmental initiatives.

In other countries, lower government authorities have taken the initiative to develop ecological networks (such as republics, regional governments and municipalities in the Russian Federation, the RENPA network in Andalusia and the TEN network in the UK, the Netherlands, Germany and Denmark). Other ecological networks are being developed by independent organisations (such as ECONET–Poland and the Sava River Ecological Network in Slovenia, Croatia, Serbia and Bosnia and Herzegovina). Regional transboundary initiatives are also underway (such as the Alpine Network of Protected Areas, the Lower Danube Green Corridor and the European Green Belt involving 23 countries along the former Iron Curtain). In Central Asia, as part of the Ecoregional Conservation Plan for the Caucasus that was endorsed during the Caucasian countries' Ministerial Conference in March 2006, a map of priority conservation areas and corridors in the Caucasus ecoregion has been prepared, and UNEP/GEF and WWF are implementing the Econet for the Long-Term Conservation of Biodiversity in the Central Asia Ecoregions to develop a regional network of protected areas, including ecological corridors and buffer zones.

With regard to the second Kiev target, an analysis of the implementation of the Resolution concluded that substantial work still has to be completed with regard to conserving the core areas of the Pan-European Ecological Network if the 2010 target is to be met. A key problem here is that the implementation of the Pan-European Ecological Network showed marked variations in implementation between the countries. One of the main challenges is to provide a coherent natural structure to the EU's Natura 2000 programme in an increasingly urbanized Europe and to prepare linkages that might help natural species and habitats to adapt to the impacts of climate change.

Meeting the 2010 Biodiversity Target

CASE STUDY

NATURA 2000

Strengthening Connectivity Across the European Union

Although the European Union is often maligned for adopting environmental measures that have little more substance than the weakest national policies of the member states, a more critical analysis shows that it often plays a leading role in advancing environmental policy across Europe. Examples of this pioneering work include the introduction of legally binding air quality standards (which did not exist in any of the member states at the time) and its decisive actions in establishing international production limits on CFCs in response to the depletion of the ozone layer.

Biodiversity conservation in Europe also benefited from a similar process. The EU Birds Directive (adopted in 1979) and the Habitats Directive (adopted in 1992) provide for the establishment of a representative system of legally protected areas throughout the EU known as Natura 2000. The primary significance of Natura 2000 is that the conservation of biodiversity has legal primacy above all other land uses in the designated sites—a degree of protection that none of the member states applied until the directives were adopted.

The Birds Directive introduced a broad protection scheme for all wild bird species of European importance (194 species are currently listed in the annex to the Directive). Significantly, the Directive provided legal protection not only for wild bird populations (including restrictions on hunting methods and trade) but also for their habitats.

This conservation approach was followed for the subsequent Habitats Directive. But the Habitats Directive marked a significant step forward in biodiversity conservation because it introduced a comprehensive and legal protection regime for all fauna and flora species of European importance (currently 865 species) and also valuable habitats. This regime requires the legal designation of protected areas that meet the criteria laid down in the Directive (so-called Special Areas of Conservation), a strict protection regime for designated species, the maintainenance of habitats and species populations in "favourable conservation status", the preparation of management plans, monitoring arrangements, and nature compensation where a project adversely affects a Natura 2000 site for reasons of "overriding public interest". The European Commission approves the various lists and management plans and takes enforcement action where necessary. Designated Natura 2000 sites now number about 30,000 in the EU member states and their aggregate area covers more than 20% of the territory of the EU, equivalent to the area of Germany.

Although Natura 2000 was conceived as a representative system of protected areas, the value of ecological

coherence and connectivity is explicity recognised in the directives. For example, the goal of Natura 2000 is "to create a coherent European ecological network". More specifically, Article 10 of the Habitats Directive provides that "Member States shall endeavour, where they consider it necessary ... with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora. Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species."

These provisions clearly infer that securing the favourable conservation status of many habitats and species in the medium-to-long term will require measures to strengthen ecological coherence and connectivity. To date, however, the need to maintain or strengthen ecological coherence has been given a low priority in implementing the directives. But despite the limited prescriptive character of these provisions, interest in strengthening the implementation of Article 10 are underway with a view to using corridors as a means of strengthening the conservation status of Natura 2000 sites. Indeed, the 2010 target has inspired further action to strengthen connectivity.

For example, the problem of ecological fragmentation and the need to strengthen coherence, connectivity and resilience of Natura 2000 as a contribution to achieving the 2010 biodiversity target are explicitly recognized in the European Commission's 2006 Communication *Halting the Loss of Biodiversity by 2010—and Beyond* and the accompanying Action Plan. The Communication was a response to the EU's 2001 commitment to halt the decline in biodiversity by 2010 and to the 2006 call by the parties to the Convention on Biological Diversity to prioritize actions to 2010. The actions are significant because they explicitly focus on the need for connectivity to be strengthened both inside and outside Natura 2000 sites as an essential means of conserving biodiversity and meeting the 2010 target. Actions that are identified as appropriate include the following:

- assessing and strengthening the coherence, connectivity and resilience of the protected areas network (including outside Natura 2000) through coordinating an assessment and developing guidelines; and
- developing and implementing spatial and programmatic plans that support the coherence of Natura 2000 and maintaining and/or restoring the ecological quality of the wider countryside through promoting best practice.

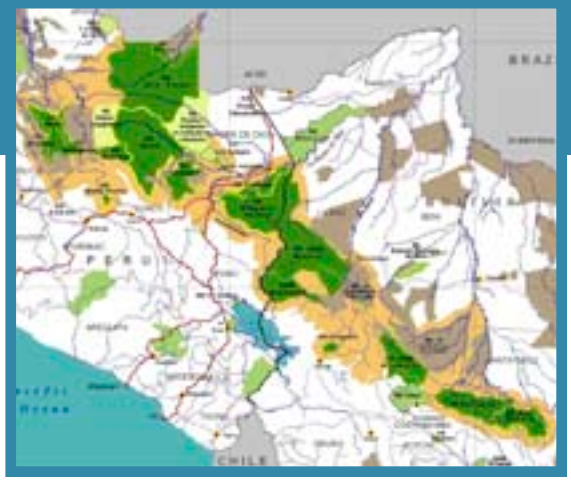
It should also be noted that the role of ecological connectivity has been highlighted by the European Commission as a crucial adaptation measure to climate change. The Commission's 2007 Green Paper on adapting to climate change included the recommendation that emphasis must be placed on ensuring the integrity, coherence and connectivity of Natura 2000 as a means to safeguard and restore biodiversity and ecosystems.

Poverty Reduction

CASE STUDY

THE VILCABAMBA-AMBORÓ CONSERVATION CORRIDOR

Building Sustainable Local Economies in the Tropical Andes Hotspot



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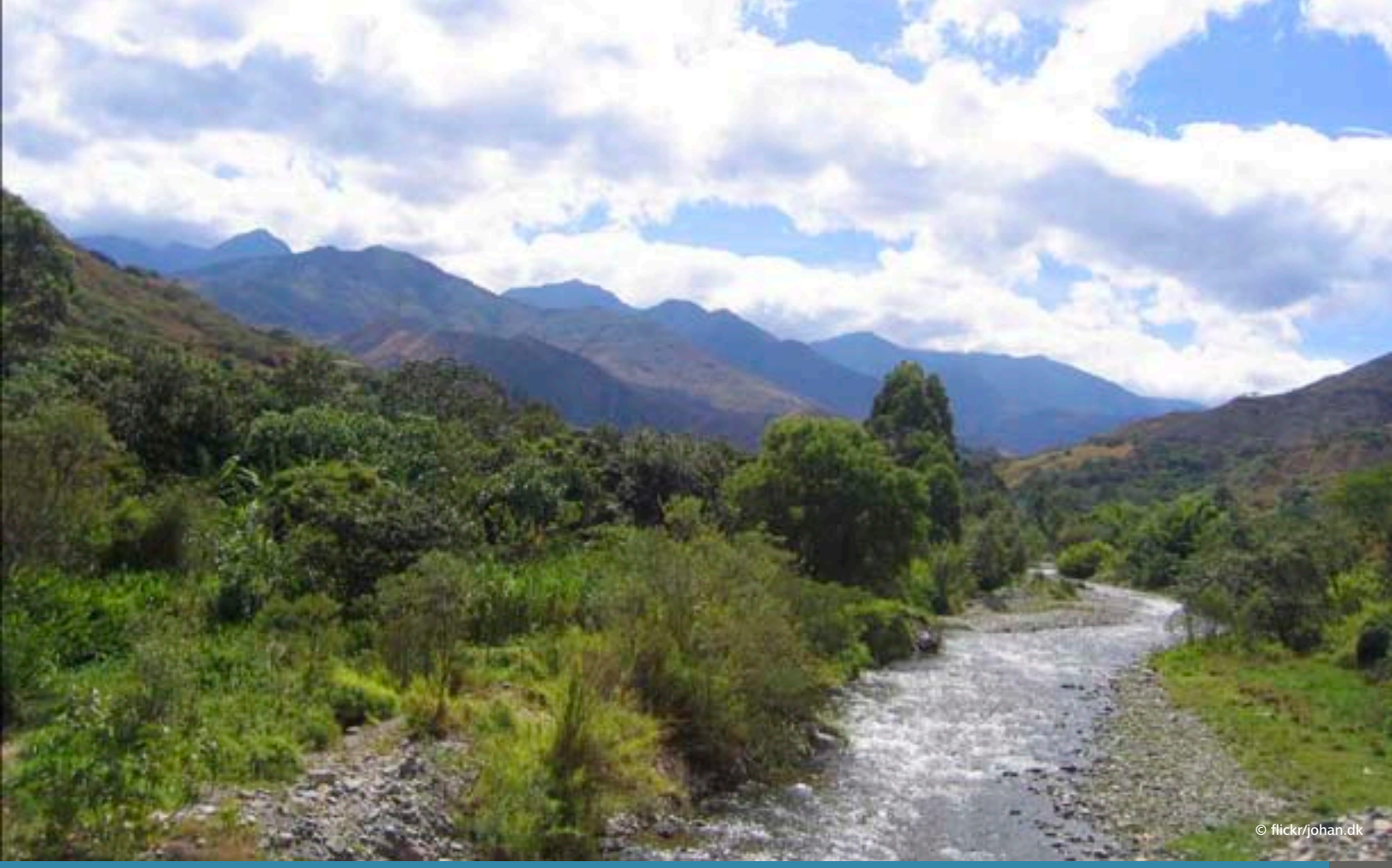
The Tropical Andes Hotspot covers an area of over a million square kilometres from Venezuela through Colombia, Ecuador, Peru and Bolivia to northern Argentina. An estimated 50,000 species of vascular plants account for about 15% of the world's total, with about 20,000 species that are found nowhere else. The region also has the highest bird diversity of any hotspot on earth and exceptionally high levels of endemism among birds, amphibians and reptiles. At the core of the hotspot, covering about a quarter of its area, is the Vilcabamba-Amboró Forest Ecosystem that extends from the Vilcabamba mountain range in south-central Peru southeast to Amboró National Park in central Bolivia.

Outside the major cities, this huge region is inhabited by less than two million people that make up about 40 different ethnic groups, including many indigenous communities. However, although the population is relatively small, human pressure is having a significant impact on the region's biodiversity. Direct threats include oil and gas exploitation, gold mining, uncontrolled logging, dam construction and road building, which brings with it increasing colonization. The forests themselves are becoming victim to illegal logging, overharvesting of heart of palms, commercial hunting and wildlife trafficking, land invasion and associated social conflicts in some protected areas and agricultural expansion, including illegal coca cultivation which also leads to confrontations with security forces. The number of oil and gas concessions is increasing, and the largest-known gas reserves in South America are located in Camisea, Peru, in the northern part of the region. Where the authorities introduce strict controls on logging, social tensions may arise when local communities depend on the timber trade for much of their income. The combination of investment incentives for the extractive industries and agriculture, underfunded protected areas and weak regulatory institutions at both national and local levels is only fuelling these developments.

Initiatives to address the destruction and fragmentation of habitats and restore ecological coherence in the southern part of the hotspot began in the mid-1990s when several large protected areas were established in Peru and Bolivia and a proposal was drawn up to create a transfrontier reserve. In 1998, the Organization of American States funded a proposal that involved the creation of a transboundary Biosphere Reserve that incorporated corridors and buffer zones into its configuration and which complemented a similar idea that was being developed by Conservation International. These developments evolved into a more ambitious ecological network called the Vilcabamba-Amboró Conservation Corridor that extends over 300,000 square kilometres. The Corridor was delineated through criteria such as biodiversity richness and endemism,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an estimated 50,000 species of vascular plants account for about 15% of the world's total, with about 20,000 species that are found nowhere else.


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the extent of intact wilderness, the potential for connectivity, the suitability of the social and institutional environment and the conservation potential of indigenous lands.

In developing the Conservation Corridor, a strategy was adopted that extended beyond biodiversity conservation, emphasizing the need to develop strong social and cultural cohesion between local groups and the source of their livelihoods. An essential aspect of the process is the active involvement of the traditional park services, the nature conservation departments and the land-use planning, land-reform and forestry agencies and local communities. Informal dialogues have been established with the mining and the oil and gas sectors, and Conservation International-Bolivia has bought out two logging concessions in protected areas.

The majority of the funding for developing the Vilcabamba-Amboró Conservation Corridor comes from a range of international donors. These include, in addition to Conservation International, WWF, the Critical Ecosystem Partnership Fund (a joint initiative of Conservation International, the Global Environment Facility, the government of Japan, the MacArthur Foundation and the World Bank) and USAID. In addition, various donors are supporting projects in the region that indirectly contribute to the network's goals, such as the Interamerican Development Bank, the World Bank and the German and Dutch governments. In Bolivia, WWF is supporting local NGOs, the preparation of municipal development plans, sustainable forestry in indigenous territories and biological baseline studies. Other international organizations that support the Corridor are the Wildlife Conservation Society, the Nature Conservancy and CARE who, together with a strong NGO community in both countries, focus on research, monitoring, wildlife management, community development, health care, sustainable natural resource use and assisting local organizations in reserve management.

Many projects are underway which aim to generate sustainable forms of income for local communities. For example:

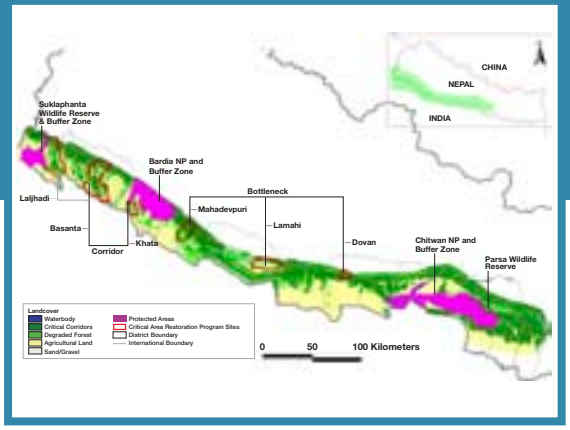
- Conservation International has been working with local groups bordering protected areas in Peru to support low-impact economic enterprises and sustainable hunting practices.
- In partnership with an isolated community, Conservation International has helped to build the Chalalán Ecolodge in Bolivia's Madidi National Park. The lodge is located on the Tuichi river, was built using local materials and incorporates wastewater treatment and solar energy. Access is by a boat along the Beni and Tuíchi rivers. Ownership of the project has now been transferred to local indigenous community enterprises.
- Several other national and international NGOs have partnered with local NGOs and park authorities to support gatherers of brazil nuts in Peruvian and Bolivian reserves.
- Directors of three protected areas in the tropical Andes hotspot signed a transnational agreement in April 2002 to coordinate and implement management efforts. The agreement includes joint actions to directly benefit communities, such as an evaluation of ecotourism in two areas and socio-economic research on the catch of *paiche*, a commercially valuable fish species.

Poverty Reduction

CASE STUDY

THE TERAI ARC LANDSCAPE

Integrating Ecosystem Restoration with Community Development



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Nepal is one of the least developed countries in the world but is also host to unique landscapes and an exceptional range of biological diversity. Seven of the world's 10 highest mountains are to be found in the country, including Mount Everest, as well as five major geomorphological zones that run east–west: the tropical lowland Terai, the sub-tropical Siwaliks along the lowest ridges of the Himalayas, the Middle Mountains, the High Mountains and the High Himal.

These remarkable landscapes harbour a rich diversity of flora and fauna. More than 6,500 higher plant species have been identified, 133 of which are endangered. Of the 157 identified mammal species, 28 are endangered, including the Indian rhinoceros, the Asian elephant, the royal Bengal tiger, the snow leopard and the red panda. Other fauna species include 858 birds, 127 reptiles, 51 amphibians, 182 fish and 643 butterflies.

Nepal's population of over 25 million is growing steadily. Almost half live in the Terai zone, a belt of land along the foothills of the Himalayas about 35 kilometres wide that stretches across southern Nepal and into India, Bhutan and Bangladesh. The relations between the Nepalese and Indian parts of the Terai are strong and there is considerable transboundary employment. However, about 20% of the Nepalese Terai population have no access to safe drinking water and 80% have no access to health care. Nearly half the children in Nepal are underweight and average life expectancy is relatively low at about 60 years for both men and women. With less than 20% of the working population employed in industry or trade and services, per capita income is only about $200 per annum.

The high human pressure on the Terai region is causing serious impacts on the environment. The vegetation has become greatly degraded by deforestation and fuel-wood collection: about a third of all the forests have been cleared, with losses continuing at about 4% a year. Surface waters are polluted by untreated waste water, and irrigation and hydroelectric projects are likely to threaten further the ecological integrity of the river basins. Poaching, which in the current political climate is difficult to control, is a major threat to endangered species such as the rhinoceros, the tiger and the elephant.

The Terai Arc Landscape is an ambitious attempt to secure the twin goals of sustainable development and biodiversity conservation. Operational since 2001 as a merger of two existing projects—the Bardiya Integrated Conservation Project and the Western Terai Tiger, Rhino and Elephant Conservation Complex—the programme is a joint initiative of Nepal's Department of National Parks and Wildlife Conservation, the Department of Forests, WWF's Nepal Programme and local communities and NGOs.

Although built on two conservation projects, the Terai Arc Landscape has established far broader goals. Working within the framework of a long-term sustainable-development and conservation vision for the region, the programme aims within a timeframe of 10 years to strengthen the existing protected areas, conserve the remaining forests, restore degraded forests, establish community forests, introduce effective management practices in the buffer zones, create corridors between critical protected areas and introduce appropriate management practices in buffer zones. The programme as a whole is formalized through agreements with the Nepalese government, which establish a legal basis for the various activities. It is supported through funds provided by WWF, with $6 million being available for the first 10-year phase.

To date, the Terai Arc Landscape has focused on five priority areas in Nepal. These include two corridors—Basanta and Bardia-Katarniaghat—and three sites where serious barriers to ecological continuity exist—Mahadevpuri, Lamahi and Dovan. Additional corridors between seven protected areas in the adjacent Indian Terai are also planned, as are linkages with protected areas across the border with India, such as between the Royal Bardiya National Park in Nepal and Katarniyaghat Wildlife Reserve in India.

Implementation is being promoted through projects focusing on sustainable community development, awareness-raising and capacity-building. Since the communities have usufruct rights and are largely dependent for their income on timber and other forest products, they have a vested interest in restoring and protecting the forests. Community forestry is therefore a viable option for habitat restoration. Since 2002, 22,000 hectares of community forests have been handed over to 200 forest users groups, comprising over 29,000 households. The programme has also provided subsidies to local communities for fuel-efficient cooking stoves and biogas plants, which use cattle dung to produce methane for cooking and lighting instead of fuelwood, saving an estimated 162 hectares of forests. In addition,

the challenges involved in securing sustainable natural-resource exploitation and biodiversity conservation in a poor, culturally diverse and politically unstable country such as Nepal are enormous.


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support to the community-forest user groups in the Khata corridor and the Lamahi bottleneck also enabled the construction of 17 Kanji houses (livestock pens) that discourage uncontrolled cattle grazing in the wildlife corridors.

These projects are being supported by education courses for 275 local livestock herders and awareness-raising programmes that are being developed by 39 newly established Ecoclubs. To meet the increasing demand for tree seedlings, 13 multi-purpose tree nurseries have been established that together have an annual production capacity of 330,000 seedlings.

In order to expand the distribution of the Nepalese rhino population, 64 animals were relocated from Royal Chitwan National Park to the Royal Bardiya National Park and four to Royal Shuklaphanta Wildlife Reserve. Illicit hunting is being discouraged by 17 units that are stationed in the protected areas, while three new anti-poaching units are discouraging poaching in the corridors, the first community-based anti-poaching initiatives in Nepal. The monitoring programme showed that tigers were detected in four of the restored corridors after five years, and the frequency of elephant and rhino movements has also increased.

The challenges involved in securing sustainable natural-resource exploitation and biodiversity conservation in a poor, culturally diverse and politically unstable country such as Nepal are enormous. Given the lack of institutional capacity, progress in the coming years will depend largely on external funding and on the ability to work closely with local communities and demonstrate that sustainable development and biodiversity conservation deliver tangible benefits in the short term while still offering a long-term perspective. In this respect, the Terai Arc Landscape has already shown that it can achieve important results.

Adaptation To Climate Change

CASE STUDY

THE GONDWANA LINK

Reconnecting Southwestern Australia to Cope With Increasing Droughts

© Wilderness Society

Australia is one of the world's richest centres of biodiversity. For example, more endemic animal species can be found in Australia than in any other country. However, Australia's fauna and flora are under grave threat. Over the past two centuries more native species have been lost than in any other single country. Today over 1,500 species are facing extinction, and Australia has the greatest number of threatened reptile and amphibian species in the world.

The large-scale clearance of native vegetation for agriculture was the first main cause of biodiversity loss. Now, fragmentation and climate change are driving a second wave. According to the IPCC's *Fourth Assessment Report*, up to 20% more droughts are expected over most of Australia by 2030 and up to 80% more droughts by 2070 in southwestern Australia. These impacts will also interact with other stresses, such as invasive species and habitat fragmentation. The most vulnerable areas include wetlands, alpine areas and the southwest Australian heathlands. In southwestern Australia, for example, the impacts will include drying and water shortages, range reductions and fragmentation for various endemic plants and crops. Indeed, a relatively small degree of warming will make many narrow-ranged endemic species vulnerable to extinction.

Several ecological network programmes which aim to implement climate adaptation measures are now underway across Australia. These include the Alps to Atherton Biological Corridor—A2A—and five projects launched by the WildCountry initiative. WildCountry applies a conservation approach that aims to integrate the needs of nature with the demands of human use by strengthening ecological processes and environmental flows. The programme's focus is therefore on maintaining and restoring ecological connections in the landscape. Specifically, the management approach will apply the following principles:

- networks of core areas should build on the criteria of comprehensiveness, adequacy and representativeness;
- biodiversity conservation assessment and planning should aim for the maintenance and restoration of large-scale ecological and evolutionary processes over the entire landscape;
- the network should be buffered from sources of disturbance and incorporate where appropriate complementary land uses and management;
- degraded landscapes should be restored, particularly in the intensive land-use areas; and
- long-term ecological connectivity should be facilitated.

the five largest areas of high biodiversity value in the region are along the south coast, where about six million hectares of public land were saved from the spread of agriculture in the early 1980s.

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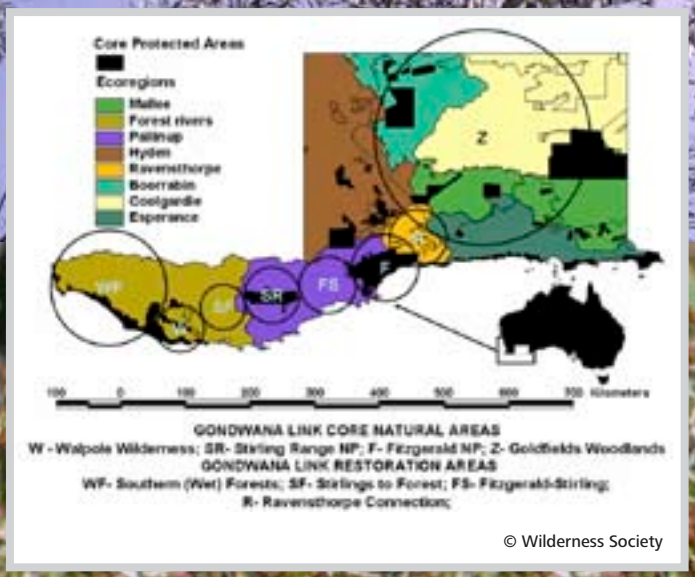

GONDWANA LINK CORE NATURAL AREAS
W - Walpole Wilderness; SR- Stirling Range NP; F- Fitzgerald NP; Z- Goldfields Woodlands
GONDWANA LINK RESTORATION AREAS
WF- Southern (Wet) Forests; SF- Stirlings to Forest; FS- Fitzgerald-Stirling;
R- Ravensthorpe Connection;

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The WildCountry programme is currently working in five regions: northern Australia, Cape York Peninsula, the Gondwana Link, the Western Wilderness and western Victoria. The Gondwana Link in southwestern Australia is a good example of the approach. Southwestern Australia is regarded as one of the world's top 25 biodiversity hotspots. However, as a result of agricultural expansion two-thirds of the vegetation has been cleared, leaving less than 10% of the original bushland. The wide-scale destruction of the original habitat has had huge impacts on species populations. For example, the Western , a species dependent on long unburned habitat, is down to a total population of about 200 birds. The removal of deep-rooted vegetation has left the resulting agricultural land very fragile, and over 30% of the agricultural land is threatened by salinity. It is now widely recognized that 30–40% of this area needs to be covered by perennial woody vegetation if it is to remain stable.

The five largest areas of high biodiversity value in the region are along the south coast, where about six million hectares of public land were saved from the spread of agriculture in the early 1980s. Together, these areas form the last remaining link between the wet forests in the continent's southwestern tip through to the dry inland. This transition zone is defined by a variable climate, with extremes of wet and dry being common. Species have adapted to these variations by moving opportunistically between seasonal feeding areas. However, the fragmentation of the region is now preventing much of this movement, with the result that population levels have fallen across the entire wheatbelt.

Five NGOs—the Australian Bush Heritage Fund, the Fitzgerald Biosphere Group, the Friends of the Fitzgerald River National Park, Greening Australia and the Wilderness Society—are cooperating within the WildCountry framework to partially restore this vital pattern of movement into and across south-coast plant communities. To achieve this goal, it is proposed to remove the least agriculturally suited areas from production (which are already economically marginal or unviable) and to develop and demonstrate the potential for other land-use options that have commercial value, such as sandalwood growing, dry-country forestry (that is, bush poles and brush fencing) and bush foods. One of the first actions is a cooperative project with the state government to secure the Walpole Wilderness Area—over 200,000 hectares of forest where the Gondwana Link corridor meets the wetter forest areas.

The next objective is to secure better management of woodland, mallee and heath to the east of the main agricultural areas. This large area, approximately the size of Tasmania, contains only one town, two main roads, a few tracks and some scattered mining sites.

In previous periods of climate change, species and systems have predominantly moved along a southwest–northeast route, which is exactly the vector that the Gondwana Link is spanning. In order to restore the minimum necessary degree of connectivity, opportunities will be exploited to consolidate north–south linkages, which may also be critical pathways for species and systems affected by the projected climate change for the region.

CASE STUDY

YELLOWSTONE TO YUKON

Maintaining Grizzly Bear Populations in the Face of Climate Change

The Rocky Mountains are North America's last intact mountain ecoregion. The region stretches over 3,200 kilometres from Yukon Territory in Canada to the Greater Yellowstone Ecosystem in Wyoming, covering over a million square kilometres. Until a century ago, pumas (also known as the cougar or mountain lion), grizzly bears, wolverines and wolves were present throughout most of the region. Today, mainly as a result of habitat destruction and hunting, they only exist as potentially viable populations in the small number of protected areas in the northern Rockies. Several aquatic indicator species are also threatened, such as the bull trout, the westslope cutthroat trout and several salmon stocks.

Human pressures on the ecoregion are increasing rapidly. The Rockies are inhabited by over four million people, including members of 31 Canadian First Nations and US Native American tribes. The main economic activities are mining, timber, agriculture, oil and gas. Logging, for example, has become more intensive over the past decades but has also extended into new areas, to the extent that it is now prevalent across almost half the total area. The oil and gas industry has also expanded, and it is estimated that about 137,000 wells will have to be drilled over the next 15 years if current rates of production are to be maintained, which in turn will require an additional 440,000 kilometres of roads to be built.

However, the highest growth rates in recent years have been in tourism, new technologies and information-based industries, and these are attracting new settlers, known as "amenity migrants", who place special value on the natural quality of the Rockies. In 1996, 78 million visitor days were recorded in the region's national and provincial forests—30% of which were devoted to hunting and fishing—and a further 37 million visitor days were recorded in the 10 national parks.

Despite the protection offered by the 10 national parks and the dozens of state and provincial parks, wilderness areas and wildlife refuges, the effects of human activities are becoming increasingly apparent, particularly in the southern part of the Rockies. Habitat fragmentation and destruction, creation of vulnerable edges within existing habitats, loss of nutrients, watershed erosion, changing water-table levels, pollution and disturbance are together taking an increasing toll on the region's biodivers-

ity. It was these threats to the unique value of the Rocky Mountains that in 1993 inspired a group of scientists and conservationists meeting in Alberta to develop a 100-year conservation vision that applied the precepts of conservation biology to the Yellowstone-to-Yukon region—"Y2Y".

Conceived as a marriage of "science with a mission" and "informed advocacy", Y2Y strives to ensure that the ecoregion is capable of supporting in the long term all of its natural and human communities. Becoming operational in 1997, the initiative is a grassroots initiative which now enjoys the support of 360 partners, about a half of which are organizations—primarily conservation NGOs—but also research institutes, First Nations and Native American tribes, companies and foundations. As an umbrella organization, Y2Y provides vision, science research, conservation tools, organizational training and some financial support to the network, which in turn brings the vision to the communities and government agencies who in general control land use and planning at the local and regional levels. Sound science, sustainability and stewardship are key concepts, often expressed in the phrase "co-existence in a healthy ecosystem".

To date, the initiative has focused on building a comprehensive and scientifically-defensible "Wildlife Network" (core areas, corridors and buffer zones) for the ecoregion and implementing the programme. One of the primary implementation challenges is climate change. Many North American species have shifted their ranges, typically to the north or to higher elevations. For example, Edith's checkerspot butterfly has become locally extinct in the southern, low-elevation part of its western range but has extended its range 90 kilometres north and 120 metres higher in elevation. These impacts are becoming an increasingly important focus of several large-scale ecological network initiatives across the continent, such as the New Mexico Highlands Wildlands Network. Climate change is also bringing other changes to the Rocky ecosystem. In the Greater Yellowstone Ecosystem, whitebark pine trees, which produce a nut that is a key source of food for grizzy bears, are being decimated by a blister rust that will probably spread even more widely and get more deadly as the climate continues to warm.

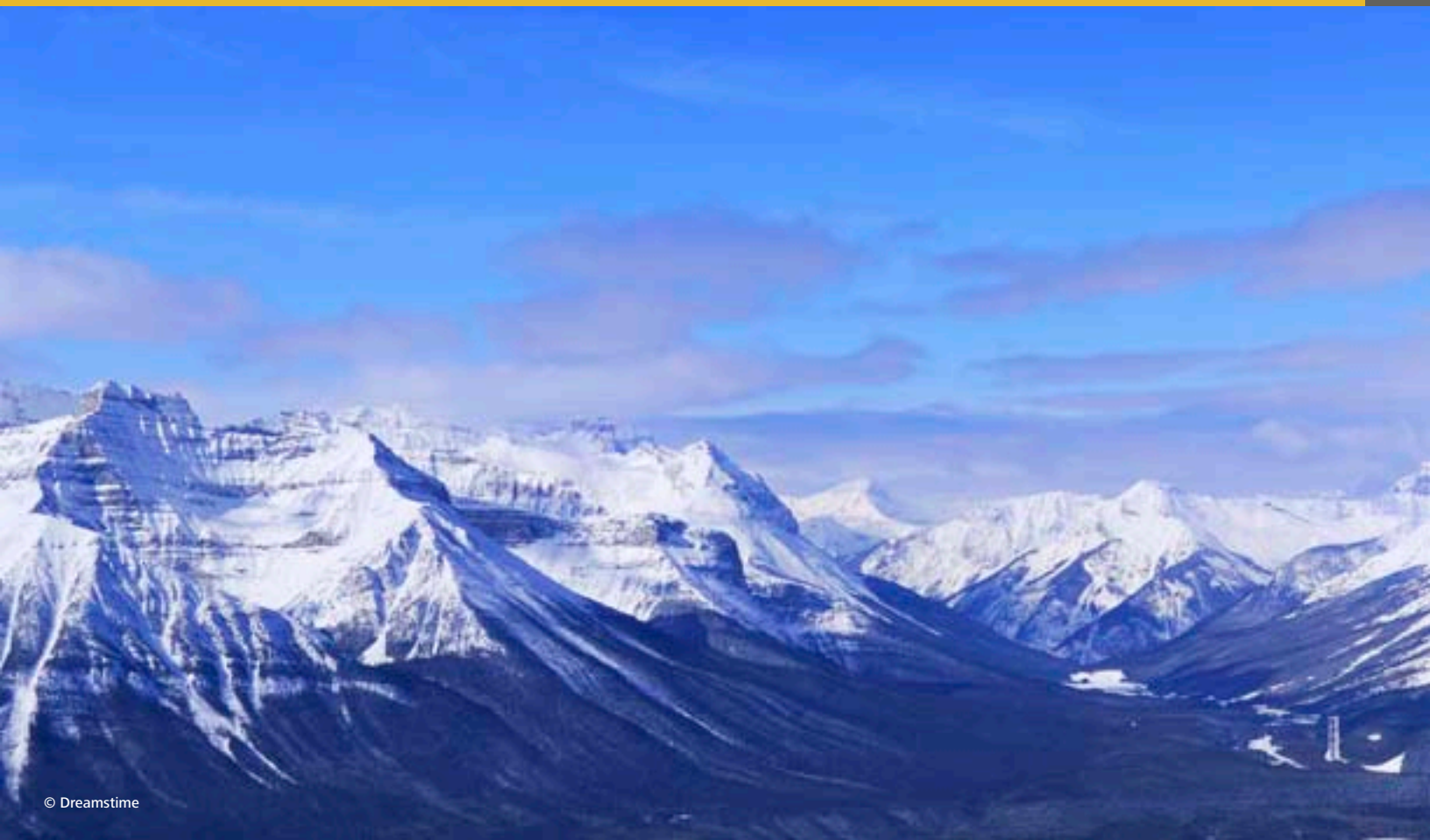
Y2Y's strategy in responding to these shifts is to analyze the way climate change could affect the region and develop appropriate grizzly bear, avian and aquatic conservation strategies. These strategies address the pressures of climate change on animal and plant species by:

- conserving large areas of connected landscapes, thereby providing plants and animals with the ability to move to more habitable locations or occupy a new niche in their traditional territory;
- establishing linked, north–south habitat zones that offer safe wildlife migrations;
- linking various elevations that allow both plant and animal species to ascend to higher ground;
- maintaining an "around-the-mountain" element, which allows plants to drift to other slope aspects in order to survive; and
- sustaining as many native plant species as possible in order to reduce the invasion of exotic species.

The grizzly bear conservation strategy, for example, aims to protect a matrix of core areas and movement corridors that contain enough undisturbed habitat to maintain an average population of 2,000 grizzly bears in perpetuity. The design allows for expected human impacts and large-scale variation in climate change and consists of three interrelated parts:

- a baseline reserve map of the Northern Rockies between the Greater Yellowstone Ecosystem, the Northern Continental Divide Ecosystem and the Selway-Bitterroot Ecosystem with least-cost-path movement habitat (corridors) between patches of secure habitat;
- a similar map for the southern portion of the region; and
- a pilot study at Bozeman Pass to document highway wildlife fatalities and cooperative work with the Montana Department of Transportation to mitigate the fatalities.

scientists and conservationists behind Y2Y have developed a 100-year conservation vision that applies the precepts of conservation biology to the region



Further Reading

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